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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	474139US03
First Named Inventor	Takeshi Okazaki
Title	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY...
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☐ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* 46] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 15]
6. **Inventor's Oath or Declaration** [*Total Pages* 2] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☐ Newly executed (original or copy)
   b. ☑ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
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ACCOMPANYING APPLICATION PAPERS

10. ☐ **Assignment Papers** (cover sheet & document(s))
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11. ☑ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☑ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☑ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☑ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☐ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☐ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☐ **Other:** _____

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

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ZESTY.AI EX1002
U.S. Patent No. 11,195,058

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Application for United States Patent

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

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474139US03

RELATED APPLICATIONS

[0001] This application is a continuation of and claims priority to U.S. Patent Application Serial No. 16/733,888 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Conditions Through Aerial Imagery Analysis" and filed January 3, 2020, which is a continuation-in-part of and claims priority to U.S. Patent Application Serial No. 15/714,376 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis" and filed September 25, 2017, which claims priority to U.S. Provisional Patent Application Serial No. 62/398, 665, entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis," filed September 23, 2016. All above identified applications are hereby incorporated by reference in their entireties.

BACKGROUND

[0002] A risk exposure database contains a compilation of as many building properties or characteristics relevant to insurance as possible. These properties can include characteristics like location coordinates, address, slope, and elevation, Other characteristics include construction type, occupancy type, year built and/or year of renovation, building height, soft stories, number of stories, and floor area. Further characteristics can include roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding (distance to closest building). Some of these characteristics can only be assessed by on-site inspections or by official documentation, but others can be measured using visual imagery.

[0003] Characteristics addressed in this disclosure include roof shape and roof condition. In one example, roof shapes can be broken into five categories: gambrel roof, gable roof, hipped

roof, square roof, and flat roof. Each roof shape has a unique response and damage vulnerability to different natural perils like earthquake or wind.

[0004] Deep learning involves computational models composed of multiple processing layers to learn representations of data with multiple levels of abstractions. These models can be thought of as a way to automate predictive analytics. Representation learning is a set of methods that allows a machine to be fed with raw data and to automatically discover the representations needed for detection or classification. Use cases for deep learning include voice recognition, motion detection, translation, and medical diagnosis. By using deep learning algorithms and sample datasets, computers can learn to distinguish and classify a wide range of characteristics to high levels of accuracy, often surpassing the recognition levels of human beings.

[0005] One model used for deep learning is the Network in Network model described in the paper "Network In Network" by M. Lin et al. and published in the International Conference on Learning Representations, 2014 (arXiv:1409.1556), the contents of which are hereby incorporated by reference in its entirety. Using the Network in Network model, a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification.

[0006] When applied to visual recognition, deep learning algorithms can break down an observation (e.g., an image) in a number of different ways to characterize features of the observation. In some examples, deep learning algorithms can be applied to review images as a set of intensity values per pixel, or in a more abstract way as a set of edges, regions of particular shape, etc. Some representations may demonstrate superior performance to others based upon the particular learning task. One of the promises of deep learning is replacing

human identification of features with efficient algorithms for unsupervised or semi-supervised feature learning and hierarchical feature extraction.

[0007] The inventors recognized that deep learning methodology could be applied to risk exposure database population to analyze aerial imagery and automatically extract characteristics of individual properties, providing fast and efficient automated classification of building styles and repair conditions. In combining location-based vulnerabilities with individual property vulnerabilities identified in part through classification of repair conditions of one or more property features, risk of damage due to disaster can be more accurately estimated.

SUMMARY OF ILLUSTRATIVE EMBODIMENTS

[0008] The forgoing general description of the illustrative implementations and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure, and are not restrictive.

[0009] Systems, methods, and computing system platforms described herein support matching aerial image features of one or more properties to corresponding property conditions (e.g., maintenance levels of property features, including structural features, manmade features included within a vicinity of a structure (e.g., on a property lot, within a property parcel, or a geographic region of the property), and/or natural features included within the vicinity of the structure) through machine learning analysis. In a preferred application, the property condition analysis may be used in estimating damage risk in light of one or more disaster conditions, such as severe storms. The analysis may further aid in estimating costs of repair or replacement of each property, in one example, should a disaster cause the estimated damage. In another example, the analysis may be used to confirm that a property has been repaired.

[0010] In one aspect, the present disclosure relates to a method for automatically categorizing a repair condition or maintenance condition of a property characteristic, including obtaining an aerial image of a geographic region including the property; identifying features of the aerial image corresponding to the property characteristic; analyzing the features to determine a property characteristic classification; analyzing a region of the aerial image including the property characteristic to determine a condition classification; and determining, using the property characteristic classification and the condition classification, a risk estimate of damage to the property due to one or more disasters. The property characteristic of a structure such as a house, factory, or barn, in some examples, can include a rooftop, porch, chimney, or skylights. Property characteristics of manmade structures within a property location, in some examples, can include a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, equipment or vehicles, or greenhouse. Property characteristics of natural features within a property location, in some examples, include trees, ponds, marshes, rivers, lakes, grasses, cliffs, or ocean shore. Further, property characteristic classifications can include shapes, materials, size (breadth and/or height, relative or actual), and/or distance of the property characteristic from other features. In some embodiments, the property characteristic classification may include existing versus not existing (e.g., in the event of determining replacement or removal of a manmade feature at a property location such as a fence). The property characteristic classification, in a particular illustration, may be a rooftop shape. Analyzing the features to determine a property characteristic may include applying a deep learning analysis model to the features. The deep learning analysis model may be NIN.

[0011] In some embodiments, analyzing the region of the aerial image including the property characteristic to determine the condition classification includes applying a machine learning analysis model to image pixels within the region. The machine learning analysis model may

include a color histogram analysis model. The condition classification may encompass classifications good and bad. Determining the risk estimate may include applying a disaster risk profile corresponding to a first disaster of the at least one disaster and the property characteristic.

[0012] In one aspect, the present disclosure relates to a system for automatically categorizing a repair condition of a property characteristic, the system including processing circuitry and a non-transitory computer-readable medium having instructions stored thereon. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to obtain an aerial image of a geographic region including the property; identify features of the aerial image corresponding to the property characteristic; analyze the features to determine a property characteristic classification; analyze a region of the aerial image including the property characteristic to determine a condition classification; and determine, using the property characteristic classification and the condition classification, a replacement cost for replacing the property characteristic. The aerial image may be a two-dimensional aerial image.

[0013] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to identifying the features, obtain a shape map image including the property; overlay the aerial image with the shape map image; and determine whether a boundary of the property as identified by the shape map matches a boundary of the property as illustrated in the aerial image. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, upon determining that the shape map does not match the boundary of the corresponding property, obtain an alternate aerial image of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, prior to identifying the features, assess orthogonality of the aerial imagery. The property may be a single family home.

[0014] In one aspect, the present disclosure relates to a non-transitory computer readable medium having instructions stored thereon, where the instructions, when executed by processing circuitry, cause the processing circuitry to receive identification of a property and at least one property characteristic; obtain an aerial image of a geographic region including the property; and identify respective features of the aerial image corresponding to each property characteristic of the at least one property characteristic. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, for each property characteristic, analyze the corresponding features to determine a respective property characteristic classification, and analyze a region of the aerial image including the respective property characteristic to determine a respective condition classification. The instructions, when executed by the processing circuitry, may cause the processing circuitry to determine, using the property characteristic classification of each property characteristic and the condition classification of each property characteristic, at least one risk estimate representing risk of damage due to disaster.

[0015] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to obtaining the aerial image of the geographic region, determine, based upon the at least one property characteristic, a preferred image type corresponding to each property characteristic of the at least one property characteristic. The at least one property characteristic may include two or more property characteristics. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, responsive to determining the preferred image type corresponding to a first property characteristic of the at least one property characteristic is a terrestrial image, obtain a terrestrial image of the geographic region including the property.

[0016] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to access one or more known property characteristics.

Determining the at least one risk estimate may include determining the at least one risk estimate further based on the one or more known property characteristics. The one or more known property characteristics may include at least one of a property age, a property elevation, a property slope, a year built, a year renovated, and a building height.

[0017] In some embodiments, receiving identification of the property and the at least one property characteristic includes receiving, via a network from a remote computing device, the identification of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to provide, via the network to the remote computing device in real-time responsive to receiving the at least one property characteristic, the at least one risk estimate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one or more embodiments and, together with the description, explain these embodiments. The accompanying drawings have not necessarily been drawn to scale. Any values dimensions illustrated in the accompanying graphs and figures are for illustration purposes only and may or may not represent actual or preferred values or dimensions. Where applicable, some or all features may not be illustrated to assist in the description of underlying features. In the drawings:

[0019] FIG. 1 is a flow diagram of an example system operational flow for matching aerial image features to corresponding property maintenance levels;

[0020] FIG. 2A illustrates example characteristic classifications and corresponding risk profile data;

[0021] FIG. 2B illustrates examples of condition characteristics and corresponding example histograms;

[0022] FIG. 2C illustrates an example condition profile corresponding to an example property characteristic type;

[0023] FIG. 2D is an example error rate graph comparing training data with test data in conducting matching aerial image features to corresponding rooftop shapes;

[0024] FIG. 3 is a block diagram of an example environment for matching aerial image topographical features to corresponding property maintenance levels;

[0025] FIG. 4 is a flow chart of an example method for classifying condition characteristics of a property based on aerial image analysis;

[0026] FIG. 5A illustrates an example structure shape map of a geographic area;

[0027] FIG. 5B illustrates an example two-dimensional aerial image of the geographic area of FIG. 5A;

[0028] FIG. 5C illustrates an example overlay map image of a section of the structure shape map of FIG. 5A overlaying a corresponding section of the aerial image of FIG. 5B;

[0029] FIG. 6 is a block diagram of an example computing system;

[0030] FIG. 7 is a block diagram of an example distributing computing environment including a cloud computing environment; and

[0031] FIGs. 8A, 8B, and 8C illustrate a series of example user interface screen shots for reviewing property characteristic and maintenance level information.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0032] The description set forth below in connection with the appended drawings is intended to be a description of various, illustrative embodiments of the disclosed subject matter. Specific features and functionalities are described in connection with each illustrative embodiment; however, it will be apparent to those skilled in the art that the disclosed embodiments may be practiced without each of those specific features and functionalities.

[0033] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments. Further, it is intended that embodiments of the disclosed subject matter cover modifications and variations thereof.

[0034] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context expressly dictates otherwise. That is, unless expressly specified otherwise, as used herein the words "a," "an," "the," and the like carry the meaning of "one or more." Additionally, it is to be understood that terms such as "left," "right," "top," "bottom," "front," "rear," "side," "height," "length," "width," "upper," "lower," "interior," "exterior," "inner," "outer," and the like that may be used herein merely describe points of reference and do not necessarily limit embodiments of the present disclosure to any particular orientation or configuration. Furthermore, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components, steps, operations, functions, and/or points of reference as disclosed herein, and likewise do not necessarily limit embodiments of the present disclosure to any particular configuration or orientation.

[0035] Furthermore, the terms "approximately," "about," "proximate," "minor variation," and similar terms generally refer to ranges that include the identified value within a margin of 20%, 10% or preferably 5% in certain embodiments, and any values therebetween.

[0036] All of the functionalities described in connection with one embodiment are intended to be applicable to the additional embodiments described below except where expressly

stated or where the feature or function is incompatible with the additional embodiments. For example, where a given feature or function is expressly described in connection with one embodiment but not expressly mentioned in connection with an alternative embodiment, it should be understood that the inventors intend that that feature or function may be deployed, utilized or implemented in connection with the alternative embodiment unless the feature or function is incompatible with the alternative embodiment.

[0037] Turning to FIG. 1, a flow diagram of an example system operational flow 100 for matching aerial image features to corresponding property maintenance levels obtains images (104) at property locations 102b is illustrated. In some implementations, commencement of at least a portion of the operational flow 100 by the system may be triggered by a property classification request submitted by a user, such as an insurance carrier or real estate investment broker at a dashboard interface screen on a computing device connected to the system via a network. For example, as illustrated in FIG. 8A, a particular property or, alternatively, a neighborhood of properties, may be selected within a map view user interface 800. The operational flow 100 may be used to analyze the condition of features of each property at each property location 102b based on aerial imagery 102c. In some implementations, the operational flow 100 may aid in estimating costs of repair or replacement of each property characteristic detected in the aerial images, for example. In another example, the operational flow 100 may be used to confirm that a property location 102b has been repaired.

[0038] The property locations 102b may represent, in some examples, locations of properties insured by a particular insurer, locations of properties recently affected by a disaster such as a tornado, hurricane, earthquake, fire, storm surge, or explosion, locations of properties held in an investment portfolio, or locations of properties considered for addition to an investment

portfolio. The property locations 102b may be identified, in some examples, by a street address, global positioning system coordinates, or other geographic coordinates.

[0039] In some implementations, the operational flow 100 obtains images (104) at each property location 102b. The images can include aerial imagery 102c stored by the system or accessed by the system from a remote networked location. The aerial imagery 102c, for example, may include a three-dimensional or two-dimensional image of a geographic location including at least one of the property locations 102b. In one example, based upon street address or geographic coordinates, the system may query a remote database to obtain recent aerial imagery 102c including an image of at least one of the property locations 102b. The remote database, in some examples, can include private industry databases such as Google® Earth images by Google, Inc. of Mountain View, CA or NTT Geospace Corporation of Japan. In other examples, the remote database can include one or more databases of publicly owned organizations such as the Geospatial Information Authority (GSI) of Japan, the United States Geological Survey, or the Federal Agency for Cartography and Geodesy of Germany. Aerial imagery can be collected from one or more remote network locations, in some embodiments, using an Open Source Geographic Information System (GIS) such as QGIS by the Open Source Geospatial Foundation (OSGeo). The format for the images of the property locations 102b, in some embodiments, depends upon the format accepted by the various sources available for aerial imagery 102c. An example aerial image 510 of multiple property locations 102b is illustrated in FIG. 5B.

[0040] In some embodiments, the system may be configured to query multiple remote database systems to obtain at least two aerial images of a given property location 102b. The aerial images available at the various databases, for example, may differ in resolution and recency of capture. Through collecting two or more images of a particular property, for example, the system may analyze each image to determine a best quality image for use in

condition analysis. The condition analysis can include balancing of multiple factors such as, in some examples, clarity, completeness, and recency.

[0041] Further, in some embodiments, the system may be configured to query multiple remote database systems to obtain both a two-dimensional aerial image and a three-dimensional aerial image. Different property characteristics may be discerned based upon whether the aerial image is captured in two-dimensional or three-dimensional format. Two-dimensional aerial images, in some examples, can be used to determine location coordinates of the property, street name, occupancy type, floor area, existence of skylights, existence of chimneys, roof condition, roof shape, roof covering, roof anchors, roof equipment, and/or pounding. Three-dimensional aerial images, in comparison, can be used to determine location coordinates, street name, construction type, occupancy type, year built, building height, soft stories, number of stories, roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding. Where there is an overlap in characteristics identifiable using either a two-dimensional image or a three-dimensional image, in some embodiments, machine learning analysis of both images can be combined to provide increase confidence in identification of the individual characteristics.

[0042] In some implementations, the system obtains (104) shape map images 102a of each of the property locations 102b. The shape map images 102a, for example, include a block shape layout of existing properties in a municipality, such as urban planning maps used in urban planning and development. The shape map images 102a, in another example, can include block shape layout maps used in presenting information to a user of a computer-based navigation system. The shape map images 102a, in one example, can be obtained from Geospatial Information Authority of Japan or Zenrin Co. Ltd. of Japan. An example of an urban planning map 500 is illustrated in FIG. 5A (image obtained from the Geospatial Information Authority of Japan, Digital Map 2500 (Spatial Data Framework)).

[0043] The shape map images 102a, in some embodiments, are used to confirm location of a particular property. The shape map image 102a of a geographical area, for example, can be overlaid with a corresponding aerial image 102c to match properties with images. An example overlaid image 520 of planning map image 500 of FIG. 5A with aerial image 510 of FIG. 5B is illustrated in FIG. 5C. In some embodiments, the shape map image 102a may not match in shape or location with the aerial image 102c. As illustrated in FIG. 5C, for example, a shape map outline (illustrated in a thickened line) for a location 522 may not be rectangular, while a rooftop shape beneath the outline may be rectangular in shape. In some embodiments, analyzing multiple aerial images 102c to determine the best quality image may include identifying one or more aerial images 102c that substantially align with the corresponding shape map image 102a. The overlay of the aerial image 102c with the shape map image 102a, further, can be used in aiding in cropping the aerial image 102c to focus analysis on a particular property location 102b. For example, turning to FIG. 5C, property location 524 is substantially aligning with the corresponding planning map image, and the general outline can be used in aiding in cropping of the property location 524. In some examples, the property location 524 may be identified within the overlaid image 520 when the property location 524 aligns with a property in the overlaid image 520 within a predetermined tolerance in order to account for renovations that may have been made to the property 524, such as property additions that may alter an overall shape of the property.

[0044] Returning to FIG. 1, in some embodiments, the shape map images 102a may be used to correct or compensate for alignment errors or inconsistencies of the corresponding two-dimensional aerial images 102c. For example, an aerial image representing a normal orthophoto angle may not be directly centered upon the planning map block. Using the planning map block as a guide, for example, the aerial image can be geometrically corrected to obtain a true orthophoto version of the aerial image.

[0045] As illustrated in FIG. 1, in some implementations, the system identifies (106) features of each aerial image 102c to classify property characteristics. Using machine learning for analysis, for example, the system can extract features of the aerial image of a particular property location 102b. Groupings of extracted features, such as angles, outlines, substantially homogenous fields, etc. can be used to identify property features such as rooftop, swimming pool, chimney, and sky lights. The groupings of extracted features, for example, may include pixel groupings obtained through filtering, cropping, or otherwise adjusting the original image. Upon extracting image-related features identifiable as a property feature (e.g., rooftop), the extracted features may be analyzed to determine one or more property characteristics of that feature (e.g., type of rooftop). In one example, a swimming pool may be identified as the property feature of a pool (e.g., various shapes of outlines of a particular size or greater bordering a substantially homogenous field of blue), then characterized as a particular shape (e.g., rectangular, round, or kidney bean, etc.), type (e.g., above ground or in-ground), and/or size (e.g., approximate area). The machine learning classifier used in the machine learning analysis, in some embodiments, includes a convolutional neural network (CNN) to preprocess the aerial image 102c of the particular property location 102b and to classify the property features as property characteristics 110. Using CNN technology, for example, the biological process of visually reviewing and identifying an object or feature of an object is mimicked through a feed-forward artificial neural network where multilayer artificial perception minimizes preprocessing. CNN is a well-established and popular machine-learning methodology. An example of a CNN processing model is Alexnet. (See Krizhevksy et al. "ImageNet Classification with Deep Convolutional Neural Networks", Advances in neural information processing systems. 2012, the entire contents of which has been incorporated herein by reference). In other embodiments, the machine learning classifier may include a Network in Network (NIN)

where a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification. NIN has demonstrated superior performance outcome to conventional CNN processing. Additionally, NIN processing is less storage-intensive than CNN processing.

[0046] In some implementations, property characteristic profiles 108 are used in classifying property features. The property characteristic profiles 108, for example, may be developed through training the machine learning algorithms using aerial images (and, in some embodiments, terrestrial images 102d) of known property characteristics. Each property feature, for example, may be broken down into multiple classifications. In an illustrative example involving a classification of terrestrial images, cladding can include stone, brick, stucco, shingles, vertical boards, horizontal boards, or metal. The machine learning algorithms, for example, may generate a percentage confidence in a match between a new aerial image 102c including a gambrel rooftop and the characteristic profile 108 of gambrel rooftops.

[0047] In an illustrative example, turning to FIG. 2A, extracted angular and outline features of aerial images 204 may be used to classify a roof shape 202 of the particular property location 102b. In a first example, a gable roof 202b includes a central peak upon a generally rectangular outline, as depicted in corresponding aerial image 204b. A gambrel roof 202a includes these features of the gable roof 202b but, as illustrated in aerial image 204a, the gambrel roof additionally includes a "skirt" region surrounding the central gable-shaped portion. The "skirt" region can be identified, in part, based upon its corner edges extending from the four corners of the gable-shaped portion. A hipped roof 202c, as shown in aerial image 204c, includes a central peak and two opposing triangular ends extending from either end of the central peak. The central peak forms a top edge of two trapezoidal sections. A

square roof 202d, in contrast, has no central peak. Instead, as illustrated in aerial image 204d, the square roof includes four triangular portions meeting at a central point. Finally, a flat roof 202e, as shown in aerial image 204e, is represented by a substantially flat surface outlined by a rectangle.

[0048] Turning to FIG. 2D, an example error rate graph 240 compares training data 242 with accuracy of matching test data 244 in matching aerial image rooftop characteristics to corresponding rooftop type (e.g., shape). A test was conducted using NIN deep learning algorithms to classify rooftop shape in two-dimensional aerial images including a mix of gambrel, gable, hipped, square, and flat roof shapes of assorted colors. Further tests involved differing image sizes and mini-batch sizes. In particular, images were scaled using a formula of $y = w * (x\text{-}100) + z$, where x represents a property size (e.g., building with a small border surrounding the area of the rooftop), y represents pixel size, w ranged from 0.33 to 0.40 and z ranged from 90 to 110. The error rates ranged, among initial test cases involving mini batches from 5 to 20, from about 4.3% to about 10%. As shown by the error rate graph 240, in a test situation involving 2,250 sample images in a training dataset and 250 test images in a test dataset, the minimum error rate in determining rooftop condition was 6%, corresponding to an accuracy rate of 94%.

[0049] To improve accuracy rate, in some implementations, the image can be cropped and/or resized prior to analyzing. For example, the image may be cropped to include the property of interest, or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Resizing to a standard image size, in another example, can contribute to accuracy improvement.

[0050] Further to roof shape, in some embodiments, feature analysis can be used to discern additional roof features such as, in some examples, roof covering, roof anchors, roof

equipment, skylights, widow's walks, turrets, towers, dormers, and/or chimneys. Furthermore, upon identifying the outline of the roof, a footprint of the property location 102b (e.g., size of the roof) can be calculated based upon a scale of the aerial image 102c.

[0051] Returning to FIG. 1, rather than exclusively analyzing the particular property locations 102b individually, in some implementations, the particular property locations 102b are each classified based in part upon nearby structures. For example, based upon property location 102b dimensions, which may include lot dimensions, machine learning can be used to identify additional structures at the property location 102b such as, in some examples, a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, or greenhouse. Further, the particular property locations 102b may be classified in part based upon distance from neighboring structures and/or natural features (e.g., pounding).

[0052] In some implementations, terrestrial images 102d may be used to classify features difficult to recognize using aerial imagery 102c. The terrestrial images 102d, in some examples, can include street view images obtained from a street view service or real estate listing. In some examples, street view images including a street-facing view of the property location 102b may be obtained from Google® Street View by Google, Inc., Bing® Maps Streetside by Microsoft Corp. of Redmond, WA, or Mapillary by Mapillary AB of Sweden. Using a terrestrial image, for example, the system can identify features such as construction type, cladding, building height, number of soft stories, number of floors, location coordinates, street name, slope, elevation, year built, and/or occupancy type. Where the characteristics identifiable via the terrestrial imagery 102d overlap with characteristics identifiable via two-dimensional or three-dimensional aerial imagery 102c, analysis of terrestrial imagery 102d can be combined with analysis of aerial imagery, in some embodiments, to increase confidence in identification of the particular characteristic(s). For example, house siding

features may be more easily detected in terrestrial imagery 102d and/or three-dimensional aerial imagery 120c than in two-dimensional aerial imagery 102c.

[0053] In some implementations, a condition of each property feature may be classified (112) as a corresponding condition characteristic 116. New properties are in good condition, but property feature conditions can deteriorate over time due to normal wear-and-tear on the property. Further, property features can suffer damage due to external forces such as storms and natural disasters. Eventually, conditions of housing features can deteriorate to the point where repair and/or replacement may be necessary. As with property characteristics described above at block 106, machine learning algorithms can be used to classify a present condition of individual detected property features. Using machine learning for analysis, for example, the system can extract pixel intensity distributions of previously identified property features of the aerial image of the particular property location 102b. In some examples, newly constructed property features generally have sharp contrast and well-defined features in machine learning image analysis. Conversely, weathered or damaged property features can have softened edges, blurred contrasts, and asymmetrical patches of wear. The machine learning classifier used in the machine learning condition analysis, in some embodiments, includes a machine learning analysis to process the aerial image 102c of the particular property location 102b and to classify the condition of previously identified property characteristics 110 as condition characteristics 116. The machine learning analysis, in some examples, can include two-dimensional color histogram analysis or three-dimensional color histogram analysis. In other embodiments, the machine learning analysis may be performed using pattern recognition algorithms (e.g., determining missing fence posts or missing/misaligned rooftop shingles). In other embodiments, the machine learning classifier includes deep learning analysis such as CNN or NIN. For example, CNN analysis may leverage feature maps created during the training process to assess the condition through

extracting meaningful features within a given image through convolution and pooling layers. Other machine learning models and algorithms are possible.

[0054] In an illustrative example, turning to FIG. 2B, examples of condition characteristics of aerial images of hipped rooftops and corresponding example histograms generated through machine learning analysis of pixel intensity are presented. For example, a set of good condition aerial images 210a through 214a, are presented alongside corresponding good condition histograms 210b through 214b. The good condition histograms 210b through 214b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 210c through 214c demonstrates the peak probability of grayscale color distribution of a good condition roof. The values, for example, can range from 0 (total black) to 255 (total white).

[0055] Conversely, a set of poor condition aerial images 216a through 220a, are presented alongside corresponding poor condition histograms 216b through 220b. The poor condition histograms 216b through 220b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 216c through 220c demonstrates the peak probability of grayscale color distribution of a good condition roof. The maximum values 216c through 220c corresponding to the poor condition rooftops 216a through 220a are markedly lower than corresponding maximum values 210c through 214c of good condition rooftops 210a through 214a. In addition, a width of the distributions of the poor condition histograms 216b through 220b may be markedly wider than a width of the distributions of the good condition histograms 210b through 214b. As can be seen of the aerial images of the poor condition rooftops 216a through 220a, the color distribution is patchy and bleached out, while the edges of the rooftops have lost their crisp lines. Conversely, looking to the aerial images of the good condition rooftops 210a through 214a, the rooftops are more substantially uniform in color with crisp lines on the edges.

[0056] Turning to FIG. 2C, a condition profile 230 for a rooftop condition is illustrated. In some implementations, pixel value distribution histograms such as the histograms 210b through 220b, in some implementations, can be combined to generate an example condition profile 230 corresponding to rooftop condition. The condition profile 230, for example, may be included as one of the condition profiles 114 of FIG. 1. Example reference bars 232a, 232b on the condition profile 230 illustrate values corresponding to a non-deteriorated hipped roof 214a and the deteriorated hipped roof 216a, respectively. In some examples, the closer the value of a reference bar 232 comes to 1 on the Y-axis, the better the condition of the roof, while values close to 0 represent poor condition rooftops. In one example, the reference bars 232 of the example condition profile 230 correspond to a test conditions sample data set including 2,500 images). The reference bars 232 can be combined, in some embodiments, in a logistic regression to generate a roof condition profile graph 236. The accuracy rate of the image histogram is 80% based on some validation.

[0057] Although illustrated as a single condition profile 230 corresponding to different types of rooftops (e.g., at least the hipped rooftop 216a and the gable rooftop 234), in other embodiments, individual condition profiles 114 can be generated for each property characteristic (e.g., profiles specific to gabled, gambrel, flat, hipped, square, etc.). In further refinements, in certain embodiments, individual condition profiles 114 can be generated for combinations of property characteristics (e.g., a gabled, shingled roof, a gabled, clay tiled roof, a gabled, metal roof, etc.) to increase accuracy rate based upon pixel densities corresponding to the combined characteristics. Many combinations of characteristics of property features may be used singly or in combination to generate a condition profile 114 designed to accurately identify the condition of the corresponding property feature.

[0058] Returning to FIG. 1, in some implementations, the property characteristics 110 and/or condition characteristics 116 may be analyzed to calculate (120) a risk estimate 122

corresponding to a risk of damage based upon one or more types of disasters. The types of disasters can include, in some examples, earthquake, hurricane, tornado, storm surge, fire, straight line winds, or explosion. The types and estimated severity of disasters, in some embodiments, may depend upon the particular property location 102b. For example, properties near active fault lines may be more susceptible to earthquakes, while coastal properties may be more susceptible to storm surge damage. The risk estimate 122, in some examples, can include an actuarial percentage indicating a likelihood of damage based upon the particular property characteristics. Different property characteristics, for example, may be more susceptible than others to certain types of damage. For example, flatter rooftops may be more susceptible to damage from excessive snow build-up, while peaked rooftops may be more vulnerable to strong winds.

[0059] In some embodiments, in calculating damage risk, one or more disaster risk profiles 118 can be applied based upon property characteristics. Vulnerability to damage due to disaster can vary, in some examples, by location, altitude, slope, rooftop shape, rooftop condition, cladding type, cladding condition, and/or pounding. In a particular example, as shown in FIG. 2A, a graphical risk profile 206 ranks types of rooftops by their vulnerability to strong winds. Vulnerability to wind damage increases from lowest vulnerability (flat rooftop 202e) to square roof 202d, to hipped roof 202c, to gable roof 202b, with the greatest wind damage vulnerability in gambrel roofs 202a.Vulnerability may be mathematically modeled based upon statistical information built from past damage results due to varying types and/or severity of disaster. In combining location-based vulnerabilities with individual property characteristic-based vulnerabilities, risk of damage due to disaster can be more accurately estimated.

[0060] Referring back to FIG. 1, the risk estimates 122, in some embodiments, can be used in insurance assessments. For example, the risk estimate 122 may be used in determining

whether a property is adequately insured against potential damage. Further, when tracking an impending natural disaster, an insurance company may use the risk estimates 122 to estimate claims based upon the forecast path and severity of the storm. Additionally, the risk estimates 122 may be applied by investors when selecting investment properties for an investment portfolio.

[0061] In some implementations, repair or replacement costs can be calculated (126) to determine a cost estimate 128 to place one or more property characteristics in good or "like new" condition. The cost estimates 128, in some embodiments, can be based in part on one or more replacement cost profiles 120. Replacement costs, in some examples, may vary based upon type of materials (e.g., rooftop materials, cladding materials, etc.), size of the job (e.g., estimated area of the roof, estimated length of fence, etc.), and/or additional property characteristics (e.g., contributing to the complexity of the work). The replacement profiles 120, in further examples, may be based in part on location (e.g., varying costs of material and labor regionally). In some implementations, the cost estimates 128 for repair or replacement of the property characteristics may be output to a dashboard interface screen at a remote computing device of a requester, such as an insurance carrier or real estate investment broker.

[0062] In some embodiments, cost estimates 128 can be used in automatically analyzing insurance claims. The cost estimate 128, further, may be combined with the risk estimate 122 in analyzing adequacy of insurance coverage for a particular property location 102b. Further, the cost estimates 128 may be used by investors in determining cost of maintaining/upgrading a particular investment property.

[0063] Although the operational flow is illustrated as a series of computational stages, in other implementations, more or fewer computational stages may be included. For example, aerial imagery 102c may be analyzed after an insurance claim has been paid to verify that the insured property has been repaired and/or to upgrade the estimated value of the property (e.g.,

in the circumstance where the owner upgraded the property rather than applying a straight repair/replacement of the damaged property characteristics.

[0064] Additionally, in other implementations, certain computational stages may be performed in a different order. For example, cost estimates 128 may be calculated prior to risk estimates 122. Other modifications of the operational flow 100 are possible.

[0065] FIG. 3 is a block diagram of an example environment 300 for matching aerial image topographical features to corresponding property maintenance levels. The example environment 300, for example, can be used to implement the operational flow 100 described in relation to FIG. 1. The example environment 300 includes a property characteristic classification and condition analysis system 302 in communication with client computing system(s) 306, a number of cost data and/or risk data source computing system(s) 308, and a number of shape map, aerial imagery, and/or terrestrial imagery source computing system(s) 304. The communication connection may be wired or wireless, over a variety of network types. In a general overview, the system 302 obtains property identifier(s) 340 from client computing system(s) 306, accesses images of a property identified by the property identifier 340 from the imagery source computing system(s) 304, and analyzes the images to determine property characteristic(s) 342 and condition characteristic(s) 344. Using cost and/or risk data obtained from cost and risk data source computing system(s) 308, the system 302 may determine replacement cost estimate data 350 and/or disaster risk estimate data 352 based upon the property characteristics and their condition.

[0066] In some implementations, a user of a particular client computing system 306 submits a request to the system 302 through a graphical user interface supplied by a graphical user interface engine 334. The request, for example, may include at least one property identifier 340 as well as one or more property characteristics 342 and/or identification of at least one of a replacement or repair cost estimate, a disaster risk estimate, and a confirmation of repair

assessment. The property identifier 340, in some examples, may include location information (e.g., address, geolocation coordinates, lot boundaries, etc.). The location information, for example, may conform with property location information 102b described in relation to FIG. 1. In other embodiments, the property identifier 340 may be a unique property identifier (e.g., number or string) used to look up property location information in a data store 310. In another embodiment, rather than submitting a property identifier, the user may submit a unique user identifier used to look up one or more properties associated with the user (e.g., properties insured by an insurance client, properties held by an investment client, etc.).

[0067] In one example, turning to FIG. 8A, a user may identify locations of one or more properties by selecting the properties within a graphical map interface 800. A number of properties are identified within the map view user interface 800 as indicated with an associated pin, such as pin 804. The pins, in some examples, may indicate properties insured by a particular insurance carrier, a type of property (e.g., commercial, industrial, residential, etc.), and/or properties of a value range (e.g., within a range, above a threshold, etc.). The pins, for example, may be displayed based upon filtering options supplied by the user or otherwise associated with a user profile (e.g., insurance carrier identification). In a particular example, a user may select three properties associated with three dialogue bubbles 802. As illustrated, each dialogue bubble identifies a replacement value associated with the property and invites the user to review details regarding the selected property via a details control.

[0068] In some implementations, the user enters property characteristics associated with each selected property. In other implementations, the characteristics may be accessed upon identification of the property (e.g., selection of a pin identifying a property, as illustrated in FIG. 8A). For example, the property characteristics 342 may be obtained from the data store 310, as illustrated in FIG. 3. Turning to FIG. 8B, an example property characteristics user interface 820 presents building area characteristics 822 (e.g., building area 822a, stories 822b,

and total building area 824c) and structure characteristics 824 (e.g., structure material 824a, construction class 824b). As described within, different or additional characteristics may vary per implementation. In some embodiments, the user may be provided the ability via the user interface 820 to edit the building area characteristics 822 and/or the structure characteristics 824, for example via an edit control 828a or 828b. For example, in the circumstance of recent development or renovation (e.g., construction of an addition), the user may modify previously stored characteristics values. The property characteristics user interface 820, for example, may be presented to a user upon selection of a details control of one of the dialogue bubbles 802 illustrated in the user interface of FIG. 8A.

[0069] The user interface 820 further presents, in some implementations, premium characteristics 826 such as a replacement value. The premium information, for example, may relate to an insurance policy purchased for the property or parameters for insuring the property (e.g., based upon upgraded or new characteristics). The user, in some embodiments, may be provided to update the premium information via an edit control 828c.

[0070] In some implementations, upon identification of property location information, the system 302 accesses imagery of the property from the imagery source computing system(s) 304 using an image acquisition engine 336. The images can include, in some examples, a shape map (e.g., such as the shape maps 102a described in relation to FIG. 1), two-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), three-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), and/or terrestrial imagery (e.g., such as the terrestrial imagery 102d described in relation to FIG. 1). The images obtained by the image acquisition engine 336, in some embodiments, depend upon the property characteristic(s) identified by the user. For example, certain types of images are preferred for analyzing certain types of property

characteristics. Housing siding, for example, is more easily perceived from a terrestrial image or three-dimensional aerial image than from a two-dimensional aerial image.

[0071] In some implementations, an image quality analysis and preparation engine 326 analyzes the acquired image(s) to confirm the acquired image(s) contains an adequately clear and detailed image of the property identified by the property identifier 340. In some embodiments, the image quality analysis and preparation engine 326 crops and/or resizes the acquired image(s). For example, the image quality analysis and preparation engine 326 may extract a portion of an acquired image based upon the property (e.g., building size). In some implementations, the image quality analysis and preparation engine 326 resizes each acquired image to a standard size. The standard size, in a particular example, may be 256 by 256 pixels per image. Resizing to a standard size, for example, may increase accuracy in later classification analysis. The image quality analysis and preparation engine 326, in some embodiments, may be configured to apply corrections to the acquired image(s). For example, the image quality analysis and preparation engine 326 may be configured to adjust an aerial image from a normal orthophoto angle, to a true orthophoto version as described above.

[0072] In some implementations, the image quality analysis and preparation engine 326 uses shape outlines as part of the analysis. For example, a composite image generation engine 318 may overlay an aerial image with a shape map image, as described in relation to FIG. 5C. Using the resultant composite image, the image quality analysis and preparation engine 326 may confirm the aerial image conforms with an urban planning map or other property placement guide (e.g., navigational map data, etc.). Further, the image quality analysis and preparation engine 326 may use the overlaid shape map as a guide in determining whether an aerial image requires correction to a true orthophoto angle and/or how closely to crop the image to capture the property (and, optionally, its immediate surroundings such as its lot or a portion of the proximate neighborhood).

[0073] In some implementations, if the image quality analysis and preparation engine 326 determines that the acquired image is insufficient, the image quality analysis and preparation engine 326 may request a replacement image from the image acquisition engine 336. For example, the image acquisition engine 336 may obtain images based upon a variety of factors including, in some examples, recency of capture, resolution, cost, and/or applicability to a particular property characteristic analysis. Upon determination by the image quality analysis and preparation engine 326 that the first obtained image is insufficient, for example, the image acquisition engine 336 may determine a next best source for obtaining an image of the property.

[0074] In some implementations, once an image has been approved (and, optionally, prepared and/or corrected) by the image quality analysis and preparation engine 326, a feature identification engine 320 extracts features from the property image(s) related to the identified property characteristics 342. In the circumstance of a fence, for example, the feature identification engine 320 may identify a perimeter enclosure or partial perimeter enclosure abutting and extending from the property as indicative of a fence.

[0075] In some implementations, upon identification of features by the feature identification engine 320, a property characteristic classification engine 322 classifies the property characteristic. For example, the features may be classified using one or more machine learning techniques as described in relation to computational stage 106 (classify features of each image) of FIG. 1. The property characteristic classification engine 322, for example, may generate property characteristics 342 representing a grouping, type, or other characterization of a particular property feature. Continuing with the particular example of a fence, the extracted features may be analyzed and classified in relation to height and/or material. Upon classifying the property characteristics, the property characteristic

classifications may be stored in the data store 310 as property characteristics 342 (e.g., similar to property characteristics 110 of FIG. 1).

[0076] In some implementations, the property characteristic classification engine 322 uses characteristic profile(s) 360 in classifying property characteristics. The property characteristic classification engine 322, for example, may obtain, for each property characteristic being analyzed, a particular characteristic profile 360 from a profile data store 314. The characteristic profiles, for example, may be similar to the characteristic profiles 108 described in relation to FIG. 1.

[0077] In some implementations, the property characteristic profiles 360 are generated by a characteristic classification learning engine 328. The characteristic classification learning engine 328, for example, may generate characteristic profiles 360 through a sample data set and learning process as described, generally, in relation to FIG. 2A. In a particular example, the characteristic classification learning engine 328 may analyze JPG (lossy compression digital image standard developed by the Joint Photographic Experts Group) to recognize varying rooftop shapes.

[0078] While certain property characteristic classifications are done by analysis, in some implementations, one or more feature classifications may be obtained from previously stored property characteristics 342. For example, based upon tax records, real estate records, etc. some basic materials and structure information regarding a property may be readily available through local and/or remote database system(s). In other examples, the previously stored property characteristics 342 may also be obtained from previous condition assessments performed for a property location by the system 302.

[0079] In some implementations, once the property characteristic classification engine 322 has classified the property characteristic(s), a characteristic condition classification engine 324 classifies the condition of each property characteristic. For example, the property

characteristics may be classified as described in relation to computational stage 112 (classify condition of each feature) of FIG. 1. The characteristic condition classification engine 324, for example, may generate condition characteristics 344 representing a rating, qualification, or ranking of the condition of the particular characteristic. In some examples, the characteristic condition classification engine 324 may qualify a characteristic as a) "good" or "bad", b) "like new", "acceptable", "needs repair", or "needs replacement", c) rated on a numeric scale such as a scale from 1 to 5 where 5 may correspond to "like new" and 1 may correspond to "needs replacement." In other implementations, particular problems may be identified by the characteristic condition classification engine 324 such as, in some examples, a fence feature is partially fallen, or a roof feature shows signs of structural damage.

[0080] In some implementations, the characteristic condition classification engine 324 uses condition profile(s) 362 in classifying property characteristic conditions. The characteristic condition classification engine 324, for example, may obtain, for each property characteristic being analyzed, a particular condition profile 362 from the profile data store 314. The condition profiles 362, for example, may be similar to the condition profiles 114 described in relation to FIG. 1.

[0081] In some implementations, the condition profiles 362 are generated by a condition classification learning engine 330. The condition classification learning engine 330, for example, may generate condition profiles 362 through a sample data set and learning process as described, generally, in relation to FIG. 2B. In a particular example, color histogram analysis may be used to identify peak pixel values of the images in gray scale. Using the group of calculated peak pixel values, the learning engine can classify property condition into certain categories.

[0082] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a risk

calculation engine 316 may estimate risk of damage based upon one or more types of disaster. For example, the disaster risk estimate data 352 may be calculated as described in relation to computational stage 120 (calculate damage risk) of FIG. 1. The disaster risk estimate data 350, in one example, can include a percentage likelihood of damage due to each particular type of risk based upon the particular property characteristics and/or property conditions, as described in relation to the risk estimates 122 of FIG. 1. Further, in some embodiments, the disaster risk estimate data 350 may include a set of risk estimates based upon, in some examples, a number of severities of disaster, a particular path of disaster, and/or hazard intensity of disaster. The disaster severities, in some examples, may correspond to the Richter scale of seismic activity magnitude or the Saffir-Simpson Hurricane Wind Scale category. The path of the disaster, in some examples, can include geographical direction such as northeasterly, etc. or angle of impact with respect to the property characteristic(s). The hazard intensity of disaster, in some examples, can relate to wind speed or rainfall amount. Repair costs, for example, may be more accurately estimated when the roof condition is known. Due to poor condition of a rooftop in one particular example, the roof may be more vulnerable to damage requiring replacement. In another particular example, due to a poor condition rooftop, the likelihood for interior property damage (e.g., water damage due to breach of the roof) may increase at a set level of severity of disaster and above.

[0083] In some embodiments, the risk calculation engine 316 accesses one or more risk profiles 364 from the data store 314 based upon property characteristics and/or condition characteristics. The risk profiles, for example, may be similar to the disaster risk profiles 118 described in relation to FIG. 1. The risk profiles 364, for example, may be obtained from one or more risk data sources 306 by a cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate risk profiles 364 (e.g., using risk data obtained

from one or more cost and risk data sources 306 and a risk data analysis engine (not illustrated)).

[0084] The risk estimate data 352, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use risk estimate data in making insurance assessments. In another example, a real estate investment broker or firm client 306 may apply risk estimate data 352 when selecting investment properties for an investment portfolio.

[0085] Turning to FIG. 8C, an example disaster risk user interface 840 presents risk assessment information based upon risk profiles 364 related to the selected property (e.g., one of the properties identified via the dialogue bubbles 802c of FIG. 8A). The user interface 840, for example, may be accessed by scrolling downward from the user interface 820. The user interface 840 illustrates a number of disaster risk factors 842 and associated risk estimate data 844 for the selected property. As illustrated, the disaster risk factors 842 include a fire factor 842a, a wind factor 842b, a flood factor 842c, an earthquake factor 842d, a tsunami factor 842e, and a landslide factor 842f. In some embodiments, only a subset of the risk estimate data is determined via risk assessment techniques described herein. For example, flood data 844c may be generated based upon governmental flood map evaluation rather than via aerial imaging assessment, while fire risk 844a may be determined at least in part based upon proximity to neighboring properties as derived via imaging analysis and/or construction properties derived via image analysis. Further, wind risk data 842b may be derived via rooftop analysis as described in greater detail herein.

[0086] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a cost calculation engine 336 calculates repair or replacement costs for improving problems identified by the characteristic condition classification engine 324 and generates replacement

cost estimate data 350. For example, the replacement cost estimate data 352 may be calculated as described in relation to computational stage 126 (calculate repair or replacement costs) of FIG. 1. The replacement cost estimate data 350, for example, may be similar to the cost estimates 128 described in relation to FIG. 1.

[0087] In some implementations, the cost calculation engine 336 based calculations in part on one or more cost profiles 366 (e.g., similar to the cost profiles 120 of FIG. 1). In some embodiments, the cost calculation engine 336 accesses one or more cost profiles 366 from the data store 314 based upon property characteristics and/or condition characteristics. The cost profiles 366, in some embodiments, are obtained from one or more cost data sources 306 by the cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate cost profiles 366 (e.g., by a cost data analysis engine (not illustrated) using cost data obtained from one or more cost and risk data sources 306).

[0088] The cost estimate data 350, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use cost estimate data in determining adequacy of insurance coverage for a particular property. In another example, a real estate investment broker or real estate investment firm client 306 may apply cost estimate data 350 in determining cost of maintaining/upgrading a particular investment property.

[0089] In some implementations, the cost estimate data 350 and/or risk estimate data 352 is provided to a requesting client 306, responsive to receiving identification of one or more properties, in real-time or near real-time. For example, a client 306 accessing a dashboard interface, may format a request for a risk estimate or cost estimate related to an identified property within a dashboard interface and submit the request via a network to the system 302. Responsive to the request, the system 302 may conduct the analysis described generally above and respond, in real time or near-real time to the client 306 with a risk analysis or cost

analysis. For example, risk analysis information is presented in user interface 840 of FIG. 8C.

[0090] In some implementations, the system may identify, through updated meteorological data, one or more properties within a client real estate portfolio affected by a disaster. The system, further to identification of the affected properties, may proactively prepare a repair estimate to provide to the client corresponding to the real estate portfolio shortly after the disaster took effect. In one example, the Japan Meteorological Agency may update observation data via a web site interface within an hour or so of observation. In this example, the system may provide repair cost estimates to clients between one and two hours after a disaster has taken place.

[0091] Rather than sharing cost estimate data 350 and/or risk estimate data 352 directly with the clients 306, in other embodiments, the system 302 may include a report generation engine (not illustrated) that prepares reports regarding condition, damage, and risk assessments of one or more properties. Further, in some embodiments, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to confirm whether a property owner made repairs to a property (e.g., based upon payment of an insurance claim), replaced one or more features of a property, or removed one or more features of a property (e.g., removed a hazardous collapsing structure, cut back brush encroaching a fire risk distance to a home, etc.). In another illustration, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to determine whether a repair or replacement is an upgrade (e.g., replacement using superior materials) or a downgrade (e.g., replacing an in-ground pool with an above-ground pool) to the property characteristic. Other modifications of the system 302 are possible.

[0092] FIG. 4 is a flow chart of an example method 400 for classifying condition characteristics of a property based on aerial image analysis. The flow chart, for example,

may represent computational stages 104 through 112 as described in relation to FIG. 1. The method 400 may be performed, for example, by the system 302 of FIG. 3.

[0093] In some implementations, the method 400 begins with accessing a two-dimensional shape map including the shape of a property (402). The shape map, for example, may be accessed by the image acquisition engine 336 from a shape map imagery source 304, as described in relation to FIG. 3. The two-dimensional shape map, for example, may take a form of any of the shape maps 102a described in relation to FIG. 1. In a particular example, the shape map may be in a form similar to the shape map 500 described in relation to FIG. 5A.

[0094] In some implementations, two-dimensional and/or three-dimensional aerial imagery including an image of the property is accessed (404). The two-dimensional and/or three-dimensional aerial imagery, for example, may be accessed by the image acquisition engine 336 from an aerial imagery source 304, as described in relation to FIG. 3. The two-dimensional and/or three-dimensional aerial imagery, for example, may take a form of any of the aerial imagery 102c described in relation to FIG. 1. In a particular example, the two-dimensional aerial imagery may be in a form similar to the aerial image 510 described in relation to FIG. 5B.

[0095] In some implementations, the aerial imagery is overlaid with the shape map (406). The composite image generation engine 318 of FIG. 3, for example, may overlay the aerial imagery with the shape map to generate a composite image. The composite image, for example, may be in a form similar to the composite image 520 described in relation to FIG. 5C.

[0096] If a shape match is not identified (408), in some implementations, the method 400 accesses alternate two-dimensional or three-dimensional aerial imagery (410). In some embodiments, the image quality analysis and preparation engine 326 of FIG. 3 determines

whether the composite image presents an adequate shape match of the property(s) of interest. Upon determining the image does not match, the image acquisition engine 336 of FIG. 3, for example, may obtain an alternative two-dimensional or three-dimensional aerial image from the aerial imagery source(s) 304. As described in relation to FIG. 3, for example, For the image acquisition engine 336 may determine a next best source for obtaining an image of the property based upon one or more factors. Conversely, the method 400, in other implementations (not illustrated), could proceed without matching the shape map to the aerial imagery.

[0097] If a shape match is identified (408), in some implementations, the formatting of the aerial imagery is prepared (411). In some embodiments, the image is cropped to include the property of interest or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Cropping may be based, for example, on the correlation of the shape map to the property. In illustration, the image may be cropped to include the shape map outline of the property plus a border region. In some embodiments, cropping may include cropping to a set shape (e.g., X by X pixels square, X by Y pixels rectangle, etc.). In some embodiments, in addition to cropping the image, the image may be resized. For example, depending upon the resolution of the aerial imagery, the image resolution may be reduced, for example, to fit within an X by X pixels square or an X by Y pixels rectangle. Resizing to a standard image size, for example, can contribute to analysis consistency and improvement in classification accuracy. In further embodiments, the color depth and/or color mapping of the aerial imagery may be adjusted. For consistent color histogram analysis of the imagery, for example, the color depth and color mapping may be made consistent across analyzed images. In a particular example, color images may be converted to grayscale for grayscale image analysis.

Adjustments to the imagery, for example, may be effected by the image quality analysis and preparation engine 326, described in relation to FIG. 3.

[0098] In some implementations, orthogonality of the aerial imagery is assessed (412). For example, the image quality analysis and preparation engine 326 may assess orthogonality of the aerial imagery. The image quality analysis and preparation engine 326, in one example, may determine that orthogonality correction is desired. In another example, if the image represents a normal orthophoto rather than a true orthophoto, the image quality analysis and preparation engine 326 may notify further modules which may compensate for the angle of capture of the aerial image. In other implementations (not illustrated), orthogonality may be assessed without use of an overlaid shape map.

[0099] Returning to FIG. 4, in some implementations, if the aerial imagery is not orthogonal (414), an orthogonal version of the aerial imagery is generated (416). The image quality analysis and preparation engine 326 of FIG. 3, for example, may correct a normal orthophoto form to generate a true orthophoto form. The true orthophoto form, for example, may better match the shape map overly.

[0100] In some implementations, one or more property characteristics of the property are classified (418). The property, in some embodiments, is analyzed based on the portion of the aerial image substantially bounded by the shape map of the property. In other embodiments, the property analysis encompasses a surrounding of the property (e.g., features proximate the property upon the property lot, nearby properties, etc.). The property characteristic(s), for example, may be classified by the property characteristic classification engine 322, as described in relation to FIG. 3. In a particular example, a rooftop property feature may be classified as one of a variety of rooftop shapes, as illustrated in FIG. 2A.

[0101] In some implementations, if a property characteristic classification is identified (420), a condition of each of the property characteristics can be classified (422). The property

characteristic condition(s), for example, may be classified by the characteristic condition classification engine 324, as described in relation to FIG. 3. In a particular example, a hipped classification of the rooftop feature may be classified as one of a good condition and a poor condition, as illustrated in FIG. 2B. In some implementations, the classifications of the condition of each of the property characteristics may by output to a computing device of a requester (424) via a dashboard interface screen. In some examples, in addition to providing the condition classification for the property characteristics, the dashboard interface screen may include replacement costs for replacing the property characteristics, risk cost estimates due to damage from natural disasters, or confirmation of whether or not repairs have been made to the property characteristics.

[0102] If, instead, a classification match was not identified (420), in some implementations, alternate two-dimensional or three-dimensional aerial imagery is accessed (410) and the method 400 restarts with overlaying the replacement aerial imagery with the shape map (406). Alternatively, in some embodiments, even if a classification match is not identified, condition may be assessed based upon a default profile associated with the property feature (not illustrated). For example, if the rooftop shape does not match one of the shapes trained into the system, the condition of the rooftop may still be assessed based upon a general condition profile trained with a variety of rooftop shapes. In some examples, the condition of the rooftop may be assessed by comparing the current rooftop conditions to stored historic condition characteristics for the property from a previous condition assessment.

[0103] Although the method 400 is illustrated as a series of steps, in other implementations, more or fewer steps may be included. For example, in some implementations, terrestrial images are obtained and used to classify the same and/or different property characteristics, as described in relation to the operational flow 100 of FIG. 1.

[0104] Additionally, in other implementations, certain steps may be performed in a different order. For example, in some implementations, property characteristics and condition characteristics may be classified (418, 422) in parallel. Other modifications of the operational flow 100 are possible.

[0105] Aspects of the present disclosure may be directed to computing systems for categorizing a repair condition of a property characteristic in order to provide dynamic, real-time property condition assessments in response to requests received from users such as insurance carriers or real estate investment brokers using aerial imagery. The implementations described herein improve upon conventional methodologies by applying deep learning analysis models to detected property characteristics of the obtained imagery in order to assess whether a condition of the property characteristics is degraded to a point of needing repair or replacement and determine an amount of risk exposure of the property due to the detected condition of the property characteristics. The implementations described herein improve processing efficiency of the system to reduce an amount of time it takes to perform the condition assessments and automate a condition assessment process.

[0106] Next, a hardware description of the computing device, mobile computing device, or server according to exemplary embodiments is described with reference to Figure 6. In Figure 6, the computing device, mobile computing device, or server includes a CPU 600 which performs the processes described above. The process data and instructions may be stored in memory 602. These processes and instructions may also be stored on a storage medium disk 604 such as a hard drive (HDD) or portable storage medium or may be stored remotely. Further, the claimed advancements are not limited by the form of the computer-readable media on which the instructions of the inventive process are stored. For example, the instructions may be stored on CDs, DVDs, in FLASH memory, RAM, ROM, PROM, EPROM, EEPROM, hard disk or any other information processing device with which the

computing device, mobile computing device, or server communicates, such as a server or computer.

[0107] Further, a portion of the claimed advancements may be provided as a utility application, background daemon, or component of an operating system, or combination thereof, executing in conjunction with CPU 600 and an operating system such as Microsoft Windows 6, UNIX, Solaris, LINUX, Apple MAC-OS and other systems known to those skilled in the art.

[0108] CPU 600 may be a Xenon or Core processor from Intel of America or an Opteron processor from AMD of America, or may be other processor types that would be recognized by one of ordinary skill in the art. Alternatively, the CPU 600 may be implemented on an FPGA, ASIC, PLD or using discrete logic circuits, as one of ordinary skill in the art would recognize. Further, CPU 600 may be implemented as multiple processors cooperatively working in parallel to perform the instructions of the inventive processes described above.

[0109] The computing device, mobile computing device, or server in FIG. 6 also includes a network controller 606, such as an Intel Ethernet PRO network interface card from Intel Corporation of America, for interfacing with network 6X. As can be appreciated, the network 628 can be a public network, such as the Internet, or a private network such as an LAN or WAN network, or any combination thereof and can also include PSTN or ISDN sub-networks. The network 628 can also be wired, such as an Ethernet network, or can be wireless such as a cellular network including EDGE, 3G and 4G wireless cellular systems. The wireless network can also be Wi-Fi, Bluetooth, or any other wireless form of communication that is known.

[0110] The computing device, mobile computing device, or server further includes a display controller 608, such as a NVIDIA GeForce GTX or Quadro graphics adaptor from NVIDIA Corporation of America for interfacing with display 610, such as a Hewlett Packard

HPL2445w LCD monitor. A general purpose I/O interface 612 interfaces with a keyboard and/or mouse 614 as well as a touch screen panel 616 on or separate from display 610. General purpose I/O interface also connects to a variety of peripherals 618 including printers and scanners, such as an OfficeJet or DeskJet from Hewlett Packard.

[0111] A sound controller 620 is also provided in the computing device, mobile computing device, or server, such as Sound Blaster X-Fi Titanium from Creative, to interface with speakers/microphone 622 thereby providing sounds and/or music.

[0112] The general purpose storage controller 624 connects the storage medium disk 604 with communication bus 626, which may be an ISA, EISA, VESA, PCI, or similar, for interconnecting all of the components of the computing device, mobile computing device, or server. A description of the general features and functionality of the display 610, keyboard and/or mouse 614, as well as the display controller 608, storage controller 624, network controller 606, sound controller 620, and general purpose I/O interface 612 is omitted herein for brevity as these features are known.

[0113] One or more processors can be utilized to implement various functions and/or algorithms described herein, unless explicitly stated otherwise. Additionally, any functions and/or algorithms described herein, unless explicitly stated otherwise, can be performed upon one or more virtual processors, for example on one or more physical computing systems such as a computer farm or a cloud drive.

[0114] Reference has been made to flowchart illustrations and block diagrams of methods, systems and computer program products according to implementations of this disclosure. Aspects thereof are implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other

programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0115] These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means which implement the function/act specified in the flowchart and/or block diagram block or blocks.

[0116] The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0117] Moreover, the present disclosure is not limited to the specific circuit elements described herein, nor is the present disclosure limited to the specific sizing and classification of these elements. For example, the skilled artisan will appreciate that the circuitry described herein may be adapted based on changes on battery sizing and chemistry, or based on the requirements of the intended back-up load to be powered.

[0118] The functions and features described herein may also be executed by various distributed components of a system. For example, one or more processors may execute these system functions, where the processors are distributed across multiple components communicating in a network. The distributed components may include one or more client and server machines, which may share processing, as shown on Fig. 8, in addition to various human interface and communication devices (e.g., display monitors, smart phones, tablets, personal digital assistants (PDAs)). The network may be a private network, such as a LAN or

WAN, or may be a public network, such as the Internet. Input to the system may be received via direct user input and received remotely either in real-time or as a batch process. Additionally, some implementations may be performed on modules or hardware not identical to those described. Accordingly, other implementations are within the scope that may be claimed.

[0119] In some implementations, as illustrated in FIG. 7, the innovations described herein may interface with a cloud computing environment 730, such as Google Cloud Platform™ to perform at least portions of methods or algorithms detailed above. The processes associated with the methods described herein can be executed on a computation processor, such as the Google Compute Engine by data center 734. The data center 734, for example, can also include an application processor, such as the Google App Engine, that can be used as the interface with the systems described herein to receive data and output corresponding information. The cloud computing environment 730 may also include one or more databases 738 or other data storage, such as cloud storage and a query database. In some implementations, the cloud storage database 738, such as the Google Cloud Storage, may store processed and unprocessed data supplied by systems described herein.

[0120] The systems described herein may communicate with the cloud computing environment 730 through a secure gateway 732. In some implementations, the secure gateway 732 includes a database querying interface, such as the Google BigQuery platform.

[0121] The cloud computing environment 102 may include a provisioning tool 740 for resource management. The provisioning tool 740 may be connected to the computing devices of a data center 734 to facilitate the provision of computing resources of the data center 734. The provisioning tool 740 may receive a request for a computing resource via the secure gateway 732 or a cloud controller 736. The provisioning tool 740 may facilitate a connection to a particular computing device of the data center 734.

[0122] A network 702 represents one or more networks, such as the Internet, connecting the cloud environment 730 to a number of client devices such as, in some examples, a cellular telephone 710, a tablet computer 712, a mobile computing device 714, and a desktop computing device 716. The network 702 can also communicate via wireless networks using a variety of mobile network services 720 such as Wi-Fi, Bluetooth, cellular networks including EDGE, 3G and 4G wireless cellular systems, or any other wireless form of communication that is known. In some embodiments, the network 702 is agnostic to local interfaces and networks associated with the client devices to allow for integration of the local interfaces and networks configured to perform the processes described herein.

[0123] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present disclosures. Indeed, the novel methods, apparatuses and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods, apparatuses and systems described herein can be made without departing from the spirit of the present disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the present disclosures.

CLAIMS

What is claimed is:

1. A method for automatically categorizing a condition of a characteristic of a property, the method comprising:

obtaining, by processing circuitry, an aerial image of a geographic region including the property;

extracting, by the processing circuitry, one or more features of a plurality of features from the aerial image, wherein

the one or more features are each represented by a set of pixel groupings, and

the one or more features represent the characteristic of the property, wherein

each pixel grouping of the set of pixel groupings comprises at least one of angles, outlines, or substantially homogenous pixel fields;

applying, by the processing circuitry, a first portion of the set of pixel groupings to a first machine learning classifier to determine a characteristic classification of the characteristic from a plurality of potential classifications of the characteristic, wherein

the first machine learning classifier is trained to identify at least a portion of the one or more features from the first portion of the set of pixel groupings; and

applying, by the processing circuitry, a second portion of the set of pixel groupings to a second machine learning classifier to determine a condition classification of the characteristic from a plurality of potential condition classifications of the characteristic, wherein

the second machine learning classifier is trained to identify, from the second portion of the set of pixel groupings, property characteristic conditions of the characteristic having the characteristic classification.

ABSTRACT

In an illustrative embodiment, methods and systems for automatically categorizing a condition of a property characteristic may include obtaining aerial imagery of a geographic region including the property, identifying features of the aerial imagery corresponding to the property characteristic, analyzing the features to determine a property characteristic classification, and analyzing a region of the aerial imagery including the property characteristic to determine a condition classification.

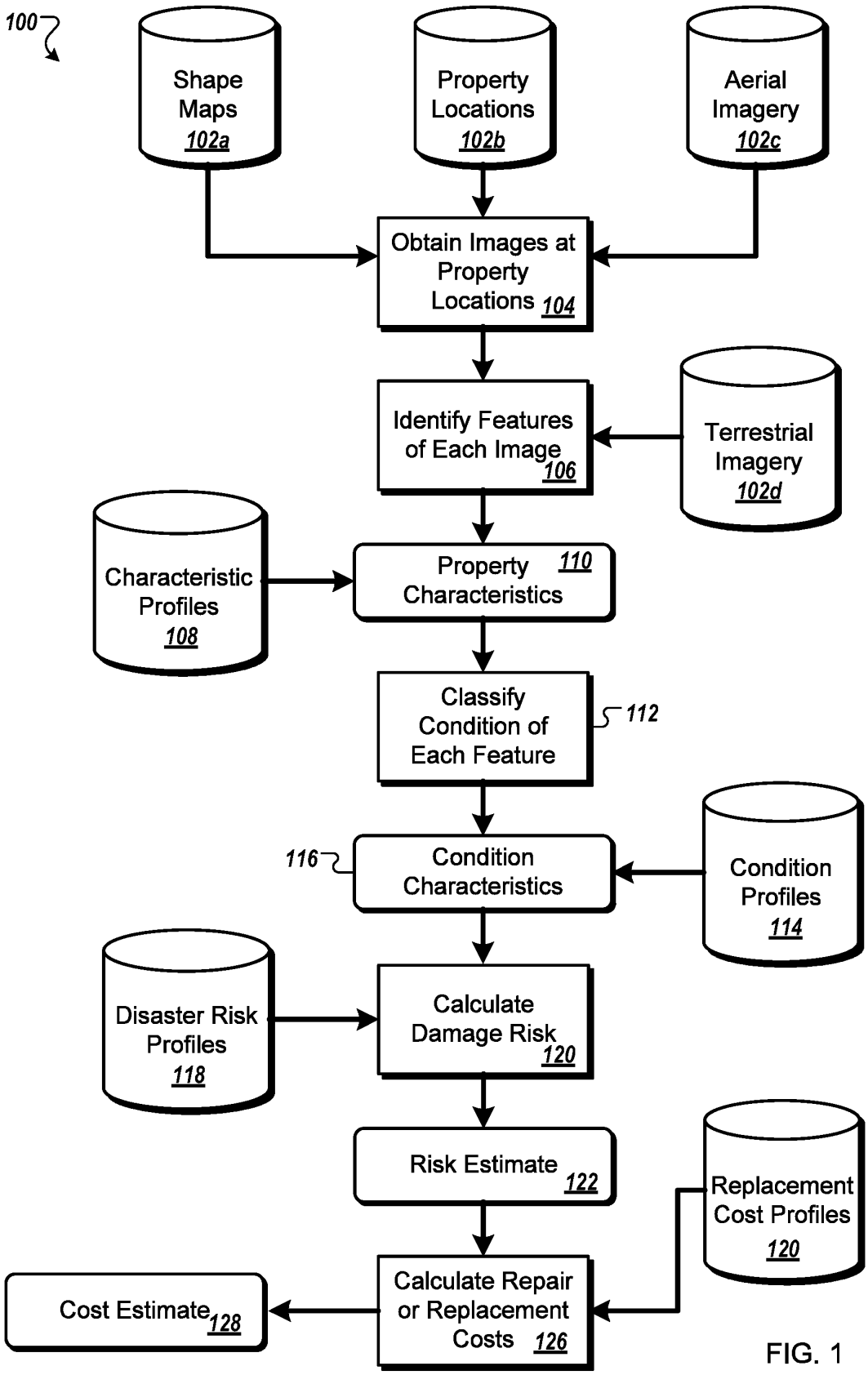

100
Shape Maps 102a
Property Locations 102b
Aerial Imagery 102c
Obtain Images at Property Locations 104
Identify Features of Each Image 106
Terrestrial Imagery 102d
Characteristic Profiles 108
Property Characteristics 110
Classify Condition of Each Feature 112
116
Condition Characteristics
Condition Profiles 114
Disaster Risk Profiles 118
Calculate Damage Risk 120
Risk Estimate 122
Replacement Cost Profiles 120
Calculate Repair or Replacement Costs 126
Cost Estimate 128

FIG. 1

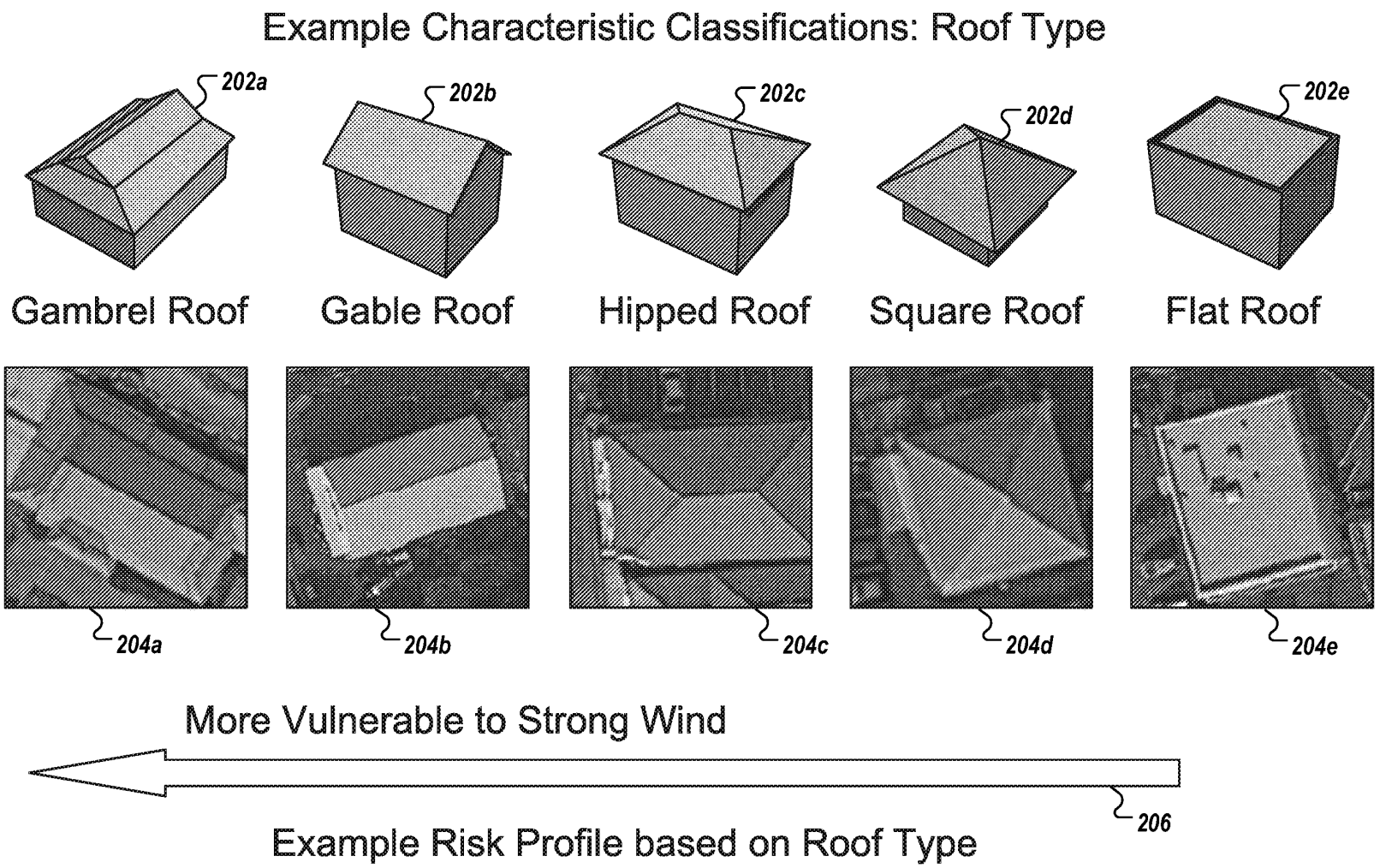

Example Characteristic Classifications: Roof Type
202a
202b
202c
202d
202e
Gambrel Roof
Gable Roof
Hipped Roof
Square Roof
Flat Roof
204a
204b
204c
204d
204e
More Vulnerable to Strong Wind
206
Example Risk Profile based on Roof Type

FIG. 2A

0050

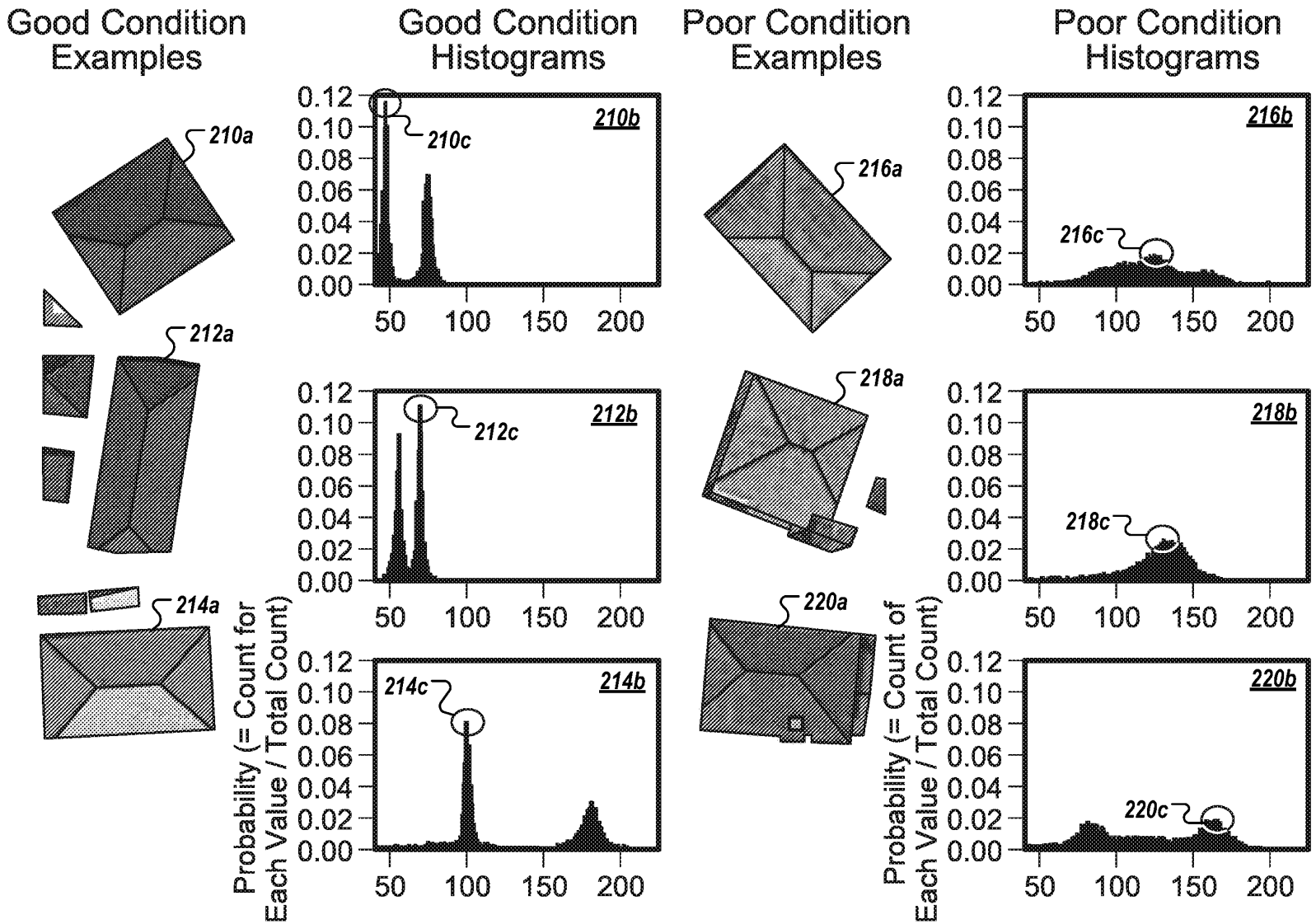
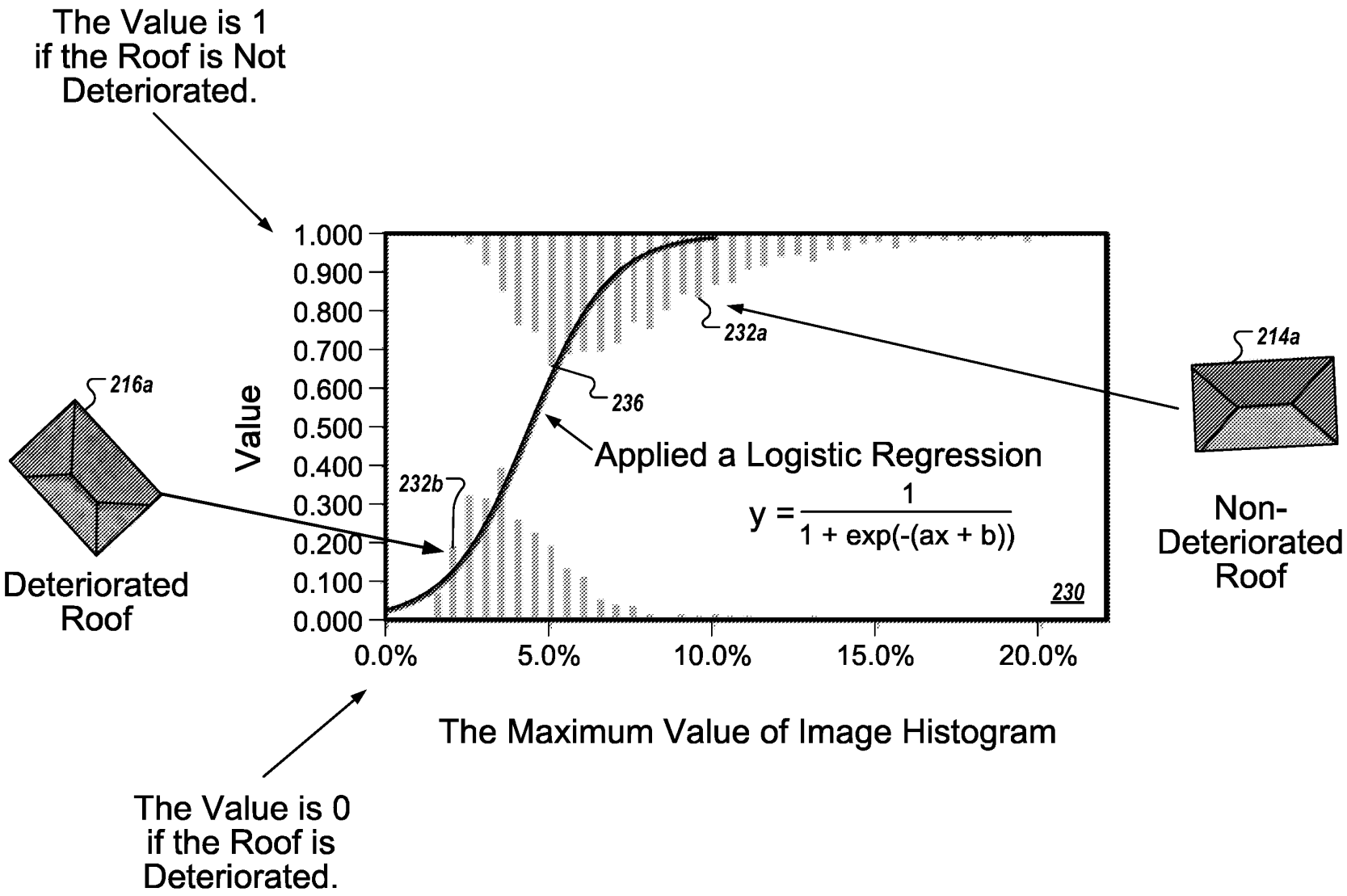

Good Condition Examples
Good Condition Histograms
Poor Condition Examples
Poor Condition Histograms
210a
212a
214a
216a
218a
220a
210b
210c
212b
212c
214b
214c
216b
216c
218b
218c
220b
220c
0.12
0.10
0.08
0.06
0.04
0.02
0.00
50
100
150
200
Probability (= Count for Each Value / Total Count)
Probability (= Count of Each Value / Total Count)

FIG. 2B

0051


The Value is 1
if the Roof is Not
Deteriorated.
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Value
0.0%
5.0%
10.0%
15.0%
20.0%
The Maximum Value of Image Histogram
232a
236
232b
Applied a Logistic Regression
y = 1 / (1 + exp(-(ax + b)))
230
216a
Deteriorated
Roof
214a
Non-
Deteriorated
Roof
The Value is 0
if the Roof is
Deteriorated.

0052

FIG. 2C

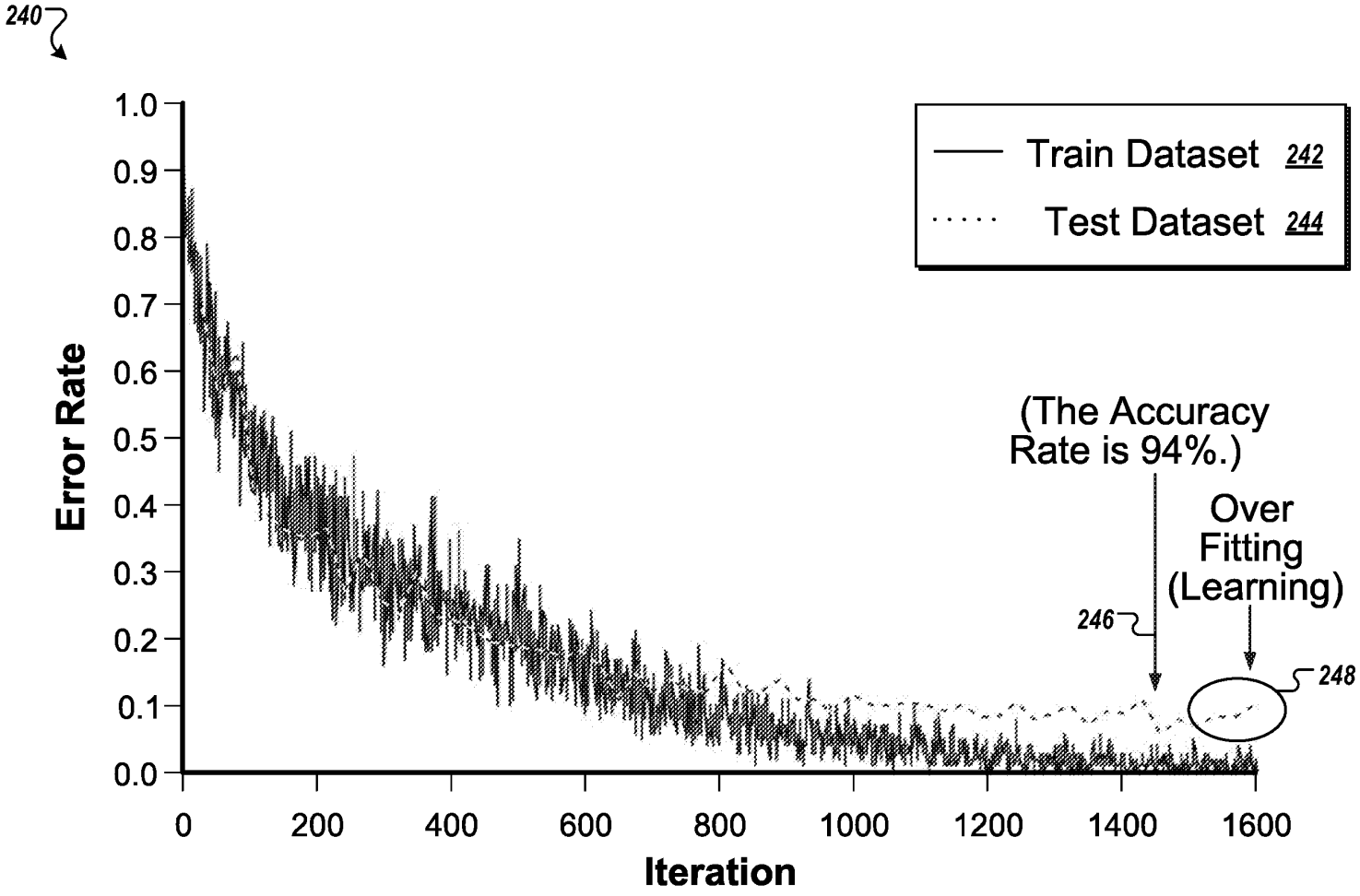

240
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Error Rate
0
200
400
600
800
1000
1200
1400
1600
Iteration
Train Dataset 242
Test Dataset 244
(The Accuracy Rate is 94%.)
Over Fitting (Learning)
246
248

FIG. 2D

0053

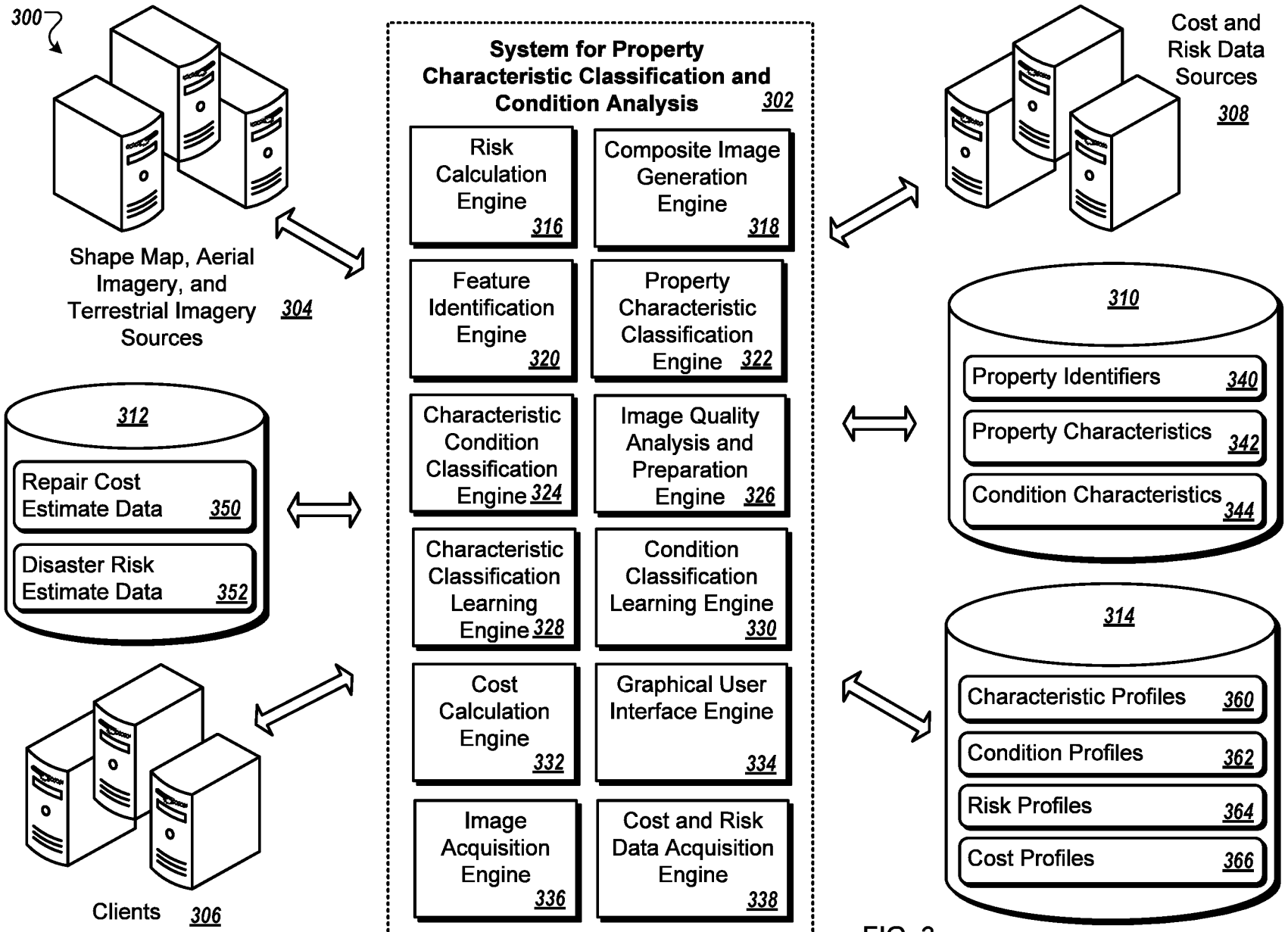

300
Shape Map, Aerial Imagery, and Terrestrial Imagery Sources 304
312
Repair Cost Estimate Data 350
Disaster Risk Estimate Data 352
Clients 306
System for Property Characteristic Classification and Condition Analysis 302
Risk Calculation Engine 316
Composite Image Generation Engine 318
Feature Identification Engine 320
Property Characteristic Classification Engine 322
Characteristic Condition Classification Engine 324
Image Quality Analysis and Preparation Engine 326
Characteristic Classification Learning Engine 328
Condition Classification Learning Engine 330
Cost Calculation Engine 332
Graphical User Interface Engine 334
Image Acquisition Engine 336
Cost and Risk Data Acquisition Engine 338
Cost and Risk Data Sources 308
310
Property Identifiers 340
Property Characteristics 342
Condition Characteristics 344
314
Characteristic Profiles 360
Condition Profiles 362
Risk Profiles 364
Cost Profiles 366

FIG. 3

0054

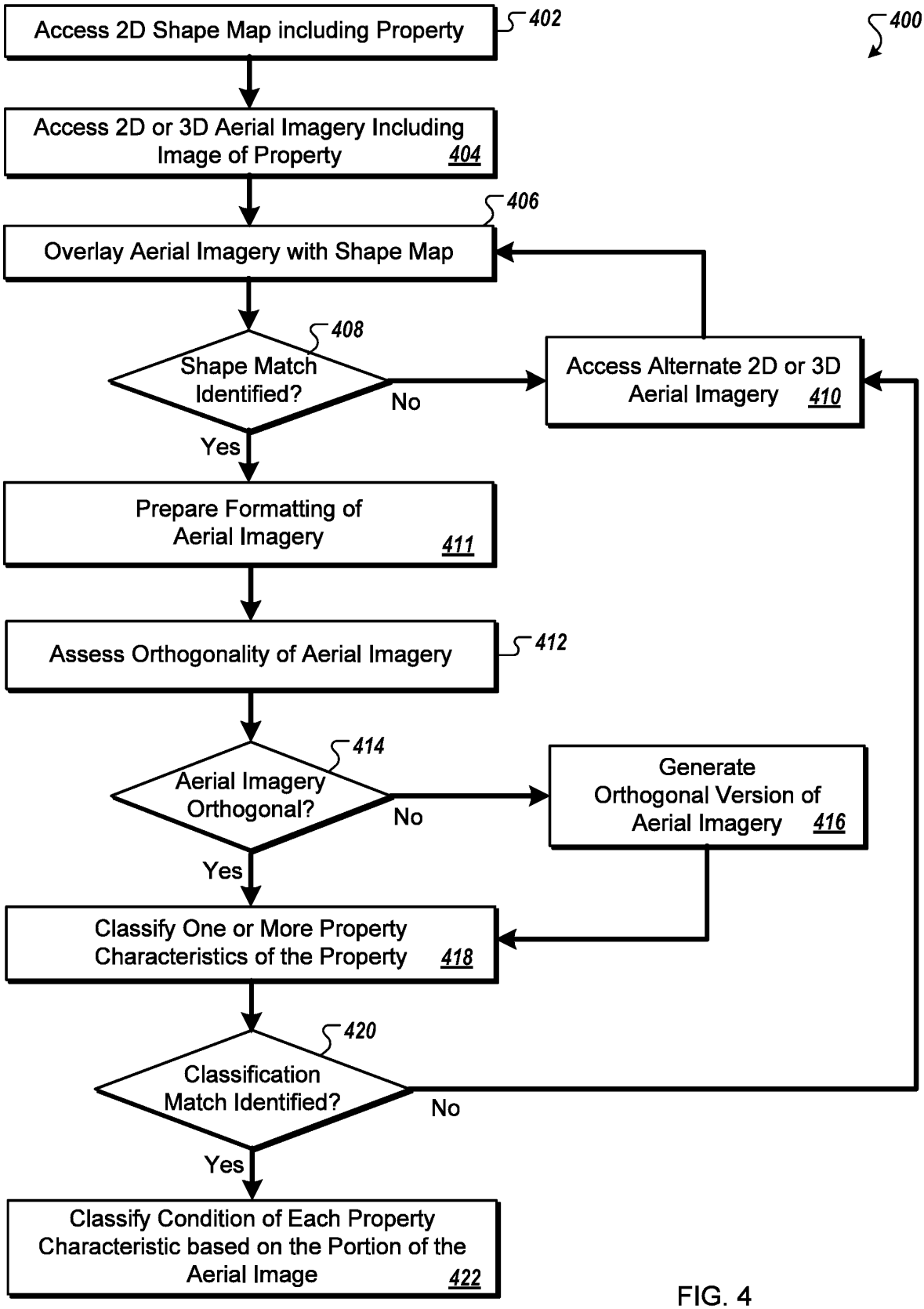

Access 2D Shape Map including Property
402
400
Access 2D or 3D Aerial Imagery Including Image of Property
404
406
Overlay Aerial Imagery with Shape Map
408
Shape Match Identified?
No
Access Alternate 2D or 3D Aerial Imagery
410
Yes
Prepare Formatting of Aerial Imagery
411
Assess Orthogonality of Aerial Imagery
412
414
Aerial Imagery Orthogonal?
No
Generate Orthogonal Version of Aerial Imagery
416
Yes
Classify One or More Property Characteristics of the Property
418
420
Classification Match Identified?
No
Yes
Classify Condition of Each Property Characteristic based on the Portion of the Aerial Image
422

FIG. 4

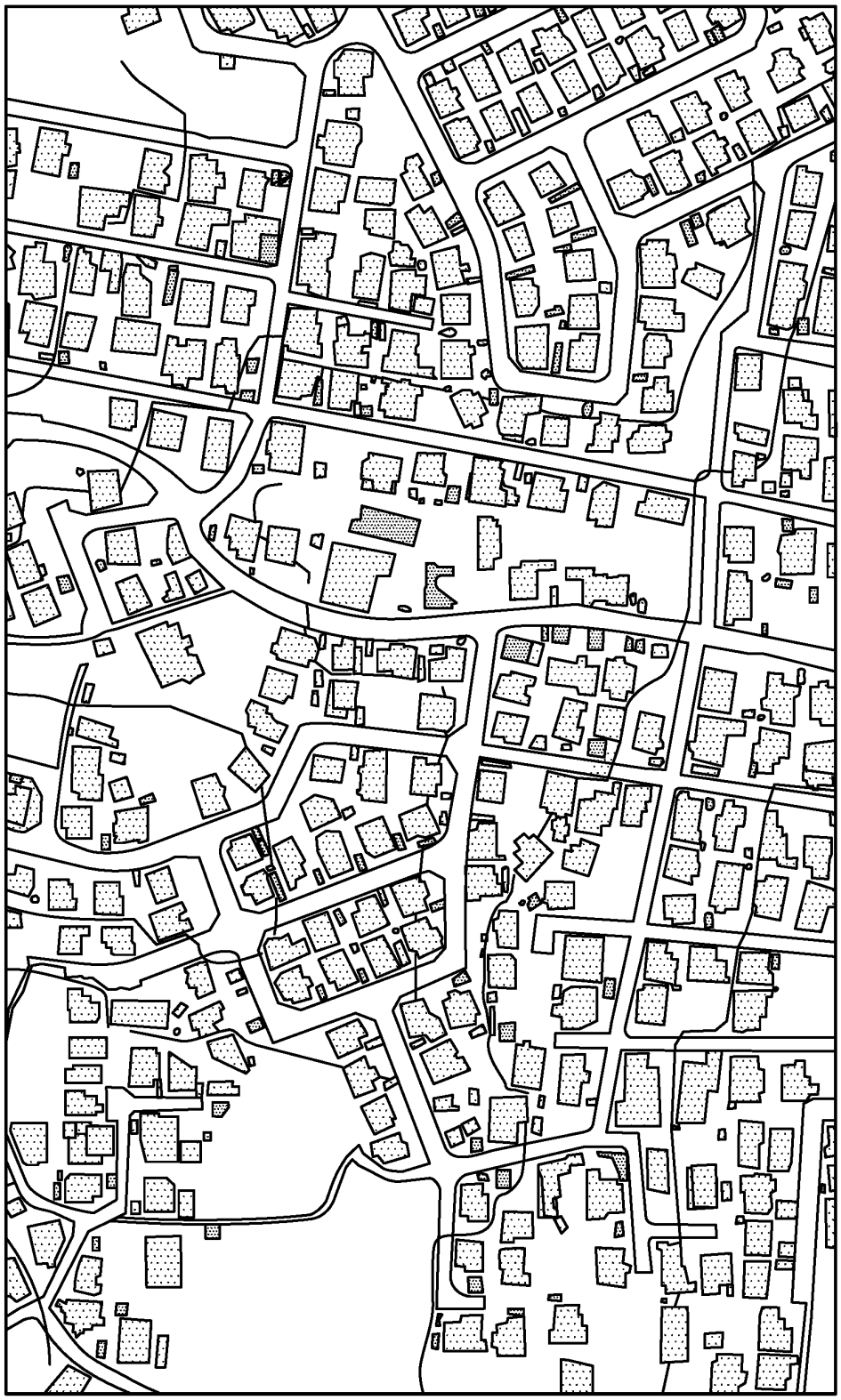


FIG. 5A



FIG. 5B

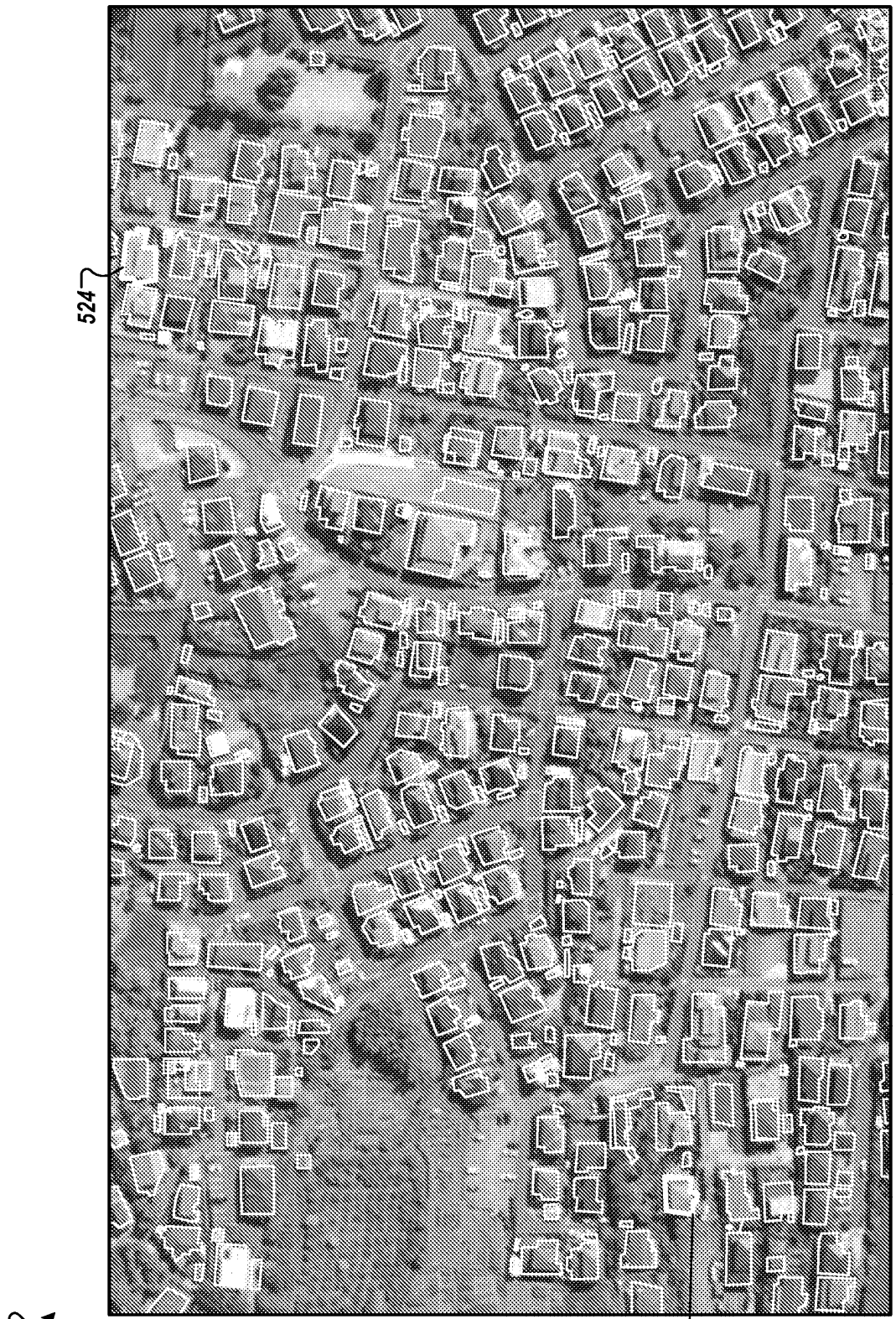


FIG. 5C

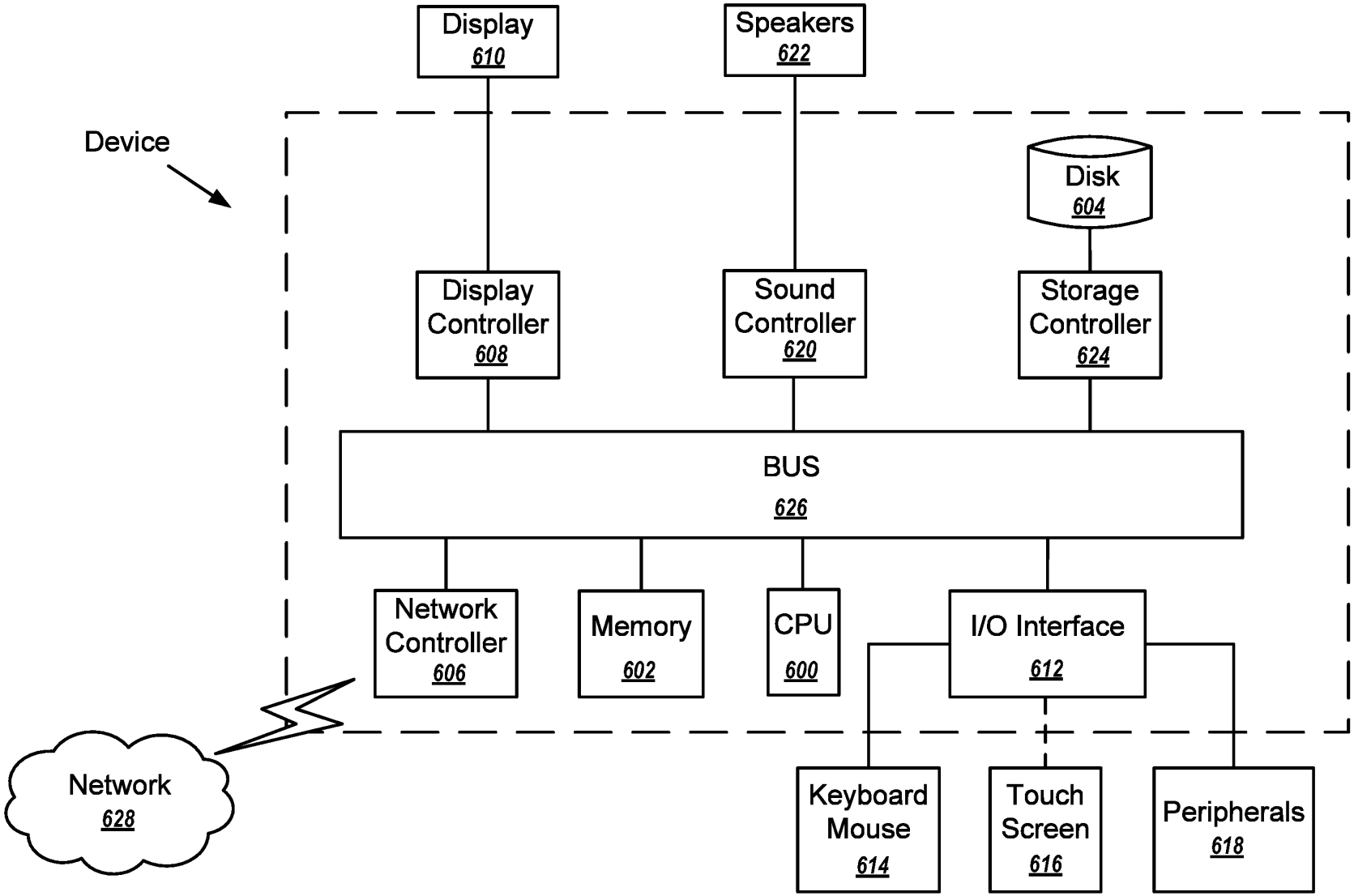

Display
610
Speakers
622
Device
Disk
604
Display
Controller
608
Sound
Controller
620
Storage
Controller
624
BUS
626
Network
Controller
606
Memory
602
CPU
600
I/O Interface
612
Network
628
Keyboard
Mouse
614
Touch
Screen
616
Peripherals
618

FIG. 6

0059

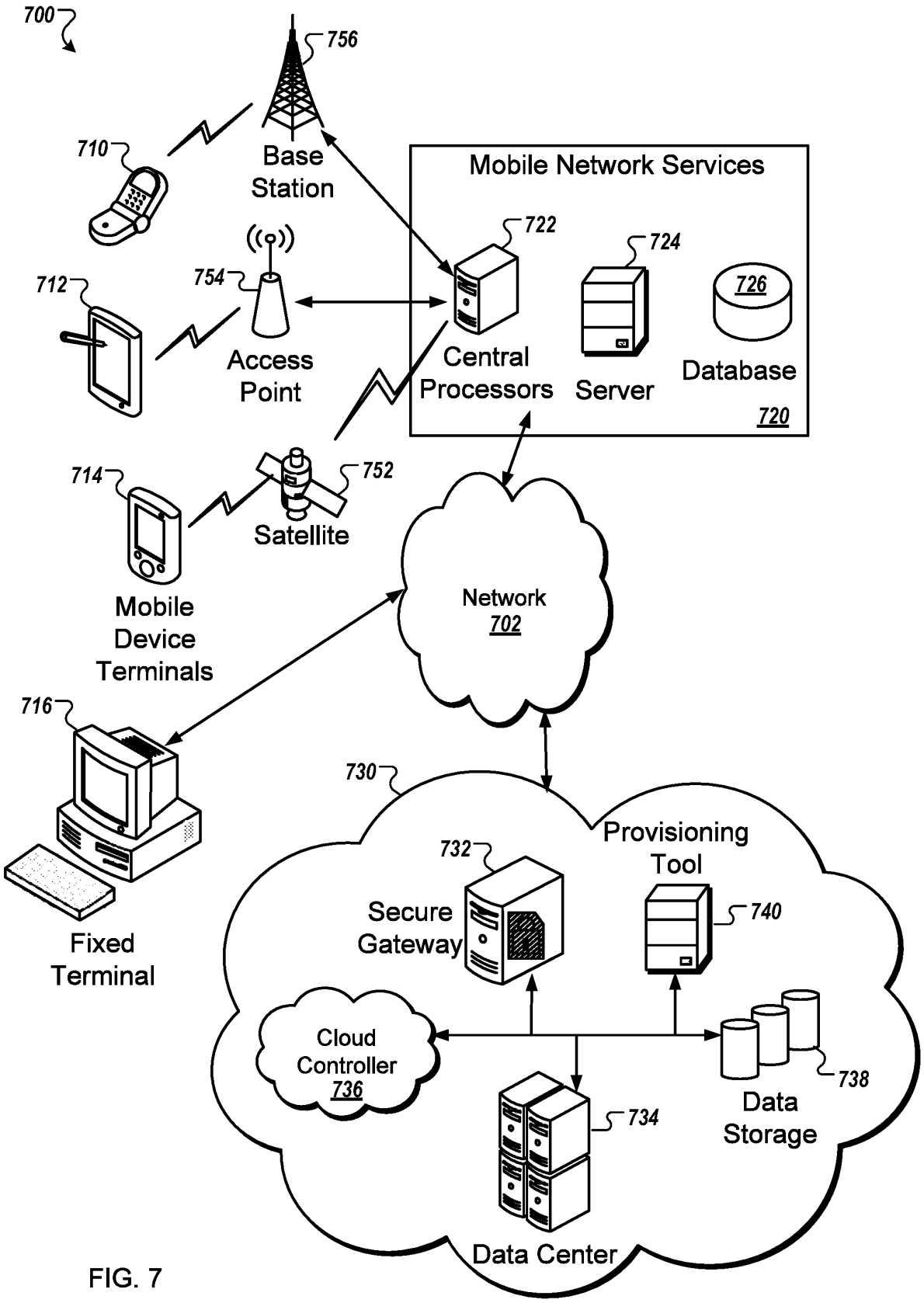

700
756
Base Station
710
Mobile Network Services
722
724
726
754
712
Access Point
Central Processors
Server
Database
720
714
752
Satellite
Network 702
Mobile Device Terminals
716
730
Provisioning Tool
732
Secure Gateway
740
Fixed Terminal
Cloud Controller 736
738
Data Storage
734
Data Center

FIG. 7

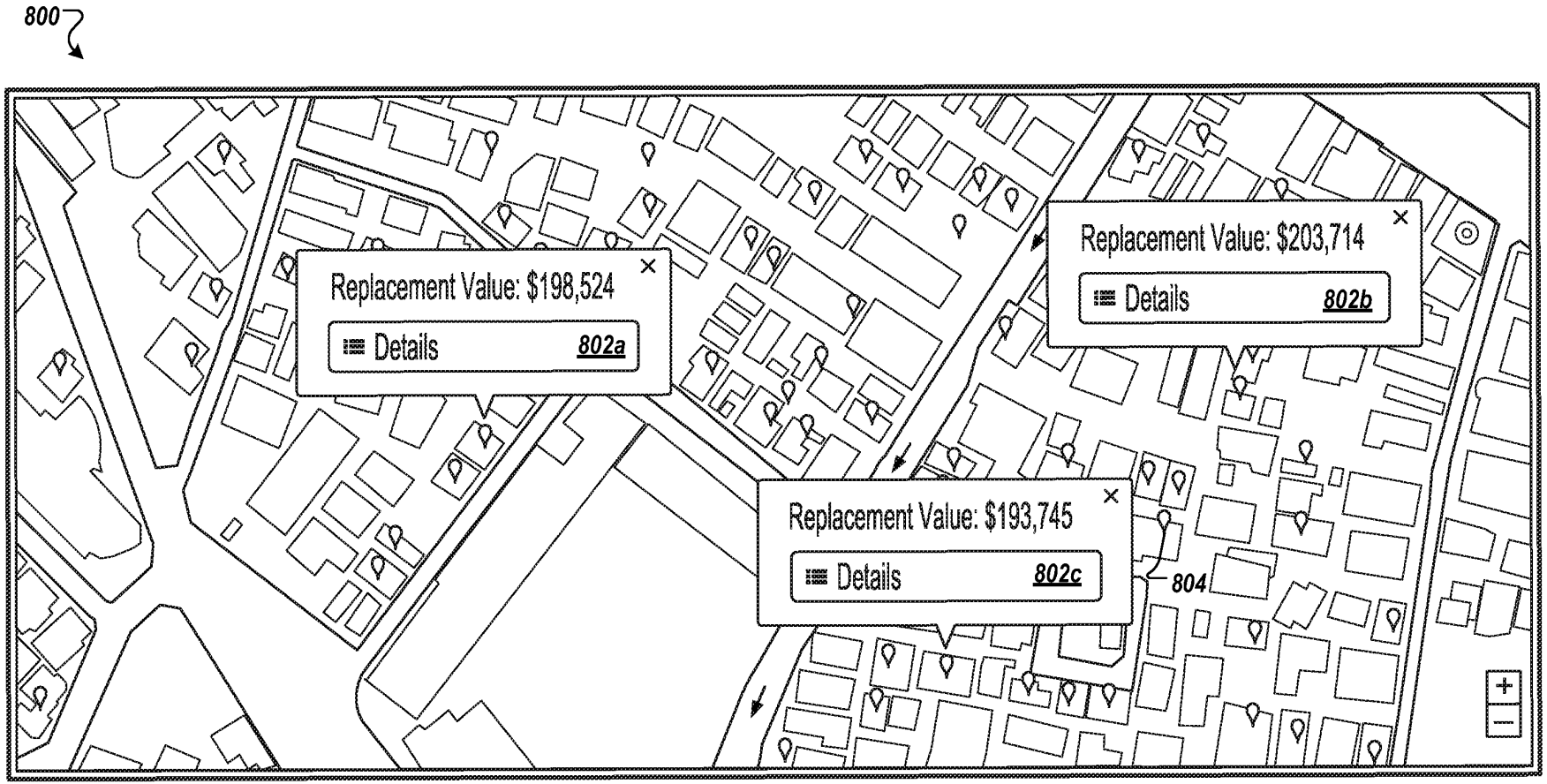
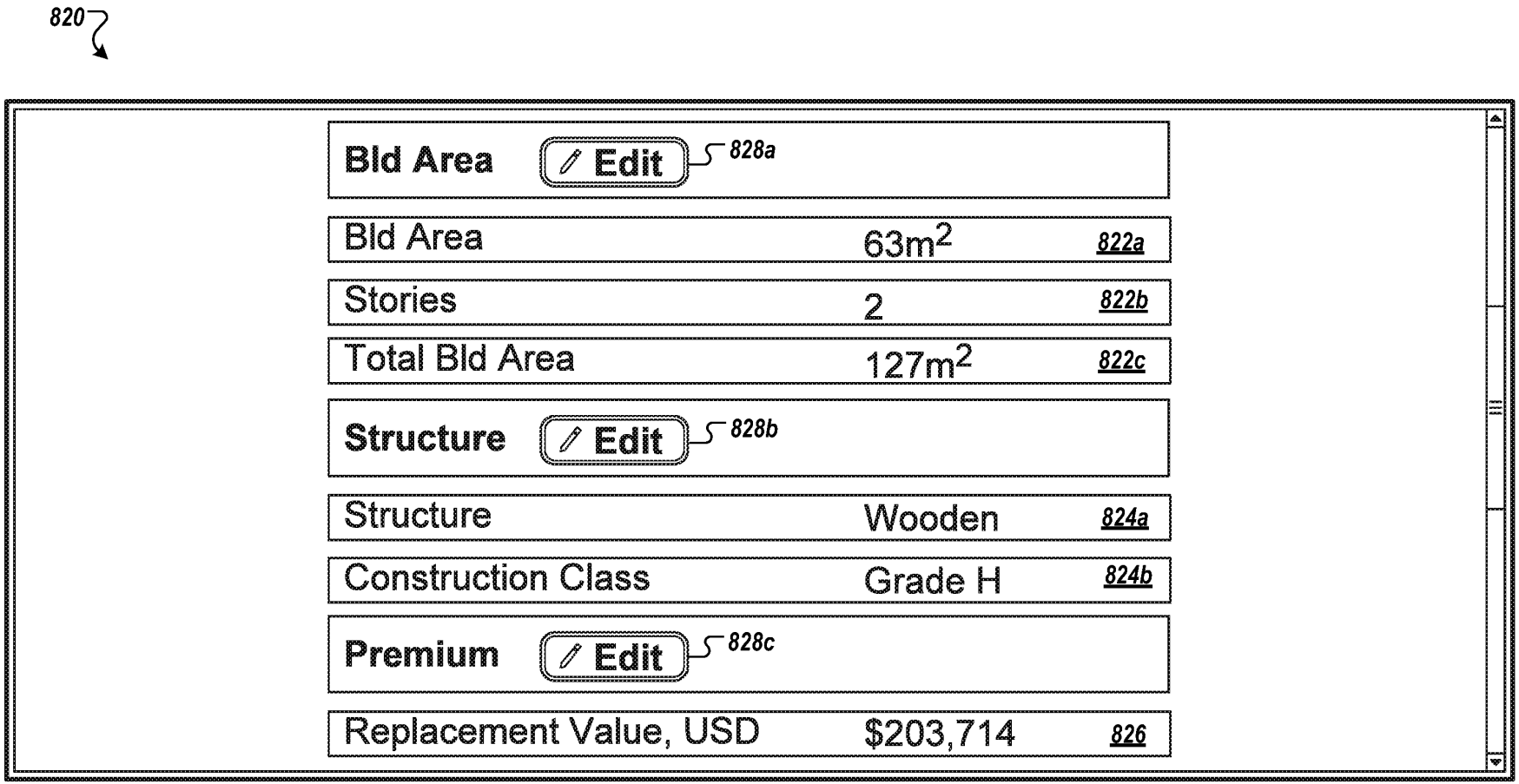
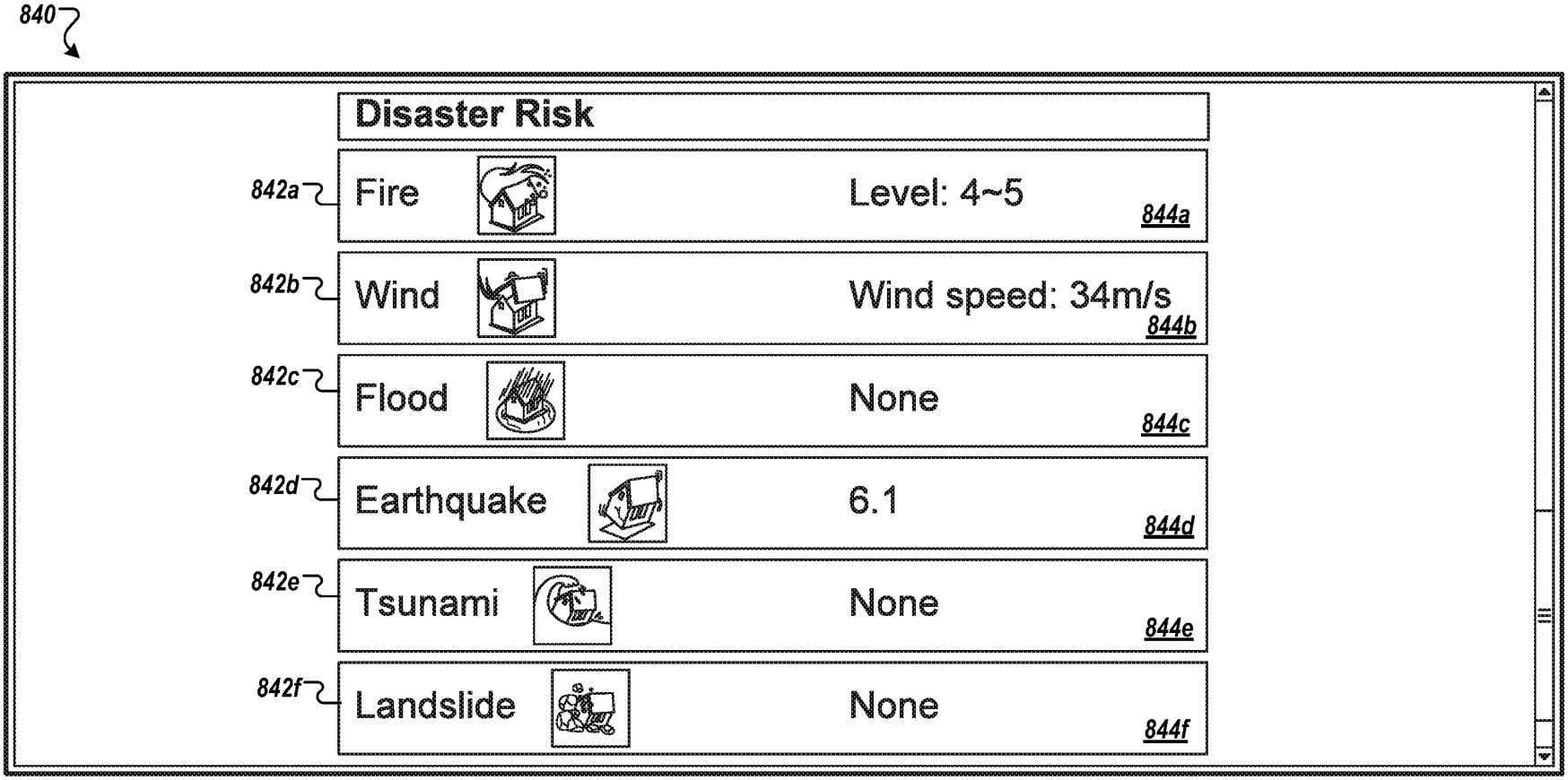

800
Replacement Value: $198,524
Details
802a
Replacement Value: $203,714
Details
802b
Replacement Value: $193,745
Details
802c
804

FIG. 8A


820
Bld Area
Edit
828a
Bld Area
63m2
822a
Stories
2
822b
Total Bld Area
127m2
822c
Structure
Edit
828b
Structure
Wooden
824a
Construction Class
Grade H
824b
Premium
Edit
828c
Replacement Value, USD
$203,714
826

0062

FIG. 8B


840
Disaster Risk
842a
Fire
Level: 4~5
844a
842b
Wind
Wind speed: 34m/s
844b
842c
Flood
None
844c
842d
Earthquake
6.1
844d
842e
Tsunami
None
844e
842f
Landslide
None
844f

0063

FIG. 8C

PTO/AIA/01 (06-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE MAINTENANCE THROUGH AERIAL IMAGERY ANALYSIS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Takeshi Okazaki Date (Optional): 25 September 2017

Signature: Takeshi Okazaki

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/80 (07-12)
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☒ Practitioners associated with Customer Number: 146018

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☒ The address associated with Customer Number: 146018

OR

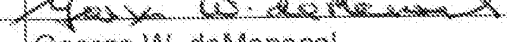
☐	Firm or Individual Name		
	Address		
	City	State	Zip
	Country		
	Telephone	Email	

Assignee Name and Address: AON BENFIELD INC.
200 EAST RANDOLPH STREET
CHICAGO, ILLINOIS 60601

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	July 13, 2017
Name	George W. deMenocal	Telephone	203.326.4379
Title	President and Chief Executive Officer - U.S.		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
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PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Aon Benfield Inc.

Application No./Patent No.: to be assigned Filed/Issue Date: 2020-05-06

Titled: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

Aon Benfield Inc., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 050623, Frame 0112, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Natalie J. Grace/	2020-05-06
Signature	Date
Natalie J. Grace	65,803
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
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PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10311302		2019-06-04	Kottenstette et al.	
	2	9141872		2015-09-22	Marchisio et al.	
	3	9569690		2017-02-14	Marchisio et al.	
	4	9858645		2018-01-02	Malitz	
	5	9031325		2015-05-12	Ouzounis	
	6	8682079		2014-03-25	Ouzounis	
	7	9589210		2017-03-07	Estrada et al.	
	8	10013774		2019-07-03	Estrada et al.	

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	Filing Date	2020-05-06
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

	9	9147132		2015-09-29	Marchisio et al.	
	10	9619734		2017-04-11	Marchisio et al.	
	11	9495618		2016-11-15	Tabb	
	12	9767565		2017-09-19	Estrada et al.	
	13	10157479		2018-12-18	Estrada et al.	
	14	9904849		2018-02-27	Estrada et al.	
	15	9230168		2016-01-05	Gueguen	
	16	8145578		2012-03-27	Pershing et al.	
	17	8670961		2014-03-11	Pershing et al.	
	18	9514568		2016-12-06	Pershing et al.	
	19	8731234		2014-05-20	Ciarcia et al.	

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	Examiner Name	
	Attorney Docket Number	474139US03

	20	9070018		2015-06-30	Ciarcia et al.	
	21	8995757		2015-03-31	Ciarcia et al.	
	22	8825454		2014-09-02	Pershing	
	23	9135737		2015-09-15	Pershing	
	24	8818770		2014-08-26	Pershing	
	25	9129376		2015-09-08	Pershing	
	26	8078436		2011-12-13	Pershing et al.	
	27	8170840		2012-05-01	Pershing	
	28	8209152		2012-06-26	Pershing	
	29	10217207		2019-02-26	Marra et al.	
	30	10178303		2019-01-08	Castillo et al.	

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	Examiner Name	
	Attorney Docket Number	474139US03

	31	9639960		2017-05-02	Loveland et al.	
	32	8775219		2014-07-08	Swanson et al.	
	33	10402676		2019-09-03	Wang et al.	
	34	8977520		2015-03-10	Stephens et al.	
	35	10346935		2019-07-09	Thornberry et al.	
	36	9183538		2015-11-10	Thornberry et al.	
	37	9330494		2016-05-03	Schultz	
	38	9959667		2018-05-01	Schultz	
	39	10198857		2019-02-05	Schultz	
	40	8401222		2013-03-19	Thornberry et al.	
	41	8515125		2013-08-20	Thornberry et al.	

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	Examiner Name	
	Attorney Docket Number	474139US03

	42	8542880		2013-09-24	Thornberry et al.	
	43	9329749		2016-05-03	Thornberry et al.	
	44	9244589		2016-01-26	Thornberry et al.	
	45	9933254		2018-04-03	Thornberry et al.	
	46	8873842		2014-10-28	Robinson et al.	
	47	10410289		2019-09-10	Tofte et al.	
	48	10102589		2018-10-16	Tofte et al.	
	49	10134092		2018-11-20	Harvey et al.	
	50	9875509		2018-01-23	Harvey et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear

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	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

	1	20150317740		2015-11-05	Emison et al.	
	2	20170161559		2017-06-08	Du et al.	
	3	20170330032		2017-11-16	Du et al.	
	4	20140245165		2014-08-28	Battcher et al.	
	5	20140245210		2014-08-28	Battcher et al.	
	6	20150370928		2015-12-24	Pershing	
	7	20130311240		2013-11-21	Pershing et al.	
	8	20170053436		2017-02-23	Pershing et al.	
	9	20120209782		2012-08-16	Pershing et al.	
	10	20160155097		2016-06-02	Venkatesha	
	11	20150025914		2015-01-22	Lekas	

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	12	20160350907		2016-12-01	Simula et al.	
	13	20150363717		2015-12-17	Lim	
	14	20160063642		2016-03-03	Luciani et al.	
	15	20140278697		2014-09-18	Thornberry et al.	
	16	20150178416		2015-06-25	Stephens et al.	
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	Examiner Name	
	Attorney Docket Number	474139US03

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	1	2017040691	WO		2017-03-09	CAPE ANALYTICS, INC.	Previously submitted in related appln. no. 15/714,376	
	2	2017151673	WO		2017-09-08	DIGITALGLOBE, INC.	Previously submitted in related appln. no. 15/714,376	
	3	2015009798	WO		2015-01-22	DIGITALGLOBE, INC.	Previously submitted in related appln. no. 15/714,376	
	4	2015017366	WO		2015-02-05	DIGITALGLOBE, INC.	Previously submitted in related appln. no. 15/714,376	
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	7	2014151122	WO		2014-09-25	EAGLE VIEW TECHNOLOGIES, INC.	Previously submitted in related appln. no. 15/714,376	

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	8	2017142788	WO		2017-08-24	PICTOMETRY INTERNATIONAL CORP.	Previously submitted in related appln. no. 15/714,376	
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	1	International Search Report and Written Opinion issued in International Application No. PCT/US2017/053265 on December 11, 2017. (Previously submitted in related appln. no. 15/714,376)	
	2	International Patent Report on Patentability issued in International Application No. PCT/US2017/053265 on March 26, 2019. (Previously submitted in related appln. no. 15/714,376)	
	3	LIN et al., Network in Network, International Conference on Learning Representations, 2014, pp. 10. (Previously submitted in related appln. no. 15/714,376)	
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	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
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	Attorney Docket Number	474139US03

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Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2020-05-06
Name/Print	Natalie J. Grace	Registration Number	65,803

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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	1	9928553		2018-03-27	Harvey et al.	
	2	10173773		2019-01-08	Flick	
	3	10137984		2018-11-27	Flick	
	4	10163164		2018-12-25	Tofte et al.	
	5	9501700		2016-11-22	Loveland et al.	
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	7	10453147		2019-10-22	Davis	
	8	6732120		2004-05-04	Du	

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	9	9846915		2017-12-19	Howe et al.	
	10	8346578		2013-01-01	Hopkins, III et al.	
	11	10275833		2019-04-30	Christopulos et al.	
	12	9152863		2015-10-06	Grant	
	13	10346687		2019-07-09	Pestun et al.	
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Name/Print	Natalie J. Grace	Registration Number	65,803

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EFS ID:	39365884
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Kristin Sims
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Attorney Docket Number:	474139US03
Receipt Date:	06-MAY-2020
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Application Type:	Utility under 35 USC 111(a)

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Warnings:					
Information:					
3		474139US03_Specification.pdf	397736 9036e4995b1cca158ce9b18af2cfc2808df03a03	yes	46

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	44
Claims	45	45
Abstract	46	46

Warnings:					
Information:					
4	Drawings-only black and white line drawings	474139US03_Drawings.pdf	2021628 85abb1da431a8353882c4f57561a594b6b9732ed	no	15
Warnings:					
Information:					
5	Oath or Declaration filed	474139US03_ExecutedDeclaration.pdf	324710 3ace94f2d829776c890e38c0e0814ac5f6f7dc22	no	2
Warnings:					
Information:					
6		474139US03_POA373.pdf	702975 7df9f260a7b6d30da4047ad6a8106de0a35820ac	yes	5

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Power of Attorney	1	2
Assignee showing of ownership per 37 CFR 3.73	3	5

Warnings:					
Information:					
7	Information Disclosure Statement (IDS) Form (SB08)	474139US03_IDSform1.pdf	1038776 8e7c4e52c6da9e6535f7b334d580b9e916db16e0	no	15
Warnings:					
Information:					
8	Information Disclosure Statement (IDS) Form (SB08)	474139US03_IDSform2.pdf	1034811 d4b56d3d080c596c4e72a7a95a212dc20530ce42	no	5
Warnings:					
Information:					
9	Other Reference-Patent/App/Search documents	NPL_16733888NFOA.pdf	245067 441ebada955c087d42f85a134b5bc11332c1fdcd	no	7
Warnings:					
Information:					
10	Other Reference-Patent/App/Search documents	NPL_16733888NOA.pdf	571303 304f97ad791a468c0747ecbe41cad01aa7cad85a	no	11
Warnings:					
Information:					
11	Non Patent Literature	NPL_feasibilitystudy.pdf	618024 d3adca3b3b101146e3f8101da927bcec4eef508b	no	5
Warnings:					
Information:					
			Total Files Size (in bytes):	8523152	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Takeshi		Okazaki	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Tokyo	Country of Residence [i]	JP

Mailing Address of Inventor:

Address 1	Capitol Tower 11F, 2-10-3		
Address 2	Nagatacho, Chiyoda-ku		
City	Tokyo	**State/Province**	
Postal Code	100-0014	**Country** [i]	JP

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	146018		
Email Address	info@gardellagrace.com	Add Email	Remove Email

Application Information:

Title of the Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS		
Attorney Docket Number	474139US03	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	15	**Suggested Figure for Publication (if any)**	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	146018		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16733888	2020-01-03

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16733888	Continuation in part of	15714376	2017-09-25	10529029	2020-01-07
Prior Application Status	Expired				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
15714376	Claims benefit of provisional	62398665	2016-09-23		
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.					Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.			Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Aon Benfield Inc.		
Mailing Address Information For Applicant:			
Address 1	200 E. Randolph Street		
Address 2			
City	Chicago	**State/Province**	IL
Country	US	Postal Code	60601
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	Aon Benfield Inc.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	200 E. Randolph Street		
Address 2			
City	Chicago	**State/Province**	IL
Country i	US	Postal Code	60601
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Natalie J. Grace/			Date (YYYY-MM-DD)	2020-05-06
First Name	Natalie	Last Name	Grace	Registration Number	65,803

Additional Signature may be generated within this form by selecting the Add button. Add

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	474139US03
	Application Number	
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 16868113 Document Date: 05/06/2020

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: March 1, 2019

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/868,113	05/06/2020		0.00	474139US03	1	1

CONFIRMATION NO. 5664

146018
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

FILING RECEIPT

OC000000118943868

Date Mailed: 05/13/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Takeshi Okazaki, Tokyo, JAPAN;

Applicant(s)

Aon Benfield Inc., Chicago, IL;

Assignment For Published Patent Application

Aon Benfield Inc., Chicago, IL

Power of Attorney: The patent practitioners associated with Customer Number 146018

Domestic Priority data as claimed by applicant

This application is a CON of 16/733,888 01/03/2020 PAT 10650285
which is a CIP of 15/714,376 09/25/2017 PAT 10529029
which claims benefit of 62/398,665 09/23/2016

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/12/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/868,113**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/868,113

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	1 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/868,113	05/06/2020	Takeshi Okazaki	474139US03

CONFIRMATION NO. 5664

146018
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

FORMALITIES LETTER

OC000000116943869

Date Mailed: 05/13/2020

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.
  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $ **300** basic filing fee.
- $ **160** surcharge.
- $ **660** search fee.
- $ **760** examination fee.
- $(**0**) previous unapplied payment amount.
- $ **1880** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tnguyen/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16868113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	474139US03

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6732120		2004-05-04	Du	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2015184405	JP		2015-10-22	Zenrin Co Ltd	English abstract included	
	2	2012111395	WO		2012-08-23	Sawada	English abstract included	
	3	62-288963	JP		1987-12-15	Jiekuto KK	English abstract included	

EFS Web 2.1.18

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	474139US03

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NON-PATENT LITERATURE DOCUMENTS [Remove]

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Japanese Office Action mailed February 20, 2020 in Japanese Application No. 2019-515883.	X

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	474139US03

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2020-08-20
Name/Print	Natalie J. Grace	Registration Number	65,803

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	|
AON BENFIELD INC.	| EXAMINER: NOT YET ASSIGNED
APPLICATION NO.: 16/868,113	| GROUP ART UNIT: NOT YET ASSIGNED
FILED: MAY 6, 2020	| DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	|

INFORMATION DISCLOSURE STATEMENT

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

Applicant wishes to make of record the reference(s) listed on the attached PTO/SB/08a form. This Information Disclosure Statement is being submitted prior to the issuance of the first action of the merits in the above-referenced application. Consequently, no certification or fee is required. If, however, any fees are required, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Respectfully submitted,

Date: August 20, 2020

/Natalie J. Grace/
Natalie J. Grace
Attorney of Record
Registration No. 65,803

GARDELLA GRACE P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
Telephone: (703) 556-9600
Facsimile: (703) 740-4541

Espacenet

Bibliographic data: JP2015184405 (A) — 2015-10-22

MAP RELATED INVESTIGATION DEVICE

Inventor(s): TANAKA TOSHIO; SAKAI SEIGO; CHIBANA KANAME; NAGATA YOSHIAKI; OTA MASAYA ± (田中 敏夫, ; 酒井 世剛, ; 知花 要, ; 永田 佳朗, ; 太田 正也)

Applicant(s): ZENRIN CO LTD ± (株式会社ゼンリン)

Classification: **- international:** ***G09B29/00***
- cooperative:

Application number: JP20140059560 20140324 Global Dossier

Priority number(s): JP20140059560 20140324

Abstract of JP2015184405 (A)

PROBLEM TO BE SOLVED: To provide a map related investigation device capable of performing accurate investigation by using only map data, and investigating various investigation items.SOLUTION: The map related investigation device includes a map data storage part for storing map data including the information of the shape of a feature and attribute information related to the feature with a plurality of versions based on the update period of the map data. Investigation items which can be investigated by using the map data are presented to a user. The investigation request of the investigation items selected from among the investigation items is accepted, and as for the selected investigation items, a change in the shape of the feature related to the investigation items or a change in the attribute information is investigated about a plurality of versions of the map data of the map data storage part, and an investigation result related to the investigation items selected on the basis of the investigation result is generated, and the generated investigation result is provided to the user.

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2015-184405
(P2015-184405A)
(43)公開日　平成27年10月22日(2015.10.22)

(51)Int.Cl.		F I			テーマコード（参考）
G09B 29/00	(2006.01)	G09B	29/00	Z	2C032

審査請求 未請求　請求項の数 5　OL　（全 26 頁）

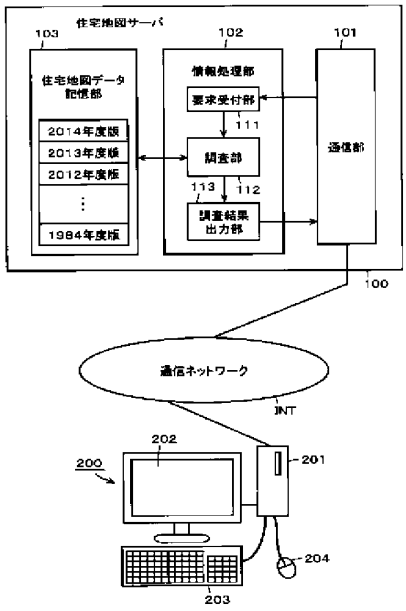
(21)出願番号　特願2014-59560 (P2014-59560)
(22)出願日　平成26年3月24日 (2014.3.24)

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最終頁に続く

(54)【発明の名称】地図関連調査装置

(57)【要約】
【課題】地図データのみを用いて正確な調査を行えると共に、種々の調査項目の調査を可能にした地図関連調査装置を提供する。
【解決手段】地物の形状の情報と、地物に関する属性情報を含む地図データを、地図データの更新時期に基づく複数の版で記憶する地図データ記憶部を備える。地図データを用いて調査可能な調査項目をユーザに呈示する。調査項目の中から選択された調査項目の調査要求を受け付け、選択された調査項目に関して、調査項目に関連する地物の形状の変化または属性情報の変化を、地図データ記憶部の複数版の地図データについて調査し、調査結果に基づいて選択された調査項目に関する調査結果を生成し、生成した調査結果をユーザに提供する。
【選択図】図１



【特許請求の範囲】
【請求項１】
地物の形状の情報と、前記地物に関する属性情報とを含む地図データを、前記地図データの更新時期に基づく複数の版で記憶する地図データ記憶部と、
選択可能な調査項目を呈示する調査項目呈示手段と、
前記調査項目の中から選択された調査項目の調査要求を受け付ける受付手段と、
前記受付手段で受け付けた前記選択された調査項目に関して、前記調査項目に関連する前記地物の形状の変化または前記属性情報の変化を、前記地図データ記憶部の前記複数版の地図データについて調査し、前記調査結果に基づいて前記選択された調査項目に関する調査結果を生成する調査手段と、
前記調査手段で生成された前記調査結果を出力する調査結果出力手段と、
を備える地図関連調査装置。
【請求項２】
前記調査項目は、建物の築年数であり、
前記調査手段は、調査対象の前記地物を前記建物とし、調査対象の建物の形状の変化を、前記地図データ記憶部の前記複数版の地図データを指定した版から過去に遡って辿りながら調査し、前記調査対象の建物の形状の変化が検出された過去の版の年度と前記指定した版の年度の差を用いて前記建物の築年数を算出する
ことを特徴とする請求項１に記載の地図関連調査装置。
【請求項３】
前記調査項目は、居住年数であり、
前記調査手段は、調査対象の前記地物を前記建物として、調査対象の建物の前記属性情報の変化を、前記地図データ記憶部の前記複数版の地図データを前記指定した版から過去に遡って辿りながら調査し、前記調査対象の建物の前記属性情報の変化が検出された過去の版の年度と前記指定した版との年度の差を用いて、前記居住年数を算出する
ことを特徴とする請求項１または請求項２に記載の地図関連調査装置。
【請求項４】
前記地物に関する属性情報は、前記地物の名称を地物に関する属性の一つとして含み、
前記調査項目は、指定されたエリアについての土壌汚染であり、
前記調査手段は、前記指定されたエリアについて、調査対象の地物の前記属性情報に含まれる前記名称として前記土壌汚染に関連する名称を、前記地図データ記憶部の前記複数版の地図データについて調査し、前記属性情報に含まれる前記名称として土壌汚染に関連する名称を検出したときに、前記指定されたエリアについて土壌汚染ありとして検出する
ことを特徴とする請求項１～請求項３のいずれかに記載の地図関連調査装置。
【請求項５】
通信ネットワークに接続される通信部を備え、
前記調査項目を呈示する手段は、前記調査項目の一覧情報を、前記通信部を通じて前記通信ネットワークを介して、前記調査要求を送ってくるクライアント装置に送って呈示し、
前記受付手段は、前記クライアント装置から前記通信ネットワークを通じて送られてくる前記調査要求を、前記通信部を通じて受け付け、
前記調査結果出力手段は、前記調査結果を、前記通信部を通じて前記通信ネットワークを介して、前記クライアント装置に送る
ことを特徴とするサーバ装置の構成とした請求項１～４のいずれかに記載の地図関連調査装置。
【発明の詳細な説明】
【技術分野】
【０００１】
この発明は、例えば建物の築年数、建物の居住者の居住年数など、地図データを用いて調査可能な項目についての調査を行うことができる地図関連調査装置に関する。

【背景技術】
【０００２】
地図に関連して種々の調査項目についての調査をすることの試みがなされている。例えば特許文献１（特開２０１０－１０８１４４号公報）には、新旧の地図データを用いることで、地図に関連する調査項目の一つの例として新築情報を入手するようにすることが開示されている。すなわち、この特許文献１には、「ゼンリン社が出版している住宅地図のディジタル地図データ“Ｚｍａｐ－ＴＯＷＮII（登録商標）では、・・・・建物属性情報は、１つの建物に対してユニークな識別文字をもっているため、「新住宅地図にあって旧住宅地図にない」識別文字を持つ建物は、その間に新築若しくは増築されたと見なすことができる」と考えて、新住宅地図と旧住宅地図との差分を抽出し、その差分に基づいて、新築建物の情報を得るようにすることが開示されている。
【０００３】
また、特許文献２（特開２００３－５６２７７号公報）には、「約５年毎に行われた過去４回の宅地利用動向調査を元に作成された土地利用に関する数値情報である」「細密数値情報（１０ｍメッシュ土地利用）：国土地理院」を用いて、汚染リスクの評価を５色の色と、その汚染リスク評価を属性とした土壌汚染リスク地図画像を提供することが開示されている。
【０００４】
さらに、特許文献３（特開２００４－５４７３号公報）には、過去の職業別電話帳情報から、既存のＧＩＳを利用してジオコーディング処理により電話帳データに緯度経度などの位置情報を付加した土地使用履歴情報を検索するためのデータベースを構築しておくと共に、ジオコーディング処理により地図データ上の住所と電話帳データとの位置とを対応付けし、過去に化学工場やガソリンスタンドとして利用されていた住所地は、土壌汚染を引き起こす可能性のある地であるとすることが開示されている。
【先行技術文献】
【特許文献】
【０００５】
【特許文献１】特開２０１０－１０８１４４号公報
【特許文献２】特開２００３－５６２７７号公報
【特許文献３】特開２００４－５４７３号公報
【発明の概要】
【発明が解決しようとする課題】
【０００６】
しかしながら、特許文献１に開示されている新築情報の調査方法は、地図データのみを用いて調査を行えるという利点はあるが、新住宅地図と旧住宅地図との２つの地図の差分、特に、建物についてのユニークな識別文字（ＩＤ）の差分を用いるものであるため、新築建物の情報を正確に得ることが困難であるという問題がある。すなわち、建物についてのユニークな識別文字は、居住者などの名称が変更されたときにも変化するものであり、単に居住者が変更になっただけで、建物が新築になったとは限らないからである。
【０００７】
また、特許文献１には、新住宅地図と旧住宅地図として、最新の住宅地図データと１年前の住宅地図データのみならず、最新の住宅地図データと複数年前の住宅地図データとの差分を用いることも開示されている。しかし、後者の場合には、最新の住宅地図データと複数年前の住宅地図データとの差分を用いるため、ユニークな識別文字（ＩＤ）の変化が、複数年の間のいつに生じたかは分からず、新築のみではなく、新築後複数年経過しているものも含まれてしまうことになる。
【０００８】
また、特許文献１の調査方法では、新住宅地図と旧住宅地図との２つの地図の差分を用いるので、建物が新築後何年経過しているかの築年数を検出することなどはできない。
【０００９】

また、特許文献２の土壌汚染リスク地図画像提供システムの場合には、地図データの他に、一定期間毎の精密数値情報を記憶すると共に、この精密数値情報を用いて、汚染メッシュ分類データを有する分類表と、汚染リスクが高い順に表にした優先度表などを生成して記憶しておく必要がある。したがって、地図データのみに基づいて調査を行う場合に比べて、一定期間毎の精密数値情報を取得しなければならないなど、手間のかかる調査手法となってしまうという問題がある。

【００１０】

特許文献３の土壌汚染危険情報調査援助システムも、地図データの他に、過去の職業別電話帳情報から、既存のＧＩＳを利用してジオコーディング処理により電話帳データに緯度経度などの位置情報を付加した土地使用履歴情報を検索するためのデータベースを構築する必要があると共に、ジオコーディング処理により地図データ上の住所と電話帳データとの位置とを対応付けしなければならないなど、煩雑な調査手法となっており、調査が高コストになる恐れがある。

【００１１】

さらに、上述の特許文献１～３では、特定の調査項目しか、調査できないという問題もある。

【００１２】

この発明は、以上の問題点に鑑み、複数の版の地図データのみを用いて、より正確な調査を行えると共に、種々の調査項目の調査を可能にした地図関連調査装置を提供することを目的とする。

【課題を解決するための手段】

【００１３】

上記の課題を解決するために、請求項１の発明は、

地物の形状の情報と、前記地物に関する属性情報とを含む地図データを、前記地図データの更新時期に基づく複数の版で記憶する地図データ記憶部と、

選択可能な調査項目を呈示する調査項目呈示手段と、

前記調査項目の中から選択された調査項目の調査要求を受け付ける受付手段と、

前記受付手段で受け付けた前記選択された調査項目に関して、前記調査項目に関連する前記地物の形状の変化または前記属性情報の変化を、前記地図データ記憶部の前記複数版の地図データについて調査し、前記調査結果に基づいて前記選択された調査項目に関する調査結果を生成する調査手段と、

前記調査手段で生成された前記調査結果を出力する調査結果出力手段と、

を備える地図関連調査装置を提供する。

【００１４】

この発明の地図関連調査装置おいては、地図データ記憶部には、地物の形状の情報と、前記地物に関する属性情報を含む地図データを記憶している。そして、地図データ記憶部には、地図データとして、地図データの更新時期に基づく複数版が記憶されている。

【００１５】

したがって、この発明によれば、複数版の地図データを指定した版から、過去に順に辿って地物の形状の変化や地物に関する属性情報の変化を検出したり、最新版から過去の所定の版までの複数版、あるいは、ある所定の版から過去のある所定の版までの複数版、について、地物の形状の変化の有無や地物に関する属性情報の変化の有無を検出したりすることで、種々の調査項目を調査することができる。

【００１６】

そこで、この発明においては、地図データを用いて調査可能な調査項目を用意し、その調査可能な調査項目を、調査を依頼する者に呈示する。そして、調査を依頼する者により調査項目の中から選択された調査項目を受付手段で受け付ける。そして、調査手段は、その受け付けた調査項目の調査を行う。すなわち、調査手段は、選択された調査項目に関連する地物の形状の変化または属性情報の変化を、地図データ記憶部の複数版の地図データについて調査し、その調査結果に基づいて選択された調査項目に関する調査結果を生成す

る。そして、その生成された調査結果を、調査を依頼した者に対して出力する。

【００１７】

そして、請求項２の発明においては、調査項目が建物の築年数である場合には、調査手段は、調査対象の地物を建物とし、調査対象の建物の形状の変化を、地図データ記憶部の複数版の地図データを指定した版から過去に遡って辿りながら調査し、調査対象の建物の形状の変化が検出された過去の版の年度と指定した版の年度の差として建物の築年数を検出する。

【００１８】

また、請求項３の発明においては、調査項目が居住年数であるときには、調査手段は、調査対象の地物を建物として、調査対象の建物の属性情報の変化を、地図データ記憶部の複数版の地図データを指定した版から過去に遡って辿りながら調査し、調査対象の建物の属性情報の変化が検出された過去の版の年度と指定した版の年度の差として、居住年数を検出する。

【００１９】

さらに、請求項４の発明においては、地物に関する属性情報は、地物の名称を地物に関する属性の一つとして含み、調査項目は、指定されたエリアについての土壌汚染である場合に、調査手段は、指定されたエリアについて、調査対象の地物の属性情報に含まれる名称として土壌汚染に関連する名称を、地図データ記憶部の複数版の地図データについて調査し、属性情報に含まれる名称として土壌汚染に関連する名称を検出したときに、指定されたエリアについて土壌汚染ありとして検出する。

【発明の効果】

【００２０】

この発明によれば、地図データは地物の形状の情報と、地物に関する属性情報を含み、当該地図データを、各更新の都度の版毎に最新版から過去に遡った複数版、地図データ記憶部に記憶しているので、地図データのみを用いて、より正確な調査を行えると共に、種々の調査項目の調査を可能にした地図関連調査装置を提供することができる。

【図面の簡単な説明】

【００２１】

【図１】この発明による地図関連調査装置の実施形態の構成例を示すブロック図である。

【図２】この発明による地図関連調査装置の実施形態で用いる住宅地図データ記憶部の記憶内容の例を説明するための図である。

【図３】この発明による地図関連調査装置の実施形態で用いる住宅地図データのデータ構造を説明するための図である。

【図４】この発明による地図関連調査装置の実施形態における処理動作の概要を説明するためのフローチャートを示す図である。

【図５】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の流れの例を説明するためのフローチャートを示す図である。

【図６】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の説明に用いる図である。

【図７】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の説明に用いる図である。

【図８】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の説明に用いる図である。

【図９】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の説明に用いる図である。

【図１０】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の説明に用いる図である。

【図１１】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理における築年数推定処理の流れの例を説明するためのフローチャートを示す図である。

【図１２】図１１のフローチャートの一部のステップの処理内容の例のフローチャートを示す図である。
【図１３】この発明による地図関連調査装置の実施形態における調査項目の例としての築年数調査の処理の説明に用いる図である。
【図１４】この発明による地図関連調査装置の実施形態における調査項目の例としての居住年数調査の処理の流れの例を説明するためのフローチャートを示す図である。
【図１５】この発明による地図関連調査装置の実施形態における調査項目の例としての居住年数調査の処理の説明に用いる図である。
【図１６】この発明による地図関連調査装置の実施形態における調査項目の例としての土壌汚染調査処理の流れの例を説明するためのフローチャートを示す図である。
【図１７】この発明による地図関連調査装置の実施形態における調査項目の例としての土壌汚染調査処理の説明に用いる図である。
【発明を実施するための形態】
【００２２】
以下、この発明による地図関連調査装置の実施形態を、図を参照しながら説明する。図１は、この発明による地図関連調査装置の実施形態の構成例を示すもので、この実施形態の構成例においては、地図関連調査装置は通信ネットワークを通じて接続されるサーバ装置と、クライアント装置とからなる通信システムの構成を備える。
【００２３】
すなわち、図１に示す例の通信システムは、住宅地図サーバ１００と、クライアント装置の例としてのパーソナルコンピュータ２００とが、通信ネットワークＩＮＴを通じて接続されて構成されている。ここで、通信ネットワークＩＮＴは、インターネットのような広域的なネットワークでも、ローカルエリアネットワークなど限定的なネットワークでもよい。本実施形態においては、通信ネットワークＩＮＴはインターネットとする。
【００２４】
また、図１では、クライアント装置の例としてのパーソナルコンピュータ２００は、１台のみを記載しているが、これは、通信ネットワークＩＮＴを通じて住宅地図サーバ１００に接続可能となるパーソナルコンピュータを示すもので、住宅地図サーバ１００は、通信ネットワークＩＮＴを通じて多数のパーソナルコンピュータと接続可能であることは言うまでもない。また、クライアント装置は、パーソナルコンピュータ２００に限らず、通信ネットワークＩＮＴを通じて、住宅地図サーバ１００に接続することができ、この住宅地図サーバ１００から提供される表示画像データを取得してブラウザにより表示画面に表示することができる機能を有するものであれば、例えば携帯電話端末など、どのような装置であってもよい。
【００２５】
住宅地図サーバ１００は、通信部１０１と、情報処理部１０２と、住宅地図データ記憶部１０３とを備えて構成されている。
【００２６】
通信部１０１は、パーソナルコンピュータ２００との通信を司る。
【００２７】
住宅地図データ記憶部１０３は、住宅地図データを、各更新の都度の版毎に最新版から過去に遡った複数版、好ましくは３版以上を記憶する。住宅地図データは全体を所定エリア単位で分割した状態で記憶されている。所定エリアとは、例えば市区町村単位である。なお、この実施形態では、住宅地図データは毎年更新をするものとし、最新年度版および過去年度版の毎年度版の住宅地図データを３年以上の複数版を保持している。この実施形態においては、２０１４年度から１９８４年度まで毎年度版の住宅地図データを保持しているものとする。なお、住宅地図データはすべてのエリアが毎年更新されているとは限らず、複数年に一度更新されるエリアもある。
【００２８】
なお、この実施形態では、住宅地図データ記憶部１０３には、図２に示すように、住宅

地図データのみではなく、建物ポイントデータ、都市計画用途地域データ、統計地図データ、相続税路線価データ、航空写真情報なども格納される。これらのデータは、本実施形態においては、調査項目についての調査内容に直接に関与するのではなく、調査エリアや、調査対象建物、調査対象者などの絞り込みや、調査結果の表示のために用いられるが、これらのデータについても本実施形態のように更新時期に基づく複数の版で記憶しておき、指定した版から過去に遡って調査することで検出した変化点を種々のシーンで活用できる。

【００２９】

建物ポイントデータは、日本全国の約３８００万棟の建物の住所（緯度、経度を含む）、部屋数、面積、建物タイプ（住居、事業所、商業施設）などの詳細情報である。この建物ポイントデータから、対象エリア内にある戸建情報、その敷地面積、建物の延床面積などを知ることができる。そして、建物ポイントデータは、住所、緯度・経度の情報を含むので、住宅地図データと関連付けがなされている。

【００３０】

都市計画用途地域データは、日本全国の建物の容積率などを含むデータである。統計地図データは、居住者の年齢別データなどを含むデータであり、例えば６５歳以上の高齢者が多いエリアなどを検索することが可能となる。また、相続税路線価データからは、例えば東京２３区内の地価が高いエリアを検索することが可能となる。これらのデータについても、位置情報を仲介として、住宅地図データと関連付けがなされている。

【００３１】

航空写真情報は、住宅地図に対応した航空写真の情報であり、位置（緯度・経度）を指定することで、その指定された位置（緯度・経度）を中心とした航空写真情報を、住宅地図データ記憶部１０３から読み出すことができるようにされている。

【００３２】

これらの建物ポイントデータ、都市計画用途地域データ、航空写真情報も住宅地図データと同様、複数の版で記憶することができる。いずれのデータも複数の版で記憶しておき、指定した版から過去に遡ることで変化点を調査できることはいうもでもない。

【００３３】

情報処理部１０２は、クライアント装置からの要求を受け付けて、要求に応じて住宅地図関連調査を実行し、その調査結果をクライアント装置に出力するもので、要求受付部１１１と、調査部１１２、調査結果出力部１１３を備える。

【００３４】

要求受付部１１１は、パーソナルコンピュータ２００からの調査要求データを通信部１０１を介して取得し、調査部１１２に指示を与える。

【００３５】

調査部１１２は、要求受付部１１１からの指示に基づいて住宅地図データ記憶部１０３に記憶された住宅地図データを調査し、調査結果を調査結果出力部１１３に渡す。

【００３６】

調査結果出力部１１３は、調査部１１２からの指示や、調査部１１２での調査結果に基づき、地図画像データや調査結果を反映した画像データを生成し、生成した画像データを通信部１０１に渡す。通信部１０１は、受け取った画像データを、調査要求してきたクライアント装置としてのパーソナルコンピュータ２００に、通信ネットワークＩＮＴを通じて送信する。

【００３７】

なお、情報処理部１０２は、要求受付部１１１と、調査部１１２、調査結果出力部１１３を、ソフトウエアプログラムを用いて処理を行うコンピュータの構成とすることができる。

【００３８】

パーソナルコンピュータ２００は、情報処理装置本体２０１と、ディスプレイ２０２と、操作入力部としてのキーボード２０３やマウス２０４を備えている。

【００３９】
以上の構成に基づき、パーソナルコンピュータ２００は、所望の調査要求を通信ネットワークＩＮＴを介して住宅地図サーバ１００に送信すると、調査結果の画像データを住宅地図サーバ１００から受け取り、ブラウザに画像データを処理させることで、ディスプレイ２０２の表示画面に画像データを表示することができる。
【００４０】
［住宅地図データのデータ構造］
住宅地図データ記憶部１０３に記憶される住宅地図データのデータ構造について説明する。図３は、住宅地図データのデータ構造を説明するための説明図である。
【００４１】
住宅地図データは、図３に示すように、道路や建物といった地物の形状ＨＳと、当該地物に関する属性情報ＡＴＩから構成されている。ここで、地物は、ベクター型で記述されており、点、線、面で表される。地物は道路や建物だけでなく、路線、敷地、水域、空き地、バス停、地下鉄出入口、一方通行などの標識、信号、地下街、行政界などを含んでいる。
【００４２】
面の場合には、地物の形状ＨＳは、閉じた多角形、すなわちポリゴンとして管理される。ポリゴンは、その各頂点の位置情報が定義されている。地物が建物である場合には、その建物の形状を示す建物枠（家枠）ＦＬがポリゴンで表されている。地物が面の場合のその他のポリゴンとしては、行政界ポリゴン（行政名称が配置されている行政界）、水域ポリゴン（湖池沼・プールおよび海・河川に関する水域）、地下街・地下鉄ポリゴン（地下街・地下鉄の領域範囲）がある。
【００４３】
地物に関する属性情報ＡＴＩは、名称、住所、種別、ＩＤ（Identification:識別情報）の各データからなる。なお、アパート・マンション・ビル等の建物には、その建物内の居住者やテナントの情報を表した別記情報が存在する。
【００４４】
名称とは、地物の呼称であり、たとえば建物の場合には、居住者の氏名（個人の名前）、事業所名、施設名、ビル名、アパート名などである。図２において「善隣太郎」と表現されているものが名称に該当する。また、名称データは、文字コードからなり、地図上に文字として表示される際の位置に関する情報である基準点ＰＯも有している。
【００４５】
住所とは、図３において「福岡県北九州市小倉北区室町１丁目１番１号」と表現されているものである。住所データは、都道府県、市区町村、町大字、丁小字などの住所コードで表されている。
【００４６】
種別とは、地物の種類であり、個人の住居は「個人の家屋」、法人の建物は「事業所」、各種公共施設や神社などは「目標物」、ビル、アパート、マンションなど個人の家屋、事業所、目標物のどれにも属さないものは「その他」で表現される。図３においては「個人の家屋」と表現されている。種別データは、地物の種類のそれぞれに対応して付与されている種別コードで表されている。
【００４７】
ＩＤとは、属性情報ＡＴＩの識別番号であり、属性情報ＡＴＩの内容が前年度版の住宅地図データから変化がない場合には前年度版と同一の番号を付し、名称や住所等に変化がある場合には前年度版と異なり、かつ他にはない唯一無二のユニークな番号が新規に付与される。
【００４８】
［住宅地図サーバ１００の処理の概要］
この実施形態の住宅地図サーバ１００において、クライアント装置であるパーソナルコンピュータ２００から、調査要求を受信したときの処理の流れの概要を、図４のフローチ

ャートを参照して説明する。

【００４９】

すなわち、情報処理部１０２の要求受付部１１１は、通信部１０１を通じてパーソナルコンピュータ２００からの調査要求を受け付けたか否か判別して、調査要求を受け付けるのを待つ（ステップＳ１１）。このステップＳ１１で、パーソナルコンピュータ２００からの調査要求を受け付けたと判別したときには、要求受付部１１１は、住宅地図関連の調査項目の一覧の画像情報を生成して、通信部１０１を通じてパーソナルコンピュータ２００に送信し、そのディスプレイ２０２の表示画面に表示させるようにする（ステップＳ１２）。すなわち、パーソナルコンピュータ２００は、内蔵するブラウザ機能により、住宅地図サーバ１００からの画像情報をディスプレイ２０２の表示画面に表示する。

【００５０】

この実施形態の住宅地図サーバ１００は、調査項目として、「建物の築年数」、「建物への居住年数」、「土壌汚染」、「その他」を提供することを想定しており、その一覧がパーソナルコンピュータ２００のディスプレイ２０２の表示画面に表示される。パーソナルコンピュータ２００の使用者（ユーザ）は、その調査項目の一覧から自分が調査を要求したい項目を選択して、その選択結果を、住宅地図サーバ１００に通信ネットワークＩＮＴを通じて送信する。

【００５１】

住宅地図サーバ１００の要求受付部１１１は、パーソナルコンピュータ２００からの調査項目の選択結果の受信を待ち（ステップＳ１３）、調査項目の選択結果を受信したと判別したときには、その選択結果の調査項目は、「建物の築年数」であるか否か判別する（ステップＳ１４）。このステップＳ１４で、選択結果の調査項目は「建物の築年数」であると判別したときには、要求受付部１１１は、築年数推定処理を含む処理を実行するように調査部１１２に指示して、調査を実行させ、調査結果出力部１１３から調査結果を出力させるようにする（ステップＳ１５）。

【００５２】

ステップＳ１４で、選択結果の調査項目は「建物の築年数」ではないと判別したときには、要求受付部１１１は、選択結果の調査項目は「建物への居住年数」であるか否か判別する（ステップＳ１６）。このステップＳ１６で、選択結果の調査項目は「建物への居住年数」であると判別したときには、要求受付部１１１は、居住年数推定処理を含む処理を実行するように調査部１１２に指示して、調査を実行させ、調査結果出力部１１３から調査結果を出力させるようにする（ステップＳ１７）。

【００５３】

次に、ステップＳ１６で、選択結果の調査項目は「建物への居住年数」ではないと判別したときには、要求受付部１１１は、選択結果の調査項目は「土壌汚染」であるか否か判別する（ステップＳ１８）。このステップＳ１８で、選択結果の調査項目は「土壌汚染」であると判別したときには、要求受付部１１１は、土壌汚染場所の推定処理を含む処理を実行するように調査部１１２に指示して、調査を実行させ、調査結果出力部１１３から調査結果を出力させるようにする（ステップＳ１９）。

【００５４】

次に、ステップＳ１８で、選択結果の調査項目は「建物への居住年数」ではないと判別したときには、情報処理部１０２は、その他の調査項目用の処理を実行するようにする（ステップＳ２０）。以上で、情報処理部１０２は、調査要求に対する処理を終了する。

【００５５】

［調査項目の築年数についての処理例］

次に、住宅地図サーバ１００の情報処理装置１０２が、図４のフローチャートにおいて、選択された調査項目が「建物の築年数」であると判別されたときに実行するステップＳ１５での処理例について説明する。「建物の築年数」とは本実施形態において、調査対象の建物が新築又は増改築してから現在までの期間を表す値である。

【００５６】

図５は、選択された調査項目が「建物の築年数」であると判別されたときに実行する処理例の流れの例を示すフローチャートである。この図５の処理例のフローチャートにおける各ステップは、要求受付部１１１と、調査結果出力部１１３と共に、調査部１１２が実行する。

【００５７】

先ず、要求受付部１１１は、パーソナルコンピュータ２００から、調査を行う地域範囲、例えば「東京エリア」などの指定を受け付けて、調査部１０３にその調査を行う地域範囲を指示する。調査部１１２は、指示された調査地域範囲の地図画像データを住宅地図データ記憶部１０３から取得して、調査結果出力部１１３に渡す。調査結果出力部１１３は、その住宅地図データから地図画像情報を生成し、通信部１０１を通じてパーソナルコンピュータ２００に送信する（ステップＳ３１）。パーソナルコンピュータ２００は、ブラウザ機能により、ディスプレイ２０２の表示画面に、受信した地図画像情報による地図画像を表示する。

【００５８】

このとき、パーソナルコンピュータ２００のディスプレイ２０２の表示画面には、例えば図６に示すように、東京２３区を中心とした地図が表示される。なお、この実施形態では、パーソナルコンピュータ２００においては、調査を行う地域範囲の指定と共に、調査エリアを絞り込むための要素の指定を伴うことができるようにされており、ディスプレイ２０２の表示画面の左側の表示欄３０１には、絞り込み条件が表示される。

【００５９】

図６の例においては、パーソナルコンピュータ２００の使用者により、６５歳以上の人口を絞り込むための要素情報（絞り込み条件）として指定されているとして、ディスプレイ２０２の表示画面の左側の表示欄３０１に、東京２３区のそれぞれにおける６５歳以上の人口が表示されている。この６５歳以上の人口の表示リストからなる絞り込み条件は、住宅地図データ記憶部１０３に格納されている統計地図データが用いられて、指定された調査地域範囲について検索されて生成される。

【００６０】

また、絞り込み条件は、統計地図データに基づくもののみではなく、建物ポイントデータ、都市計画用途地域データ、相続税路線価データに基づくものも用いられることは言うまでもない。

【００６１】

パーソナルコンピュータ２００の使用者は、この図６の表示画面の絞り込み条件を参照しながら、当該表示画面から調査エリアや調査対象の建物などについて、更なる絞り込みができる。この例では、絞り込み条件の表示画像において、例えば６５歳以上の人口が多い区として豊島区が、マウス２０４によるクリックなどにより選択されたとする。その選択された絞り込み条件の情報は、パーソナルコンピュータ２００から住宅地図サーバ１００に送られる。

【００６２】

住宅地図サーバ１００の要求受付部１１１は、この絞り込み条件の情報を受け付けて、調査部１１２に渡す。調査部１１２は、その絞り込み条件の情報に応じて、住宅地図データ記憶部１０３から必要な情報を読み出して、調査結果出力部１１３に送る。調査結果出力部１１３は、調査部１１２からの情報から画像情報を生成し、通信部１０１を通じてパーソナルコンピュータ２００に送信する。

【００６３】

このとき、この例では、パーソナルコンピュータ２００のディスプレイ２０２の表示画面には、例えば図７に示すように、豊島区のエリアの地図が表示される。図７では、縮尺に応じて、池袋駅や巣鴨駅を含む地図が表示されている。そして、この図７においては、表示欄３０１には、統計地図データが用いられて、豊島区内の各住所地毎の、６５歳以上の一般世帯比率および６５歳以上を含む夫婦のみの一般世帯比率が、さらなる絞り込み条件として表示されている。

【００６４】
パーソナルコンピュータ２００の使用者は、この図７の表示画面においても、絞り込み条件を参考にしながら、調査エリアの更なる絞り込みができる。例えば絞り込み条件の表示画像において、駒込１丁目が、マウス２０４によるクリックなどにより選択されたとする。すると、上述の場合と同様にして、その選択操作により選択された絞り込み条件の情報が住宅地図サーバ１００に送られ、住宅地図サーバ１００からは、その絞り込み条件の情報に応じた画像情報が送られてくる。すなわち、この時には、パーソナルコンピュータ２００のディスプレイ２０２の表示画面には、例えば図８に示すように、駒込１丁目のエリアの地図が表示される。
【００６５】
この実施形態では、住宅地図サーバ１００は、この図８の表示画面において、ディスプレイ２０２の表示画面の左側の表示欄３０２に、建物抽出条件が絞り込み条件として表示する画像情報を生成する。パーソナルコンピュータ２００の使用者は、この表示欄３０２において建物抽出条件について選択指定をすることができる。図８においては、表示欄３０２には、建物分類、建物面積、容積率、などの指定を受け付ける項目欄が表示される。
【００６６】
さらに、この表示欄３０２は、スライドバー３０２Ｓを操作することで、上側にスクロールすることができ、そのスクロール後の画面として、図９に示すような表示欄３０２の表示状態とすることができる。この図９の表示欄３０２においては、その上下方向の中ほどの位置に、統計地図データから得られる６５歳以上の方が居住する一般世帯数が占める割合を指定するための項目欄が表示されていると共に、表示欄３０２の下側に都市計画用途地域データから得られる容積率を指定するための項目欄が表示されており、それぞれの項目欄において、項目の指定が可能である（ステップＳ３２）。
【００６７】
図７および図８では、表示欄３０２においては、絞り込み条件として、建物分類について個人の家屋が指定されていると共に、「築年数が古い建物を抽出する」ことが指定されている。その他の絞り込み条件はチェック欄にマークが入っておらず、指定されていないことを意味している。ここで、「築年数が古い建物を抽出する」とは、築年数が所定年数以上、例えば２０年以上である建物を抽出することとされている。なお、この場合の古い建物とする築年数の所定年数は、利用者が指定することができるようにしてもよいことは言うまでもない。
【００６８】
使用者は、この表示欄３０２における絞り込み条件の指定をした後には、当該表示欄３０１中に表示されている「抽出」のアイコンボタン３０３を操作することにより、「築年数が古い建物を抽出する」ために必要な築年数推定処理の開始指示をすることができる。
【００６９】
要求受付部１１１は、パーソナルコンピュータ２００から送られてくる使用者の操作情報を監視して、「築年数が古い建物を抽出する」がチェックされ、かつ、「抽出」のアイコンボタン３０３が操作されたか否かにより、築年数推定処理の開始指示がなされたか否か判別する（ステップＳ３３）。このステップＳ３３で、築年数推定処理の開始指示がなされていないと判別したときには、パーソナルコンピュータ２００からの使用者の操作情報に基づいて、その他の指示がなされたか否か判別し（ステップＳ３４）、その他の指示がなされていなければ、ステップＳ３１に戻る。また、ステップＳ３４で、その他の指示がなされたと判別したときには、その指示に応じた処理のルーチンに移行する（ステップＳ３５）。
【００７０】
そして、ステップＳ３３で、築年数推定処理の開始指示がなされていると判別したときには、要求受付部１１１は、指定された調査地域範囲の情報および絞り込み条件とを含む築年数推定処理の開始指示を、調査部１１２に送る。調査部１１２は、この要求受付部１１１からの開始指示を受けて、住宅地図データのうち、指定された調査地域範囲および絞

り込み条件に適合する住宅地図データを用いて、築年数推定処理を行う（ステップＳ３６）。この調査部１１２での築年数推定処理については、後で詳述する。

【００７１】

調査部１１２での築年数推定処理により求められた、指定された調査地域範囲および絞り込み条件に適合する範囲の建物の築年数と、その建物についての情報は、調査結果出力部１１３に送られる。調査部１１２は、いずれの調査項目についての調査結果であるかも調査結果出力部１１３に通知する。

【００７２】

調査結果出力部１１３は、調査部１１２から受け取った情報に基づいて、調査結果出力の画像情報を生成し、通信部１０１を通じてパーソナルコンピュータ２００に送信する（ステップＳ３７）。調査結果出力部１１３は、この時には、調査項目は、「築年数が古い建物を抽出する」であることから、調査部１１２から受け取った築年数が、２０年以上である建物を抽出し、その建物についての情報を用いて、築年数が古い建物の一覧リストを生成し、その一覧リストを地図画像と合成した画像情報を、パーソナルコンピュータ２００に送信する。

【００７３】

パーソナルコンピュータ２００では、受け取った画像情報により、一覧リストを、図８および図９に示すように、ディスプレイ２０２の表示画面の下欄３０４に表示する。なお、この一覧リストにおいては、その中の一つの建物の欄が選択中状態となっており、その選択中状態の建物の欄は、例えば図８及び図９において塗りを付して示すようにして、選択中であることが表示されている。この選択中状態の建物の欄の位置は、使用者により変更指定することが可能である。そして、地図上には、選択中状態の建物のポリゴンの上に、選択マーク３０５が重畳表示されて、その位置が使用者に報知される。

【００７４】

そして、この実施形態では、使用者が、ディスプレイ２０２の表示画面の地図上に表示されている選択マーク３０５の位置で、例えばマウスをダブルクリックすると、その選択中の建物の詳細表示要求をすることができるように構成されている。ここで、この実施形態では、建物の詳細表示は、例えば航空写真とされている。

【００７５】

要求受付部１１１は、パーソナルコンピュータ２００から送られてくる使用者の操作情報を監視して、選択中の建物についての詳細表示要求の操作がなされたか否か判別する（ステップＳ３８）。このステップＳ３８で、選択中の建物についての詳細表示要求の操作がなされたと判別したときには、要求受付部１１１は、選択中の建物についての詳細表示指示を調査部１１２に伝達する。調査部１１２は、その詳細表示指示を受け取ると、その選択中の建物位置を中心とした範囲の航空写真情報を、住宅地図データ記憶部１０３から読み出し、調査結果出力部１１３に渡す。調査結果出力部１１３は、例えば図１０に示すような、地図画像と航空写真画像とを並べた画像の情報を生成し、その生成した画像情報をパーソナルコンピュータ２００に送信する（ステップＳ３９）。

【００７６】

パーソナルコンピュータ２００では、この画像情報を受けて、ディスプレイ２０２の表示画面に、図１０に示すように、航空写真画像３０６を地図と対比して表示する。このとき、地図上には、選択マーク３０５が表示されると共に、航空写真の画像の対応する建物位置にも、対応する選択マーク３０７が重畳表示されて、建物の対応関係が使用者に分かるようにされている。

【００７７】

使用者は、この航空写真画像３０６を見ることで、例えばビルが建ち並ぶ地域に、平屋建ての家屋が孤立的に建っていることなどを知ることができる。したがって、使用者が新築又は増改築工事を請け負う業者であれば、当該建物に対して、新築又は増改築についての営業活動をすることができる。

【００７８】

ステップＳ３９の次には、情報処理部１０２では、パーソナルコンピュータ２００から終了指示が到来したか否か判別する（ステップＳ３４０）。ステップＳ３８で、選択中の詳細表示要求はなされていないと判別したときにも、このステップＳ４０に進んで、パーソナルコンピュータ２００から終了指示が到来したか否か判別する。

【００７９】

このステップＳ３４０で、終了指示は到来していないと判別したときには、情報処理部１０２は、処理をステップＳ３８に戻し、他の建物が選択され、その詳細表示要求がなされれば、当該他の建物についての航空写真画像の表示を行う。

【００８０】

また、ステップＳ３４０で、終了指示が到来したと判別したときには、情報処理部１０２は、以上の処理ルーチンを終了する。

【００８１】

なお、以上の例では、築年数が２０年以上の建物を調査して、その調査結果を表示するようにしたが、指定された調査地域範囲において絞り込み条件に適合する全ての建物のそれぞれの築年数を調査することも勿論できる。その場合には、調査結果の築年数を、住宅地図画像において、各建物に対応して重畳して表示するようにすることもできる。もちろん、上述の例と同様に、調査地域範囲の対象建物について、それぞれの築年数の項目を含めた一覧リストを生成して表示するようにしてもよい。

【００８２】

以上の説明では、調査結果は表示画像情報としてクライアント装置に提供するようにしたが、表示画像情報に限られるものではなく、例えば上述した築年数が古い建物の一覧リストや指定された調査地域範囲の建物の築年数の一覧リストを、ＣＳＶ（comma-separated value）形式のデータとして、クライアント装置に提供するようにしても勿論よい。

【００８３】

なお、一覧リストは、築年数に基づきソートするようにしてもよい。また、ソートは、築年数に限らず、建物枠（ポリゴン）の面積に基づき行ってもよいし、築年数と建物枠面積の両者を組み合わせる方法であってもよい。こうすることで、パーソナルコンピュータ２００の使用者が住宅のリフォーム業者の営業マンなどの場合、より営業効率を高めることができる。

【００８４】

［ステップＳ３６における築年数推定処理］

図１１および図１２は、築年数推定処理を説明するためのフローチャートである。また、図１３は、築年数推定処理を説明するための説明図である。図１１および図１２のフローチャートは、指定された一つの建物についての築年数推定処理を示すもので、調査地域範囲として所定の地域範囲が指定された場合には、その指定された地域範囲における絞り込み条件に適合する建物の全てについて、図１１および図１２の処理を行うものである。

【００８５】

建物の築年数は、対象の建物の建物枠ＦＬの形状変化を、住宅地図データを最新版から過去に順次に遡って辿ることで調査し、対象の建物の建物枠ＦＬの形状変化を検出した版までの年数として算出（推定）する。具体的には、版の年度の変数をＸとして、Ｘ年度版と（Ｘ－１）年度版との２つの版の比較を行って、建物枠ＦＬの形状の変化の有無を検出し、建物枠ＦＬの形状の変化がなかったときには、変数ＸをＸ＝Ｘ－１として、同様の処理を繰り返す。そして、繰り返しの回数の変数ｎとして、築年数を算出する。

【００８６】

図１１に示すように、まず、要求受付部１１１は、パーソナルコンピュータ２００から、調査項目として築年数の要求を受け付けると、最新版住宅地図表示の指示を調査部１１２に送る。この最新版住宅地図表示の指示を受け取った調査部１１２は、築年数の推定処理のための初期化処理として、版の年度の変数ＸをＸ＝２０１４（最新年度）とすると共に、築年数を求めるための繰り返し回数の変数ｎをｎ＝１とする（ステップＳ５１）。このとき、調査部１１２で住宅地図データ記憶部１０３から読み出された最新版である２０

１４年度版住宅地図データは、調査結果出力部１１３で地図画像データにされて、通信部１０１を介してパーソナルコンピュータ２００に送信される。

【００８７】

次に、調査部１１２は、パーソナルコンピュータ２００で指定された調査地域範囲内の建物の一つを、築年数の調査対象として受け付ける（ステップＳ５２）。すなわち、調査地域範囲内に調査対象の複数の建物がある場合には、調査部１１２は、当該調査地域範囲内の調査対象の建物について、順次に、この図１１に示す処理ルーチンを行うので、このステップＳ５２では、その調査地域範囲内で築年数が未調査の調査対象の建物の中の一つを受け付ける。なお、調査対象として、所定の一つの建物がパーソナルコンピュータ２００で指定された場合には、調査部１１２は、通信部１０１および要求受付部１１１を通じて、調査対象である建物の指定を受け付ける。

【００８８】

次に、調査部１１２は、比較するＸ年度版の地図データと、（Ｘ－１）年度版の地図データとの位置合わせをする（ステップＳ５３）。これは、住宅地図データは、年度によって、同じ地域でも元となる地図の縮尺が変わる場合があり、縮尺の違いに基づく位置ずれ（誤差）が生じる場合があるので、そのような位置ずれを建物枠ＦＬの形状の変化として検出してしまわないようにするためである。

【００８９】

次に、調査部１１２は、Ｘ年度版と、（Ｘ－１）年度版との比較を行って、建物枠ＦＬの形状変化の有無を調査する（ステップＳ５４）。ここで、建物枠ＦＬの形状変化の有無は、建物枠ＦＬのポリゴン同士を重ね合わせて、その重複率により判断する。

【００９０】

図１２は、このステップＳ５４における建物枠ＦＬの形状変化の有無の調査の手順の一例を示すものである。すなわち、この例では、ステップＳ５４においては、Ｘ年度版と（Ｘ－１）年度版との間で建物枠ＦＬの形状について「重複率＝９０％以上」であるかどうか判断し（ステップＳ６１）、「重複率＝９０％以上」の場合、建物枠ＦＬの形状変化なしと判断する（ステップＳ６４）。

【００９１】

また、ステップＳ６１で「重複率＝９０％以上」でない場合には、Ｘ年度版と（Ｘ－１）年度版との間で建物枠ＦＬの形状について「重複率＝８０％以上」かつ「属性情報ＡＴＩの名称が完全一致」であるかどうか判断し（ステップＳ６２）、そうであれば、変化なしと判断する（ステップＳ６４）。すなわち、この実施形態では、重複率＝９０％未満であっても、属性情報ＡＴＩの名称が完全一致であって変化がなければ、新築又は増改築は行われていないと推定する。そして、ステップＳ６２で、「重複率＝８０％以上」かつ「属性情報ＡＴＩの名称が完全一致」ではないと判断した場合には、建物枠ＦＬの形状が変化したと判断する（ステップＳ６３）。

【００９２】

ステップＳ５４の次には、調査部１１２は、ステップＳ５４の調査結果を参照して、建物枠ＦＬの形状が変化したか否か判別する（ステップＳ５５）。このステップＳ５５で、建物枠ＦＬの形状の変化なしと判別したときには、調査部１１２は、版の年度の変数Ｘを、Ｘ＝Ｘ－１としてデクリメントして、比較する２つの版の年度を、調査を終了した年度Ｘの１年前の版と、２年前の版にすると共に、繰り返しの回数の変数ｎを、ｎ＝ｎ＋１として、１だけインクリメントする（ステップＳ５６）。そして、調査部１１２は、処理をステップＳ５３に戻し、このステップＳ５３以降の処理ステップを繰り返す。

【００９３】

そして、ステップＳ５５で、建物枠ＦＬの形状の変化ありと判別したときには、調査部１１２では、調査対象の建物は、調査を行ったＸ年度と（Ｘ－１）年度との間に新築又は増改築がなされたと判断し、その時の繰り返しの回数の変数ｎの値を築年数として算出（推定）する（ステップＳ５７）。以上で、一つの建物についての築年数の推定処理は終了である。

【００９４】
図１３を参照して、以上の築年数の推定処理を、具体例を挙げてさらに説明する。この図１３の例においては、ステップＳ５２で、最新年度版である２０１４年度版の地図データにおいて、属性情報のＩＤが、ＩＤ＝００１であり、かつ、名称が「善隣太郎」である建物が指定されたものとする。
【００９５】
この場合に、ステップＳ５３においては、２０１４年度版の住宅地図と２０１３年度版の住宅地図の重ね合わせを行って位置合わせを行う。具体的には、２０１４年度版の住宅地図データと２０１３年度版の住宅地図データに共通して存在するＩＤを有する、重ね合わせの対象となる建物を抽出し、当該建物の位置を一致させることで行う。図１３の例においては、共通するＩＤとして、ＩＤ＝１０２、ＩＤ＝１０３が抽出され、当該ＩＤ＝１０２、ＩＤ＝１０３の建物を用いて位置合わせが行われる。位置合わせは、例えば建物枠ＦＬのポリゴンの重心位置を一致させることで行う。これにより、２つの住宅地図の位置合わせを精度よく行うことが可能となる。なお、重ね合わせの対象となる建物を共通のＩＤで特定したが、建物の位置情報から特定しても良い。
【００９６】
その後、調査部１１２は、ステップＳ５４において、２０１４年度版と２０１３年度版の住宅地図データとを比較し、善隣太郎さんの建物枠ＦＬの形状変化の有無を調査する。この建物枠ＦＬの形状変化の有無の調査の結果、変化が無かった場合には、新築又は増改築されていないと判断し、版の年度の変数Ｘをマイナス１カウント（すなわち、Ｘ＝２０１３）とし、繰り返し回数の変数ｎをプラス１カウント（すなわち、ｎ＝２）とした後、今度は、２０１３年度版と２０１２年度版の住宅地図の重ね合わせを行って、善隣太郎さんの建物枠ＦＬの形状変化の調査をすることになる。
【００９７】
図１３の例では、２０１４年度版と２０１３年度版の住宅地図データとを比較した結果、善隣太郎さんの建物枠ＦＬの形状変化があったと判定され、２０１３年から２０１４年の間に新築又は増改築されたと判断する。その時の繰り返し回数の変数ｎの値は、ｎ＝１となる。したがって、図１３の例の場合には、善隣太郎さんの建物の築年数は、「１年未満」とされる。このように、築年数は、繰り返し回数の変数ｎのカウント数によって表され、ｎ＝２の場合は「２年未満」、ｎ＝３の場合は「３年未満」となる。
【００９８】
以上のようにして、上述の実施形態によれば、クライアント装置としてのパーソナルコンピュータ２００のユーザは、最新版住宅地図上で任意に指定した建物や、指定した地域範囲の対象の建物について、築年数の推定を簡易かつ迅速に行うことが可能となる。そして、たとえば、築年数５年であれば「畳の表替え」や「室内クリーニング」、１０年であれば「温水洗浄便座」や「室内のクロス（壁紙）交換」、１５年であれば「屋根補修」や「外壁塗装」、２０年であれば「フローリング工事」、「キッチン交換」、「ユニットバス交換」、「トイレ交換」、「床下シロアリ除去」、２５年であれば「間取り変更」など、築年数に応じた新築・増改築・リフォームなどの営業を効率的に行うことができる。また、住宅地図サーバ１００の提供側としても、簡易に既存の住宅地図データの付加価値を高めることが可能となる。
【００９９】
なお、上述の調査項目「築年数」の推定処理の実施形態においては、調査対象は建物であることを前提に説明したが、これに限らず、空き地や駐車場の継続年数推定にも、上述した築年数推定処理を応用することができる。
【０１００】
また、本実施形態において、調査部１１２はＸ年度の住宅地図データを基準に築年数の推定処理を行ったが、これに限らず種々の方法が可能である。例えば調査部１１２は調査時の年月日を基準に築年数を推定してもよい。具体的には、例えば調査時が２０１４年３月であり、２００９年から２０１０年の間に新築又は増改築されたと調査部１１２が判断

した場合、築年数は「５年３ヶ月未満」と算出しても良い。このようにすることで、正確な築年数を算出できる。また、本実施形態において、調査部１１２は住宅地図データの更新年度単位で築年数を算出していたが、住宅地図データの更新年月単位や住宅地図データの地図調査時単位で築年数を算出しても良い。

【０１０１】

また、本実施形態において、調査結果出力部１１３はステップＳ５６における繰り返し回数の変数ｎの値を用いて築年数を「ｎ未満」と表現したが、これに限らず種々の表現が可能である。例えば、調査結果出力部１１３は、形状変化したＸ年度の住宅地図データとＸ－１年度の住宅地図データとの期間を用いて築年数を表しても良い。具体的には、例えば最新版の住宅地図データが２０１４年度版であり、２００９年から２０１０年の間に新築又は増改築されたと調査部１１２が判断した場合、築年数は「４年から５年」と表しても良い。また、この場合、築年数を「４・５年」と期間の中点で表しても良いし、「約５年未満」とおおよその値として表しても良い。また、例えば「２００９年から２０１０年」というように、新築又は増改築された期間を直接表しても良い。このような表示は住宅地図データが毎年更新されず、複数年に一度更新されるような地区で特に有効である。

【０１０２】

また、本実施形態において、築年数推定処理において調査部１１０は地物を建物における形状変化等の調査をしたが、調査部１１０は地物を道路、路線、敷地、水域、空き地、バス停、地下鉄出入口、一方通行などの標識、信号、地下街、行政界における形状変化等の調査をしても良い。

［調査項目の居住年数についての処理例］

次に、住宅地図サーバ１００の情報処理装置１０２が、選択された調査項目が「建物への居住年数」であると判別されたときに、実行するステップＳ１７での処理例について説明する。「建物への居住年数」とは、本実施形態において、所定の居住者がどれくらいの期間（年数）対象の建物に居住したかを表す値である。

【０１０３】

この調査項目「居住年数」の場合においても、図５に示したフローチャートのステップＳ３１およびステップＳ３２は同様に行われて、調査地域範囲の指定（１個の地物（建物）の指定を含む）や、建物分類、建物面積、容積率などの指定がなされる。

【０１０４】

そして、パーソナルコンピュータ２００の使用者により、居住年数推定処理開始指示がなされると、調査部１１２は、以下に説明するような居住年数推定処理を実行する。そして、調査結果出力部１１３は、調査部１１２での調査処理結果に基づいて、調査結果出力情報を生成し、通信部１０１を通じてパーソナルコンピュータ２００に送信する。

【０１０５】

その場合の調査結果出力情報は、指定された調査地域範囲において絞り込み条件に適合する全ての調査対象の建物のそれぞれの築年数を調査することも勿論できる。その場合には、調査結果の居住年数を、住宅地図画像において、各調査対象の建物に対応して重畳して表示するようにすることもできる。もちろん、上述の例と同様に、調査地域範囲の調査対象の建物の居住者について、それぞれの居住年数の項目を含めた一覧リストを生成して表示するようにしてもよい。

【０１０６】

［居住年数推定処理］

図１４は、居住年数推定処理を説明するためのフローチャートである。また、図１５は、居住年数推定処理を説明するための説明図である。図１４のフローチャートは、指定された一つの調査対象の建物の居住者の居住年数推定処理を示すもので、調査地域範囲として所定の地域範囲が指定された場合には、その指定された地域範囲における絞り込み条件に適合する調査対象の建物の居住者の全てについて、図１４の処理を行うものである。

【０１０７】

この実施形態では、居住年数は、調査対象の地物である建物の属性情報ＡＴＩの変化を

、住宅地図データを最新版から過去に順次に遡って辿ることで調査し、属性情報ＡＴＩの変化を検出した版までの年数として算出（推定）する。具体的には、版の年度の変数をＸとして、Ｘ年度版と（Ｘ－１）年度版との２つの版の間で、対象の建物の属性情報ＡＴＩの変化の有無を検出し、属性情報ＡＴＩの変化がなかったときには、変数ＸをＸ＝Ｘ－１として、同様の処理を繰り返す。この例では、属性情報ＡＴＩの変化があったか否かは、Ｘ年度版の住宅地図データには存在していた属性情報ＡＴＩと同じ属性情報ＡＴＩが、（Ｘ－１）年度版の住宅地図データに存在しているか否かにより判定する。そして、繰り返しの回数の変数ｎとして、居住年数を算出する。

【０１０８】

図１４に示すように、まず、要求受付部１１１は、パーソナルコンピュータ２００から、調査項目として居住年数の要求を受け付けると、最新版住宅地図表示の指示を調査部１１２に送る。この最新版住宅地図表示の指示を受け取った調査部１１２は、居住年数の推定処理のための初期化処理として、版の年度の変数ＸをＸ＝２０１４（最新年度）とすると共に、築年数を求めるための繰り返し回数の変数ｎをｎ＝１とする（ステップＳ７１）。このとき、調査部１１２で住宅地図データ記憶部１０３から読み出された最新版である２０１４年度版住宅地図データは、調査結果出力部１１３で地図画像データにされて、通信部１０１を介してパーソナルコンピュータ２００に送信される。

【０１０９】

次に、調査部１１２は、パーソナルコンピュータ２００で指定された調査地域範囲内の調査対象の建物の一つを、居住年数の調査対象として受け付け、最新版である２０１４年度版住宅地図データから、当該調査対象の建物（地物）の属性情報ＡＴＩを抽出して受け付ける（ステップＳ７２）。

【０１１０】

調査地域範囲内に調査対象の複数の建物がある場合には、調査部１１２は、当該調査地域範囲内の調査対象の居住者が居住する建物（地物）について、順次に、この図１４に示す処理ルーチンを行うので、このステップＳ７２では、その調査地域範囲内で居住年数が未調査の調査対象の建物の中の一つを受け付ける。なお、調査対象として、所定の一つの建物の居住年数がパーソナルコンピュータ２００で指定された場合には、調査部１１２は、通信部１０１および要求受付部１１１を通じて、調査対象である建物の指定を受け付けるようにする。その場合に、パーソナルコンピュータ２００での使用者による居住年数の調査対象である建物の指定は、地図上における建物枠（ポリゴン）の指定であってもよいし、居住者名、あるいは住所などであってもよい。

【０１１１】

次に、調査部１１２は、ステップＳ７２でＸ年度版の住宅地図データから取得した調査対象の建物の属性情報ＡＴＩが、（Ｘ－１）年度版の住宅地図データにおいて変化したか否か調査する。すなわち、まず、調査部１１２はＸ年度版の属性情報ＡＴＩの名称と、（Ｘ－１）年度版の属性情報ＡＴＩとの名称が完全に一致しており、かつ、名称の文字の基準点位置が完全に一致しているか否かをチェックする（ステップＳ７３）。ここで一致していると判別したときには、調査部１１２は、版の年度の変数Ｘを、Ｘ＝Ｘ－１としてデクリメントして、比較する２つの版の年度を、調査を終了した年度Ｘの１年前の版と、２年前の版にすると共に、繰り返しの回数の変数ｎを、ｎ＝ｎ＋１として、１だけインクリメントする（ステップＳ７４）。そして、調査部１１２は、処理をステップＳ７３に戻し、このステップＳ７３以降の処理ステップを繰り返す。

【０１１２】

ステップＳ７３において、Ｘ年度版の属性情報ＡＴＩの名称と、（Ｘ－１）年度版の属性情報ＡＴＩとの名称の文字が完全には一致しておらず、あるいは、名称の文字の基準点位置が完全に一致してはいないときには、建物の位置の重心（ポリゴンの重心）が一致しており、かつ、名称の文字が前年度版の名称を包含する形で一致しているかどうかチェックする（ステップＳ７５）。ここで、名称の文字が（Ｘ－１）年度版の名称を包含する形で一致しているとは、例えば（Ｘ－１）年度版の名称の文字が「山田太郎」であり、Ｘ年

度版の名称が「山田」である場合などである。ここで一致していると判別したときには、調査部１１２は、版の年度の変数Ｘを、Ｘ＝Ｘ－１としてデクリメントして、比較する２つの版の年度を、調査を終了した年度Ｘの１年前の版と、２年前の版にすると共に、繰り返しの回数の変数ｎを、ｎ＝ｎ＋１として、１だけインクリメントする（ステップＳ７６）。そして、調査部１１２は、処理をステップＳ７３に戻し、このステップＳ７３以降の処理ステップを繰り返す。

【０１１３】

ステップＳ７５でのチェックの結果、建物の位置の重心（ポリゴンの重心）が一致しておらず、あるいは、名称の文字が前年度版の名称を包含する形では一致していないときには、調査対象の建物の属性ＡＴＩに変化があったとして、調査部１１２はステップＳ７７に進んで、居住年数推定処理の調査結果の送出処理を行う。すなわち、このステップＳ７７においては、調査部１１２は、ステップＳ７５で、調査対象の属性情報ＡＴＩに変化があったと判別したときには、調査対象の建物の居住者は、Ｘ年度と（Ｘ－１）年度との間に変わったと判断し、その時の繰り返しの回数の変数ｎの値を居住年数として算出（推定）し、それを調査結果として送出する。以上で、一つの建物の居住者についての居住年数の推定処理は終了である。

【０１１４】

図１５を参照して、以上の居住年数の推定処理について具体例を挙げてさらに説明する。この図１５の例においては、ステップＳ７２で、最新年度版である２０１４年度版の地図データにおいて、調査対象の居住者の建物が指定されたとする。図１５の例では、名称が「善隣太郎」である建物が指定されたものとする。

【０１１５】

すると、調査部１１２は、２０１４年度版において、指定された建物の属性情報ＡＴＩを取得する（ステップＳ７２）。次に、調査部１１２は、２０１３年度版の住宅地図データにおける属性情報ＡＴＩの変化の有無を判定する（ステップＳ７３及びステップＳ７５）。判定の結果、２０１３年度版の住宅地図データの属性情報ＡＴＩに変化が無い場合には、２０１３年に善隣太郎さんは居住していたと判断し、版の年度の変数Ｘをマイナス１カウント（すなわち、Ｘ＝２０１３）すると共に、繰り返し回数の変数ｎをプラス１カウント（すなわち、ｎ＝２）とした後（ステップＳ７４またはステップＳ７６）、ステップＳ７３に戻り、今度は、２０１２年度版の住宅地図データにおける属性情報ＡＴＩの変化の有無を判定する。

【０１１６】

しかし、図１５の例においては、調査対象の建物には２０１３年には山田次郎さんが居住しているため、２０１３年度版の住宅地図データには、２０１４年度の属性情報ＡＴＩが存在しないので、２０１３年には善隣太郎さんは居住していないと判断する。その時の繰り返し回数の変数ｎの値は、ｎ＝１となる。したがって、ステップＳ７７では、善隣太郎さんの居住年数は「１年未満」と推定される。このように、居住年数は、繰り返し回数の変数ｎの数字によって表され、ｎ＝２の場合は「２年未満」、ｎ＝３の場合は「３年未満」となる。なお、調査対象の建物としてアパート・マンション・ビルが指定された場合、その建物の属性情報ＡＴＩである別記情報の変化の有無を判定する。

【０１１７】

以上のようにして、上述の実施形態によれば、クライアント装置としてのパーソナルコンピュータ２００のユーザは、最新版住宅地図上で任意に指定した建物の居住者や、指定した地域範囲の建物の居住者について、居住年数の推定を簡易かつ迅速に行うことが可能となる。したがって、例えば居住者の信用調査などを効率的に行うことができる。また、住宅地図サーバ１００の提供側としても、簡易に既存の住宅地図データの付加価値を高めることが可能となる。

【０１１８】

なお、居住年数推定処理は調査対象の建物の属性情報ＡＴＩの変化の有無を判定していたが、例えば属性情報ＡＴＩのＩＤの変化の有無に基づき居住者の変化を判定しても良い

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【０１１９】

なお、調査結果の居住年数は、調査項目「築年数」の場合と同様に、住宅地図画像において、各建物に対応して重畳して表示するようにすることもできる。もちろん、調査地域範囲の複数の建物について、それぞれの居住者の居住年数の項目を含めた一覧リストを生成して表示するようにしてもよい。そして、その一覧リストを、ＣＳＶ形式のデータとして、クライアント装置に提供するようにしても勿論よい。また、一覧リストは、居住年数に基づきソートしてリスト表示してもよい。また、ソートは、居住年数に限らず、建物枠（ポリゴン）の面積に基づき行ってもよいし、居住年数と建物枠面積の両者を組み合わせる方法であってもよい。

【０１２０】

なお、以上の説明では、指定された建物の居住者や指定された地域範囲の建物の居住者の居住年数を算出して、その居住年数を調査結果として出力するようにしたが、調査項目「築年数」の場合と同様に、所定年数以上、居住者が同一の建物に居住している当該建物を調査結果として出力するようにすることもできる。

【０１２１】

また、算出した居住年数は築年数データと組み合わせることで種々の情報提示が可能である。例えば、調査対象建物は新築又は増改築されてから何回居住者が変わったかといった情報や調査対象建物の居住年数の平均値の情報などを算出できる。

【０１２２】

［土壌汚染調査処理］

次に、住宅地図サーバ１００の情報処理装置１０２が、選択された調査項目が「土壌汚染」であると判別されたときに、実行するステップＳ１９での処理例について説明する。

【０１２３】

図１６は、土壌汚染調査処理のフローチャート、図１７は、土壌汚染処理を説明するための説明図である。この実施形態では、土壌汚染は、地物の属性情報ＡＴＩの内の名称を主として検索し、当該名称として、土壌汚染を生じる可能性のある職種の建物や、工場などが過去に存在したか否かを調査することにより行う。この場合に、属性情報ＡＴＩの種別の情報も参照して調査することもできる。なお、属性情報ＡＴＩの種別の情報は、調査のための補助情報であり、属性情報ＡＴＩの内の名称のみに基づいて調査を行うようにしてもよい。

【０１２４】

なお、この調査項目「土壌汚染」の場合においても、図５に示したフローチャートのステップＳ３１およびステップＳ３２は、同様に行なって、調査地域範囲の指定（１個の地物（建物）の指定を含む）や、建物分類、建物面積、容積率などの指定を行って、調査対象地物の絞り込みを行うようにすることができる。

【０１２５】

図１６に示すように、この実施形態における土壌汚染調査処理においては、地図サーバ１００では、パーソナルコンピュータ２００から最新版住宅地図表示の要求を通信部１０１が受付けると、情報処理部１０２の要求受付部１１１によりその旨が調査部１１２に指示され、調査部１１２が取得した２０１４年度版住宅地図データに基づき調査結果出力部１１３が生成した画像データを、通信部１０１を介してパーソナルコンピュータ２００に送信する。

【０１２６】

そして、住宅地図サーバ１００では、パーソナルコンピュータ２００からの土壌汚染の調査範囲（領域）の指定を、通信部１０１を通じて要求受付部１１１が受け付ける（ステップＳ８１）。次に、住宅地図サーバ１００では、パーソナルコンピュータ２００から送られてくる、調査期間の指定情報として、例えば３０年などのような遡及年数の指定情報を、通信部１０１を通じて要求受付部１１１が受け付ける（ステップＳ８２）。

【０１２７】

すると、情報処理部１０２では、指定された範囲（領域）と調査期間（遡及年数）が、要求受付部１１１を介して調査部１１２に伝えられ、調査部１１２は、最新版である２０１４年版から、ステップＳ８２で受け付けられた遡及年数分前までの各年度版の過去の住宅地図データについて、指定された調査範囲（領域）に含まれる全ての地物の属性情報ＡＴＩの中に、土壌汚染の可能性のある名称及び種別があるか否か調査する（ステップＳ８３）。この実施形態では、土壌汚染の可能性のある名称及び種別として、属性情報ＡＴＩの中に「種別＝事業所」であり、かつ「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」が存在するか否かを検索する。なお、調査する属性情報ＡＴＩの対象として、「種別＝事業所」であり、かつ「名称＝○○化学工場」なども加えてもよい。土壌汚染の可能性のある名称及び種別は予めデータベース化されていても良いし、ユーザにより入力されても良い。

【０１２８】

そして、ステップＳ８３での調査の結果、土壌汚染の可能性のある名称及び種別があった時には、指定した調査範囲（領域）は、土壌汚染の可能性があるとして、その土壌汚染の可能性を示す「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」などを調査結果として出力（表示画像情報など）する（ステップＳ８４）。

【０１２９】

なお、その土壌汚染の可能性を示す「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」などを検出した住宅地図データの版の年度を併せて表示するようにしてもよい。これにより、何年前まで、土壌汚染の可能性を示す「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」が存在したかを把握することができる。

【０１３０】

以上で、土壌汚染調査処理は終了となる。図１７を参照して、具体例を挙げて土壌汚染調査処理をさらに説明する。

【０１３１】

ステップＳ８１では、図１７の下側に示すように、最新版である２０１４年度版の住宅地図表示において、例えば点線で囲んで示す右下のＡ範囲（領域）が土壌汚染の調査範囲として指定されたとする。そして、ステップＳ８２において、調査期間が、例えば３０世代前である１９８４年版までの各年度版の住宅地図データが指定されたとする。

【０１３２】

すると、ステップＳ８３では、調査部１１２は、最新版から、３０世代前である１９８４年度版までの各年度版の住宅地図データについて、Ａ範囲（領域）に含まれる全ての地物の属性情報ＡＴＩの中に、「種別＝事業所」であり、かつ「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」が存在するか否かを検索する。なお、検索範囲はＡ範囲に含まれる名称の文字列を検索しても良いし、Ａ範囲に建物形状が一部または所定割合重複する建物の名称を検索しても良い。

【０１３３】

そして、調査部１１２は、ステップＳ８３において、検索の結果、「種別＝事業所」であり、かつ「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」が存在する場合には、土壌汚染の可能性があると判断する一方、存在しない場合には、土壌汚染の可能性はないと判断する。

【０１３４】

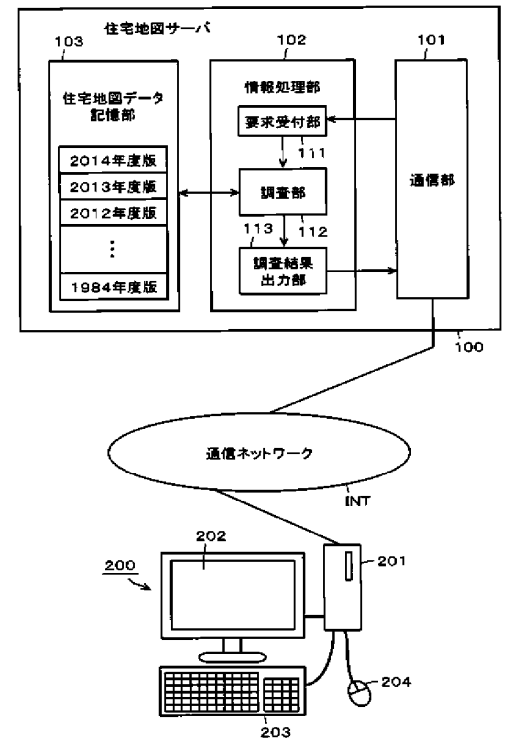
その後、判断結果を受け取った調査結果出力部１１３は、ステップＳ８４において、判断結果を表示するための画像データを生成し、通信部１０１を介してパーソナルコンピュータ２００に送信する。パーソナルコンピュータ２００では、ディスプレイ２０２の表示画面に表示された２０１４年度版住宅地図上に、調査結果が重ねて表示される。

【０１３５】

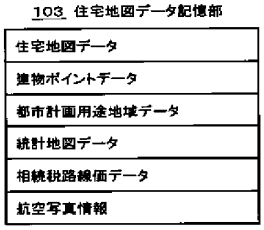
図１７の例の場合、Ａ範囲（領域）においては、「名称＝クリーニング工場」もしくは「名称＝ガソリンスタンド」のどちらも存在せず、土壌汚染の可能性はない旨が表示されることになる。

【０１３６】
そして、ステップＳ８２において、２０１４年度版の住宅地図表示において、図１７で点線で囲んで示す右上と右下の両方を含むＢ範囲（領域）が指定された場合、２０１３年度版の住宅地図中に、「名称＝クリーニング工場」が存在するので、調査結果としては、土壌汚染の可能性がある旨が表示されることになる。
【０１３７】
以上説明した土壌汚染調査処理の実施形態によれば、パーソナルコンピュータ２００のユーザは、最新版住宅地図上で任意に指定した範囲（領域）について、任意に指定した期間の土壌汚染調査を簡易かつ迅速に行うことが可能となり、土地取引を効率的に行うことができる。また、住宅地図サーバ１００の提供側としても、簡易に既存の住宅地図データの付加価値を高めることが可能となる。
【０１３８】
［他の実施形態または変形例］
上述の実施形態では、調査項目の例として、築年数と、居住年数と、土壌汚染を挙げたが、住宅地図データ記憶部１０３に記憶されている複数版の住宅地図データを用いることで、その他種々の調査項目の調査が可能である。例えば、指定された範囲（領域）のそれぞれの地物における、例えば過去３０年分の属性情報中の名称の一覧の検索調査をすることもできる。
【０１３９】
上述の実施形態では、地図データを複数の版で記憶し、指定した版から過去に遡って調査して検出した変化点から個別の建物の築年数、居住年数および土壌汚染を求めたが、複数の建物から、あるエリアの築年数、居住年数および土壌汚染の傾向を求めても良い。例えば築年数が５年未満の建物が所定以上密集する地域を「新築エリア」として求め、ディスプレイ２０２に表示しても良い。また、例えば居住年数が５年未満の建物が密集する地域を「転勤族エリア」として求めてディスプレイ２０２に表示しても良い。また、例えば複数の土壌汚染の状況から汚染度を求め、その汚染度は色わけしてディスプレイ２０２に表示しても良い。またさらに、築年数、居住年数および土壌汚染の期間を区切って調査することで、それらの経年的な推移を分析できる。
【０１４０】
また、上述の実施形態においては、地図関連調査装置は、住宅地図サーバとクライアント装置としてのパーソナルコンピュータ２００とが通信ネットワークを通じて接続される構成としたが、この発明の地図関連調査装置は、上述のサーバとクライアント装置の機能を併せ持つスタンドアロン型の装置の構成とすることが可能であることは勿論である。
【符号の説明】
【０１４１】
１００…住宅地図サーバ、１０１…通信部、１０２…情報処理部、１０３…住宅地図データ記憶部、１１１…要求受付部、１１２…調査部、１１３…調査結果出力部、２００…パーソナルコンピュータ

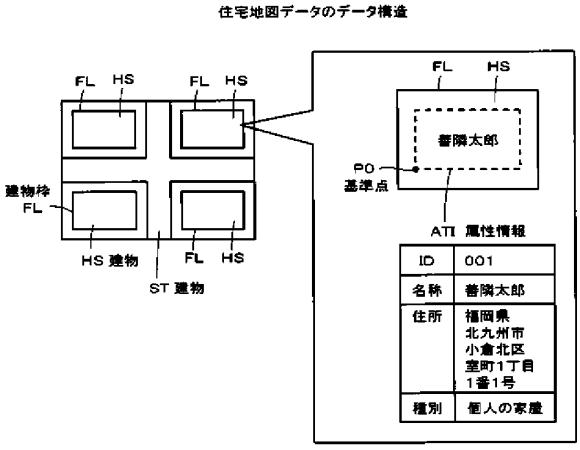
【図１】


住宅地図サーバ
103
住宅地図データ記憶部
2014年度版
2013年度版
2012年度版
1984年度版
102
情報処理部
要求受付部
111
調査部
113
112
調査結果出力部
101
通信部
100
通信ネットワーク
INT
202
200
201
204
203

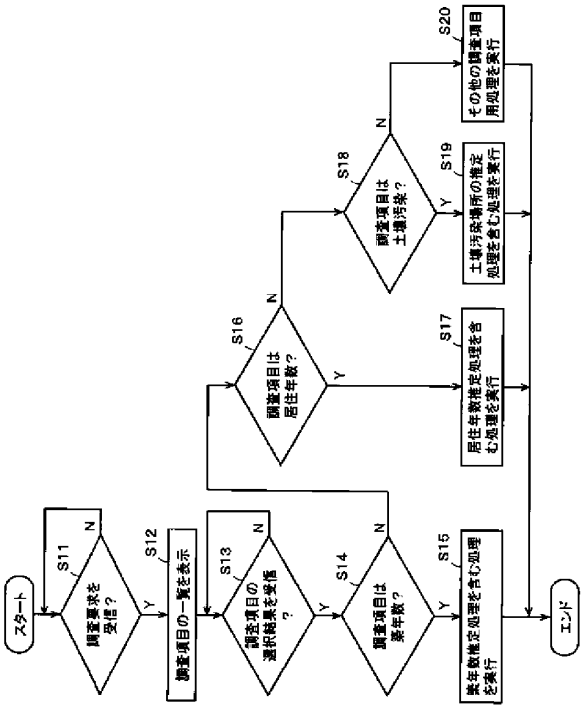
【図２】


103 住宅地図データ記憶部
住宅地図データ
建物ポイントデータ
都市計画用途地域データ
統計地図データ
相続税路線価データ
航空写真情報

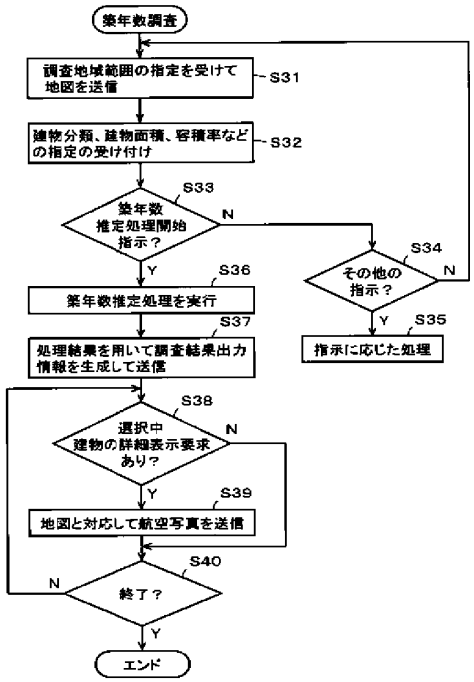
【図３】


住宅地図データのデータ構造
FL HS
FL HS
建物枠
FL
HS 建物
FL HS
ST 建物
FL HS
善隣太郎
P0
基準点
ATT 属性情報
ID 001
名称 善隣太郎
住所 福岡県 北九州市 小倉北区 室町1丁目 1番1号
種別 個人の家屋

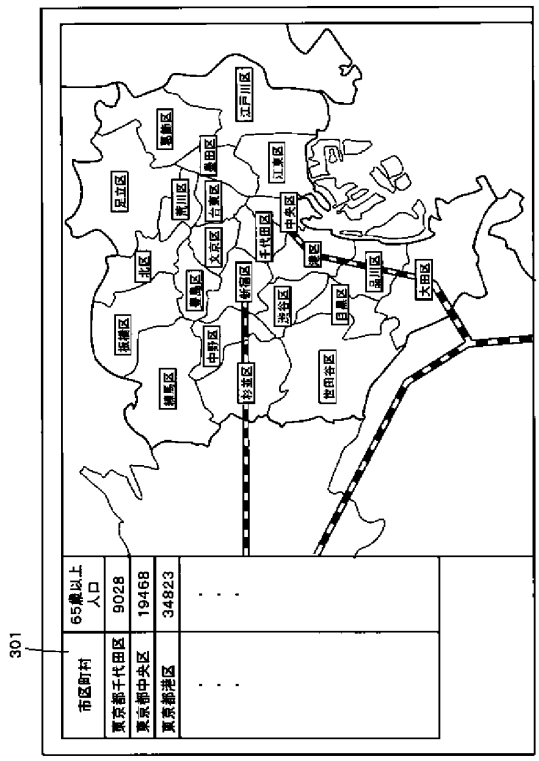
【図４】


スタート
S11
調査要求を受信？
N
Y
S12
調査項目の一覧を表示
S13
調査項目の選択結果を受信？
N
Y
S14
調査項目は築年数？
N
Y
S15
築年数推定処理を含む処理を実行
S16
調査項目は居住年数？
N
Y
S17
居住年数推定処理を含む処理を実行
S18
調査項目は土壌汚染？
N
Y
S19
土壌汚染場所の推定処理を含む処理を実行
S20
その他の調査項目用処理を実行
エンド

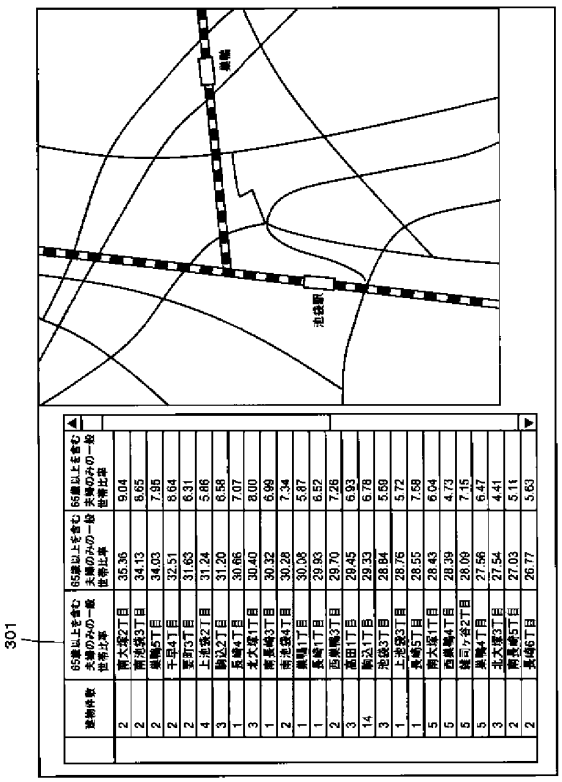
【図５】


築年数調査
調査地域範囲の指定を受けて地図を送信
S31
建物分類、建物面積、容積率などの指定の受け付け
S32
S33
築年数推定処理開始指示？
N
Y
S34
その他の指示？
N
Y
S35
指示に応じた処理
S36
築年数推定処理を実行
S37
処理結果を用いて調査結果出力情報を生成して送信
S38
選択中建物の詳細表示要求あり？
N
Y
S39
地図と対応して航空写真を送信
S40
終了？
N
Y
エンド

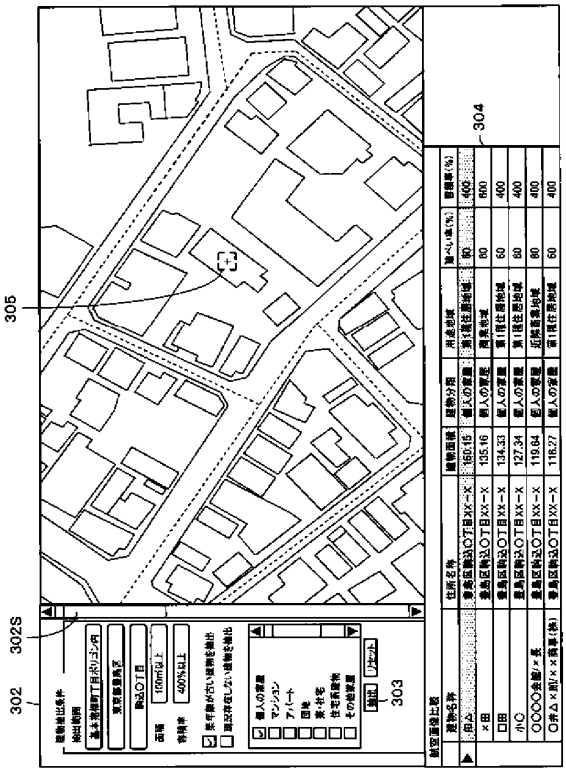
【図６】


301
市区町村
65歳以上人口
東京都千代田区 9028
東京都中央区 19468
東京都港区 34823
千代田区
中央区
港区
江戸川区
江東区
墨田区
台東区
文京区
荒川区
北区
足立区
板橋区
練馬区
豊島区
新宿区
渋谷区
目黒区
世田谷区
中野区
杉並区
大田区

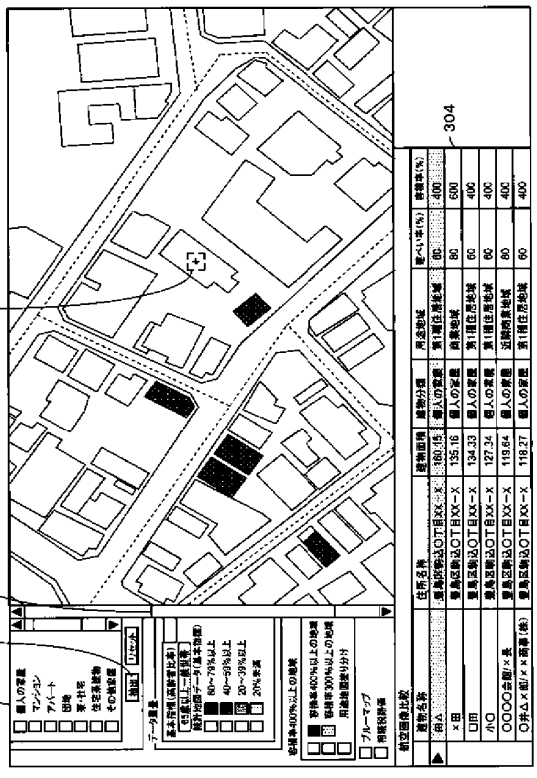
【図７】


301
池袋駅
巣鴨
建物棟数
65歳以上を含む夫婦のみの一般世帯比率
65歳以上を含む夫婦のみの一般世帯比率
2 南大塚2丁目 35.36 9.04
2 南池袋3丁目 34.13 8.65
2 巣鴨5丁目 34.03 7.95
2 千早4丁目 32.51 8.04
2 要町3丁目 31.63 6.31
4 上池袋2丁目 31.24 5.86
3 駒込2丁目 31.20 6.58
1 長崎4丁目 30.86 7.07
1 北大塚1丁目 30.40 8.00
3 南長崎3丁目 30.32 6.99
1 南池袋4丁目 30.28 7.34
2 要町1丁目 30.08 5.87
1 長崎1丁目 29.83 6.52
1 南大塚1丁目 29.70 7.28
2 西巣鴨3丁目 28.45 6.93
3 高田1丁目 28.45 6.93
14 駒込1丁目 29.23 6.78
3 池袋3丁目 28.84 5.69
1 上池袋3丁目 28.76 5.72
1 長崎5丁目 28.55 7.58
5 南大塚1丁目 28.43 6.04
6 西巣鴨4丁目 28.39 4.73
5 雑司ヶ谷2丁目 28.09 7.15
5 巣鴨4丁目 27.56 6.47
3 北大塚3丁目 27.54 4.41
2 南長崎5丁目 27.03 5.11
2 長崎6丁目 26.77 5.63

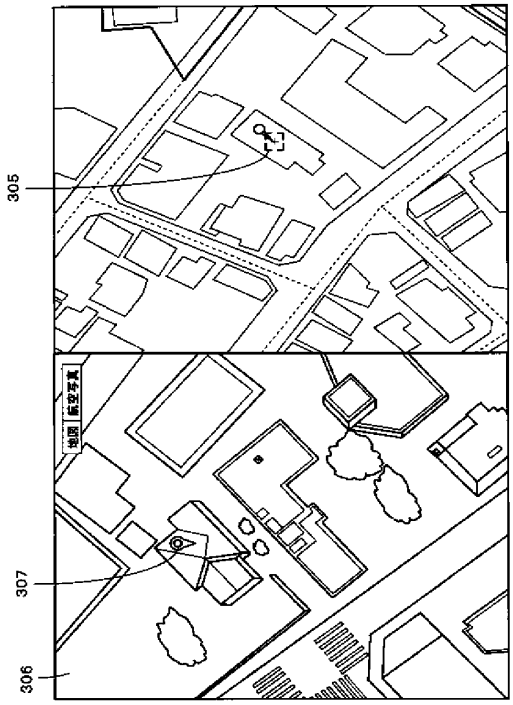
【図８】


305
302
302S
303
304
住所名称
建物面積
建物分類
用途地域
地べた率(%)
容積率(%)
向ヵ
×田
□田
小〇
〇〇〇〇会館ハ系
〇井△×町ハ×号第1棟
豊島区南池袋OT目XX−X 180.15 個人の賃貸 第1種住居地域 80 400
豊島区南池袋OT目XX−X 135.16 個人の賃貸 商業地域 80 600
豊島区南池袋OT目XX−X 134.33 個人の賃貸 第1種住居地域 60 400
豊島区南池袋OT目XX−X 127.34 個人の賃貸 第1種住居地域 60 400
豊島区南池袋OT目XX−X 119.84 個人の賃貸 近隣商業地域 80 400
豊島区南池袋OT目XX−X 118.27 個人の賃貸 第1種住居地域 60 400

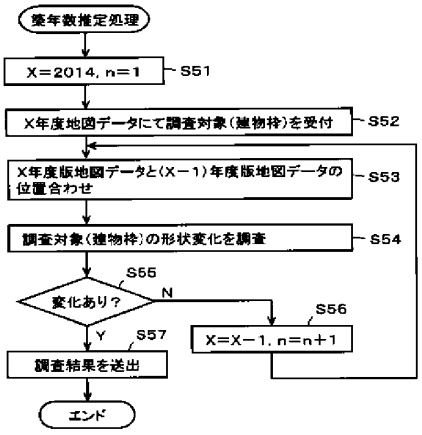
【図９】


305
302
302S
303
304
住所名称
建物面積
建物分類
用途地域
地べた率(%)
容積率(%)
向ヵ
×田
□田
小〇
〇〇〇〇会館ハ系
〇井△×町ハ×号第1棟
豊島区南池袋OT目XX−X 180.15 個人の賃貸 第1種住居地域 80 400
豊島区南池袋OT目XX−X 135.16 個人の賃貸 商業地域 80 600
豊島区南池袋OT目XX−X 134.33 個人の賃貸 第1種住居地域 60 400
豊島区南池袋OT目XX−X 127.34 個人の賃貸 第1種住居地域 60 400
豊島区南池袋OT目XX−X 119.84 個人の賃貸 近隣商業地域 80 400
豊島区南池袋OT目XX−X 118.27 個人の賃貸 第1種住居地域 60 400

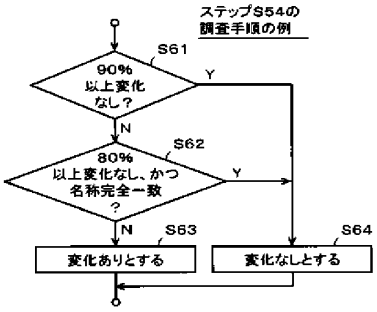
【図１０】



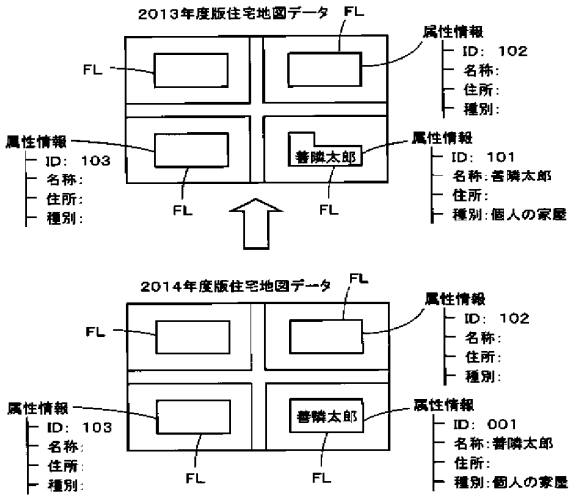
【図１１】



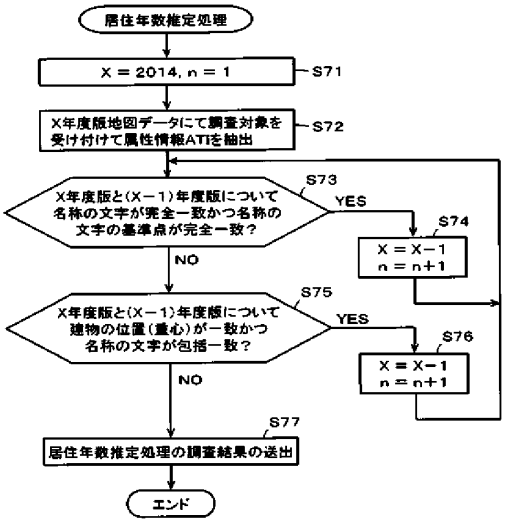
【図１２】



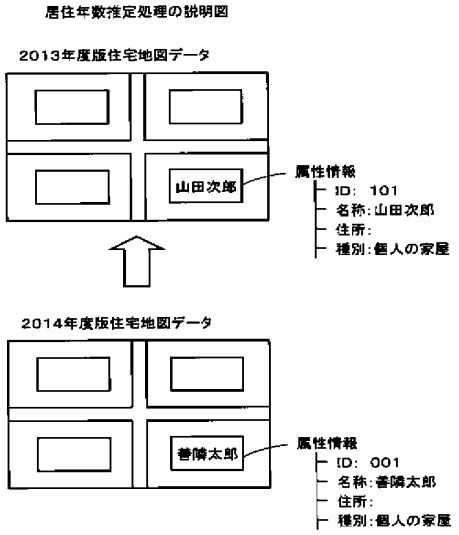
【図１３】



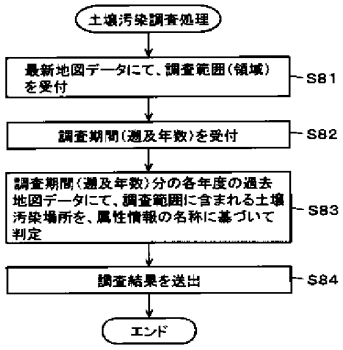
【図１４】



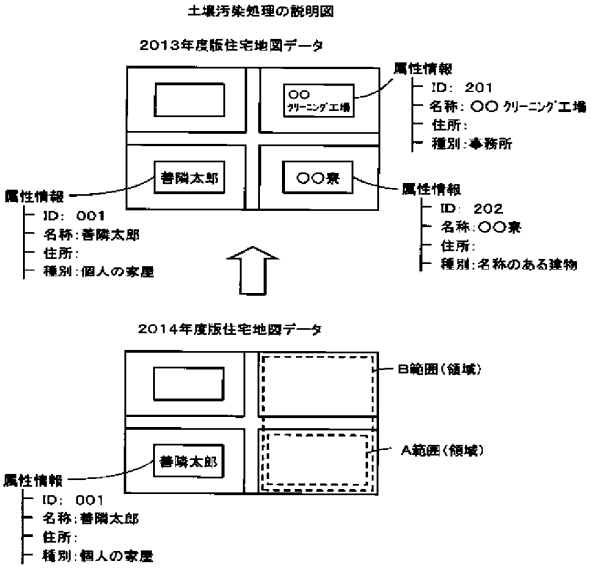
【図１５】



【図１６】



【図１７】



フロントページの続き

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Ｆターム(参考) 2C032 HA02　HB06　HB15　HC13　HC22　HC23　HC26　HC27

Espacenet

Bibliographic data: JPS62288963 (A) — 1987-12-15

REAL ESTATE EVALUATING DATA MEMORY DEVICE

Inventor(s): KATO YOSHIHARU; NAKATSU TAKASUMI ± (KATO YOSHIHARU, ; NAKATSU TAKASUMI)

Applicant(s): JIEKUTO KK ± (JIEKUTO:KK)

Classification: **- international:** (IPC1-7): G06F15/20
- cooperative:

Application number: JP19860133199 19860609

Priority number(s): JP19860133199 19860609

Abstract of JPS62288963 (A)

PURPOSE:To always uniformly evaluate fixed properties by storing line characteristic information, information of use values of lines and use states of curtilage which are evaluated with coefficients based on prescribed factors, and line value information obtained from both information by a prescribed operating means in a storage medium. CONSTITUTION:An air photograph is analyzed and is converted to a graphic pattern and is stored in the storage medium. Line numbers are given based on a land ledger and field investigation to extract lines as patterns on two-dimensional coordinates, and they are stored in the storage medium. A line value information table is operated based on formula I of the coefficient of street which indicates the use value and the utility in accordance with a width W, the classification, etc., of the line, the formula II of the coefficient of proximity which indicates the value with a distance (s) from a station, a hospital, or a pollution source, and the formula III of the coefficient of curtilage which indicates values of the use state, the cultural property, etc., of curtilage itself based on a prescribed improvement level or the like, and this table is stored in the storage medium and is automatically plotted. Coefficient total values are standardized with the line value, which has a maximum line coefficient in a region, as a constant and property values are determined based on lines. Evaluation results are corrected in accordance with transaction examples or appraisal, and stored contents are corrected in accordance with such correction. By such mechanism, fixed properties are uniformly evaluated and the evaluation reference is easily changed.

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭62－288963

⑤1Int.Cl.⁴　識別記号　庁内整理番号　⑬公開　昭和62年(1987)12月15日
G 06 F 15/20　N－7230－5B

審査請求　有　発明の数 1　(全9頁)

⑤4発明の名称　固定資産評価用データ記憶装置

⑳特　願　昭61－133199
㉒出　願　昭61(1986)6月9日

⑦2発明者　加藤　嘉治　大阪市西区北堀江2丁目3番3号　株式会社ジエクト内
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⑦1出願人　株式会社　ジエクト　大阪市西区北堀江2丁目3番3号
⑦4代理人　弁理士　倉内　義朗　外1名

明　細　書

1．発明の名称

固定資産評価用データ記憶装置

2．特許請求の範囲

1）任意に選定した路線の特性を示す特性データと、予め決めた要因に基いて、前記路線自体の利用価値、該路線に対する受益施設からの影響及び該路線の宅地利用状態を係数で評価した評価データと、前記特性データと評価データとから予め決めた演算手順で求めた路線価データとが記憶媒体に記憶されていることを特徴とする固定資産評価用データ記憶装置。

3．発明の詳細な説明

（産業上の利用分野）

本発明は、固定資産評価用データ記憶装置に関する。

（従来の技術）

売買取引の際の取引価額を決めたり、固定資産税の課税基準を算定するために、宅地等の固定資産の価格を評価する必要がある。

従来、この種の固定資産評価は、市町村の一番地価の高い標準地を評価基準地としているが、この評価基準地の価額は自治省から指示され、標準地の指定は県からされている。すなわち、自治省及び各都道府県から指示される当該地区の標準地の評定価額と現実の売買取引状況を勘案して、不動産鑑定士等が固定資産の鑑定評価をしていた。

（発明が解決しようとする問題点）

しかるに、このような固定資産評価では売買取引の実情を勘案する際に評価すべき近隣の土地の近隣の取引がかなり以前に行われていた場合には評価額が一定しないという問題があった。

本発明はかかる点に鑑み、上述した従来の固定資産評価を一定の基準に基いて矛盾のない値を算定するために必要なデータを蓄積する固定資産評価用データ記憶装置を提供することを目的とする。

（問題点を解決するための手段）

本発明は、任意に選定した路線の特性を示す特性データと、予め決めた要因に基いて、前記路線

自体の利用価値、該路線に対する受益施設からの影響及び該路線の宅地利用状態を係数で評価した評価データと、前記特性データと評価データとから予め決めた演算手順で求めた路線価データとが記憶媒体に記憶されているものである。

（実施例）

以下、本発明の実施例について図面を参照して説明する。

第１図は、本発明に係る固定資産評価用データ記憶装置に供されるコンピュータシステムのハードウェア構成を示している。

本体３０はキーボード３１から入力されるひらがな情報を漢字変換するための辞書を備えており、さらに本発明に係る固定資産評価のシステムを駆動するための基本オペレーティングシステム（ＯＳ）、及び該オペレーティングシステムに基いて動作する種々のプログラム３２～３５がＲＯＭ（図示省略）内に記憶されている。これらプログラム３２～３５の機能については後述する。キーボード３１から入力された情報及び本体３０内のＲＡＭに格納されている情報は、ディスプレイ３８に表示され、さらにプリンタ３９から記録出力されるようになされている。また、キーボード３１から入力した情報及び前記プログラム３２～３５で演算処理された各種データは、記憶媒体４０であるフロッピー４０ａ及びハードディスク４０ｂ内に記憶され、本体３０内の前記ＯＳの管理のもとに本体３０内にロールイン／ロールアウトされる。

上述したハードウェア構成は、種々の価格形成要素（ファクター）に基いて、第２図で示す手順に従って固定資産評価を行うものである。

第２図において、ステップ５０は固定資産評価をすべき地区の地番及び家屋図を作成するステップで、具体的には引伸した航空写真（第３図参照）を解析・図化プログラム３２に従って処理し、データ化して前記記憶媒体４０内に格納する。ステップ５１～５７は路線価の計算を行うステップであり、まず道路台帳の調査及び現地調査に基いて路線価を布設すべき道路の選定を行った後に、

3

ステップ５１で該道路に路線№（本例では①，②，③…で表す）を設定する。この路線名の付け方は、原則的に１街区長ごとに付けられ、宅地の状況が１街区長の間で相違すると認められる等の状況があれば適宜変更する。ステップ５２は前記ステップ５０で図化されたデータの中で路線を示すデータを２次元座標（Ｘ－Ｙ軸）上に図化抽出し（第４図参照）、路線名①～⑩のそれぞれの始点、終点、中間点１～１０の座標を例えばデジタイザーで読取り、読取結果は前記記憶媒体４０に各路線毎の特性データとして格納する。

ステップ５３～５５は本例の固定資産評価における主たるファクターである街路係数、接近係数、宅地係数を係数評価プログラム３３に従って決定評価するステップである。この評価結果は、前記記憶媒体４０に評価データとして格納される。

前記街路係数は、路線自体の利用価値、効用を係数で示すもので、当該路線の幅員及び当該路線が歩道か車道か、また舗装されているかどうか、勾配がどの程度かによって下式(1)に基いて求める

4

ものである。

街路係数＝ｔ・Ｆ(Ｗ)＋ΣＸ＝ｔ・Ｗ/Ｗｔ3＋ΣＸ　…(1)

但し　ｔ　：表１で指定される係数

Ｆ(Ｗ)：ｔ値を幅員(Ｗ)に応じて修正する係数

ΣＸ　：表２で示す街路の特性係数の総和

表１及び表２はこの街路係数の決定に供するデータの一覧を示している。

表１において、例えば幹線でよく整備されているものは、「Ｃ」ランクとなり、係数が１.２０となる。また、この道路が舗装されていれば、表２において、係数がさらに０.１０加算される。

前記接近係数は、路線の受益施設（電車駅、バス停、病院、商店街等）による受益価値又は受損施設（ゴミ処理、ガス火薬庫・変電所、公害発生源）による受損価値を示す係数であり、下式(2)に基いて算定がなされている。

接近係数＝Σｍ・Ｆ(Ｓ)＝Σｍ・(Ｓ－Ｒ/Ｓ)ⁿ　…(2)

但し、　ｍ　：表３で指定される指数

Ｆ(Ｒ)　：ｍ値を対象施設からの距離ｓに応じて逓減する係数

5

6

S　：最大受益距離

s　：宅地と対象施設の距離

表3はこの接近係数の決定に供するデータの一覧を示している。

表3において、「S」欄は当該施設の最大受益範囲を示す値で、この値は路線の中間点1～10からの距離によって示される。

第5図ないし第7図はそれぞれ受益施設の具体例を示し、Sは駅、Hは病院、Pは郵便局を示している。各路線①～⑩の中間点1～10とこれら受益施設間の距離L_{S1}～L_{S10}，L_{H1}～L_{H10}，L_{P1}～L_{P10}が当該施設の受益距離r_1，r_2，r_3より小さければ、その接近度に応じて接近係数が与えられる。

「n」欄は受益曲線を指定する欄であり、上述した「S」欄までの範囲において、どのような曲線によって受益率が逓減するかを指定するものであり、本例のように「n」欄に2を指定すると、上式(2)の計算式の中で指数nに2が代入され、第8図のグラフ81に示すような2次曲線的に受益率が減少する特性が与えられる。他に、例えば「n」欄に1を指定すると第8図のグラフ82に示すような直線が指示される。すなわち、受益施設と路線の中間点間が同一距離ℓ_1，ℓ_2であっても指数は直線のグラフ82の方が2次曲線のグラフ81よりも大きい値k_1，k_2が与えられる。他にこの「n」欄を種々設定すると、この受益曲線を任意に変更することができるので、施設の態様を十分勘案することができる。また、表3における「住宅」欄、「商業」欄、「工業」欄は、当該施設が住宅地、商業地、工業地のいずれに存在するかによって最大受益率が異なるので、この値を設定する欄である。

前記宅地係数は、宅地自身の持つ利用状態、文化性、保安性、自然環境等による価値を類似区分区域内で評価するための係数であり、表4に示す整備水準（項目U，P_0，Q_0）及び表5に示す項目に基いて下式(3)で求められる係数である。

宅地係数＝U・F（P，Q）＋ΣY

$$= U \cdot \left(1 + \sqrt{P/P_0 \times Q/Q_0}\right) + \Sigma Y \quad \cdots (3)$$

但し　U　：表4で指定される宅地の一般的利用性の基本的等級

P　：対象地域の公共要地率

P_0：表4で指定される基準公共要地率

Q　：対象地域の道路長密度

Q_0：表4で指定される基準道路長密度

ΣY：表5で示す価値効用を示す係数の総和

以上のステップ53～55で求めた係数をもとにステップ56では、表作成プログラム34に従って表6及び表7で示す路線価のデータ表を作成する。このデータ表の内容は前記記憶媒体40に格納され、作図プログラム35に従って路線価図の自動作図が可能となされている。

表6は路線価データ表の一例を示し、表7は表6におけるNo.1の路線①の街路係数、接近係数、宅地係数の演算状況の詳細を示す一覧表である。

表6及び表7で示す「係数計」の欄は、前記街路係数、接近係数、宅地係数を加算した値で、当該路線の固定資産の基準となる係数値（路線価データ）を示しており、この値が高ければ高いほど当該路線価が高いことになる。実際の路線価は、このようにして計算した係数計の値を自治省若しくは都道府県から指定される当該地区内の最大路線価格に比準させるために、当該地区内で求めた路線の中で最大の路線価係数（本例の場合は5.936で与えられている）を有する路線価格を定数（本例では10000に設定）とした場合の比準によって示している。価格もこの路線価と同じようにして最大路線価係数を有する路線に比準して決定されている。

これら表6及び表7は演算結果としてディスプレイ38に表示され、さらにプリンタ39から印字されるようになされている。

表6において、延長とは、路線の長さをいい、曲線の場合にもその中央線にわたって曲線を延長した場合の長さをいう。

ステップ57，58は計算で求めた路線価の検討、修正を行うステップで、取引事例や不動産鑑定等に応じて修正を加える。この修正は路線の区分の変更や係数値の変更等でなされ、修正結果は

前記記憶媒体４０内にすでに記憶されている内容を修正する。

上述のようにして求めた各路線毎の路線価から次にステップ５９で各筆の土地評価をして、所定の土地の固定資産評価を行う。この各筆評価は、画地の形状、路線に接する状況等によって評価を行う。この評価は、例えば宅地の一面側だけを路線に接している普通地や角地、袋地、島地等の画地形状に応じて、従来から利用されている画地計算法に基いて計算を行う。これら画地計算の結果は前記記憶媒体４０に記憶され、必要に応じて画地評価図の自動製図がなされる。また、このステップ５９の計算結果も取引事例等に応じた修正が可能である。

（以下余白）

〔表　１〕

項　目		T	係　数
幹　線	A	1	1．００
	B	2	1．１０
	C	3	1．２０
補助幹線	A	4	1．９０
	B	5	1．８０
	C	6	1．６０
一　般	A	7	1．５０
	B	8	1．４０
	C	9	1．０３
行止り	A	１０	1．００
	B	１１	０．８０
緑　道	A	１２	1．５０
	B	１３	1．２０
	C	１４	1．００

〔表　２〕

項　目	X	係　数
舗　装	1	０．１０
歩車道区分	2	０．１０
街路修景	3	０．１０
曲　線	4	－０．０５
勾　配	5	－０．０５

１１

１２

〔表　３〕

No	施設		S	n	住宅	商業	工業
1	電車駅	A	800	2	0.50	0.50	0.50
2		B	800	2	0.30	0.30	0.30
3	軌道駅	A	600	2	0.40	0.40	0.40
4		B	500	2	0.30	0.30	0.30
5	バス停	A	500	2	0.20	0.20	0.20
6		B	500	2	0.10	0.10	0.10
7	児童公園	A	500	2	0.20	0.20	0.20
8		B	500	2	0.10	0.10	0.10
9	近隣公園	A	800	2	0.30	0.30	0.30
10		B	500	2	0.20	0.20	0.20
11	保育園	A	300	2	0.30	0.30	0.30
12		B	300	2	0.20	0.20	0.20
13	幼稚園		500	2	0.20	0.20	0.20
14	小学校		500	2	0.30	0.30	0.30
15	中学校		800	2	0.30	0.30	0.30
16	公民館	A	500	2	0.30	0.30	0.30
17		B	300	2	0.20	0.20	0.20
18	図書館	A	300	2	0.30	0.30	0.20
19		B	300	2	0.20	0.20	0.10
20	病院	A	500	2	0.40	0.40	0.40
21		B	300	2	0.20	0.20	0.20
22	郵便局・銀行	A	300	2	0.30	0.40	0.40
23		B	300	2	0.20	0.30	.30
24	市役所等	A	500	2	0.30	0.30	0.30
25		B	500	2	0.20	0.20	0.20
26	商店街	A	800	2	0.50	0.50	0.50
27		B	500	2	0.30	0.30	0.30
28	ゴミ処理				-0.10	-0.10	-0.10
29	灯火薬庫・変電所				-0.10	-0.10	-0.10
30	公害発生源				-0.10	-0.10	-0.10

１３

〔表　4〕

項目	住宅			商業			工業		
	大	中	小	高	中	低	大	中	小
U	1.8	1.6	1.4	3.0	2.5	2.0	2.0	1.8	1.5
P_o	25	23	20	30	28	25	25	23	20
Q_o	250	230	200	300	280	250	250	230	200

〔表　5〕

項　目	Y	係　数
上水道	1	0．20
下水道	2	0．20
ガス	3	0．10
日照良好	4	0．10
排水不良	5	−0．10

〔表　6〕

No.	延長	幅員	街路係数	接近係数	宅地係数	係数積	路線価	価格
①	870.00	6.0	1.083	0.092	3.200	4.375	737	28,597
②	380.00	4.0	1.100	0.193	2.200	3.493	588	22,832
③	170.00	6.0	1.100	0.360	2.200	3.660	617	23,926
④	170.00	6.0	0.950	0.313	2.200	3.463	583	22,636
⑤	650.00	3.0	0.950	0.288	2.200	3.438	579	22,472
⑥	270.00	4.0	0.883	0.300	2.200	3.383	570	22,113
⑦	600.00	6.0	1.453	0.640	3.400	5.493	925	35,904
⑧	130.00	4.0	1.479	0.253	3.400	5.132	865	33,545
⑨	550.00	5.0	1.500	0.196	3.400	5.096	858	33,309
⑩	270.00	5.0	1.500	1.036	3.400	5.936	1,000	38,800
・	・	・	・	・	・	・	・	・
・	・	・	・	・	・	・	・	・
・	・	・	・	・	・	・	・	・
・	・	・	・	・	・	・	・	・

〔表　7〕

街路係数	FW=0.667	:	T:1.400	:	T・FW=0.933	
	X1=0.15	:X2 =0	:X3 =0	:X4 =0	:X5 =0	ΣX =0.15
						街路係数計= 1.083
接近係数	施設	n	m	S	s	指数
	1)公園	2	0.30	300	187	0.0426
	2)郵便局	2	0.10	500	0	0
	3)駅	2	0.60	800	640	0.0240
	4)バス停	2	0.20	300	0	0
	5)商店及厚生施設	2	0.60	500	0	0
	6)病院	2	0.10	800	450	0.0191
	7)保育所及幼稚園	2	0.10	300	0	0
	8)集会所	2	0.10	300	222	0.0068
	9)小学校	2	0.30	500	0	0
						接近係数計=0.092
宅地係数					U・F (P, Q)	=3.000
	Y1=0.15	:Y2=0	:Y3=0	:Y4=0	:Y5=0 :Y6=0	ΣY =0.15
						宅地係数計=3.200
						係数計=4.375
						路線価 R 737

（発明の効果）

以上述べたように、本発明によれば、固定資産評価用データとして土地利用状態や取引事例などを加味したデータを記憶しているので、常に一定の固定資産評価を行うことができる。また、固定資産の評価基準の変更も容易となる。

4．図面の簡単な説明

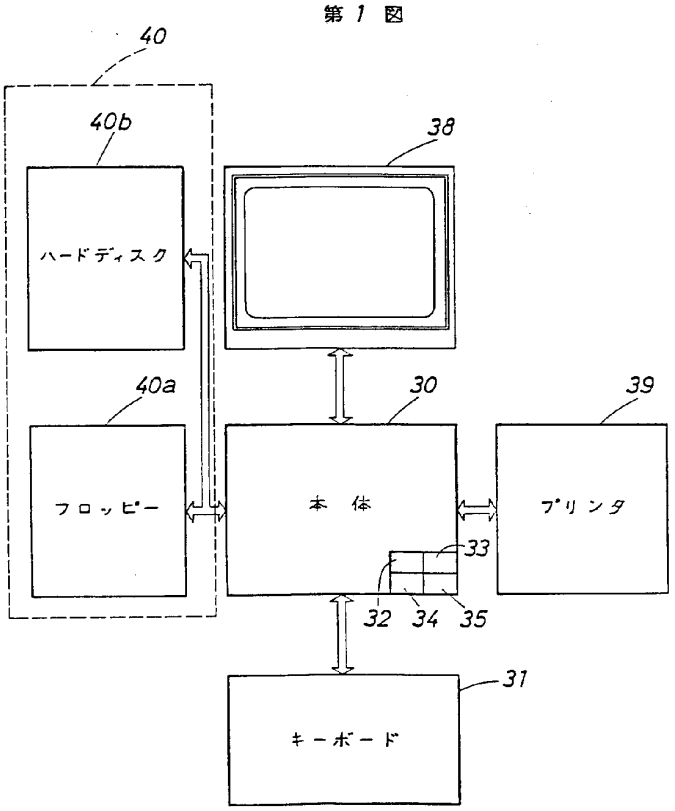
第1図は本発明に係る固定資産の評価データ記憶装置に供されるコンピュータシステムのハードウェア構成を示すブロック図、第2図は固定資産の評価手順を示す流れ図、第3図は航空写真の一例を示す図、第4図は路線名の設定及び受益施設の読取例を示す図、第5図ないし第7図はそれぞれ受益施設と路線間の距離測定を示す図、第8図は受益曲線を例示するグラフである。

30…本体　　31…キーボード

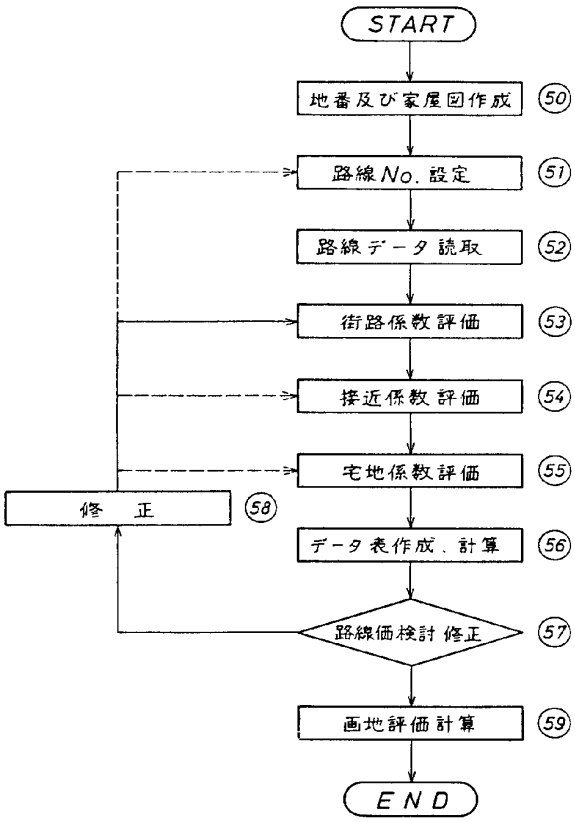
38…ディスプレイ　39…プリンタ

40…記憶媒体

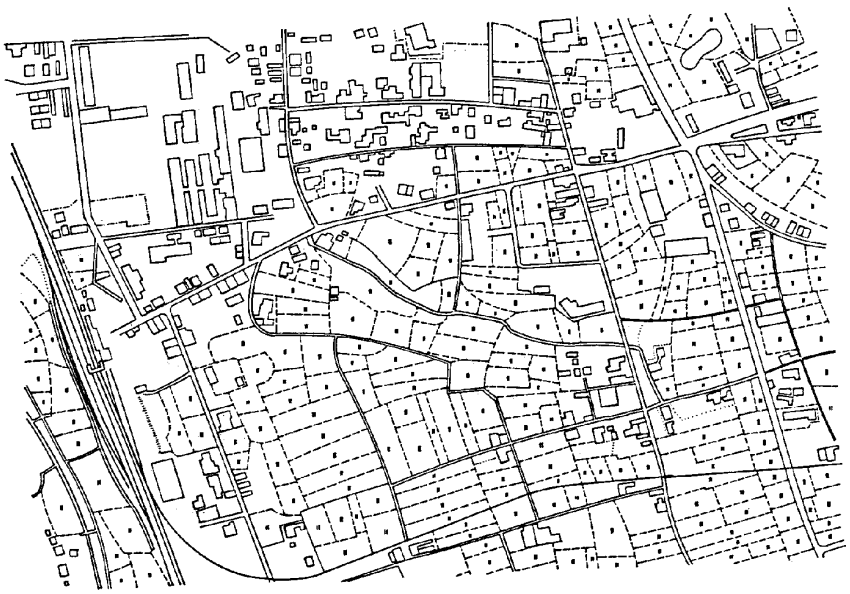
第 1 図


40
40b
ハードディスク
38
40a
フロッピー
30
本 体
39
プリンタ
33
32
34
35
31
キーボード

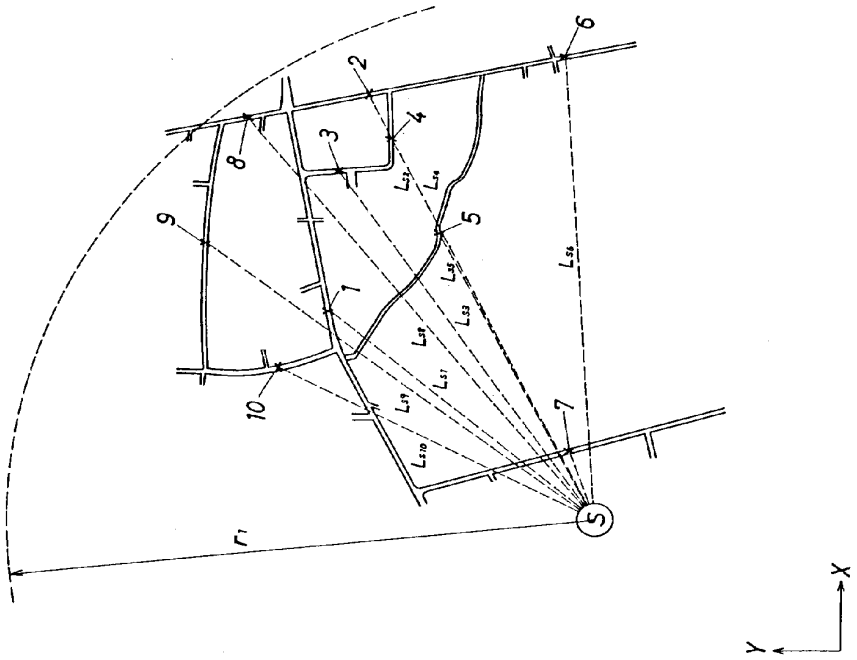
第 2 図


START
地番及び家屋図作成
50
路線No. 設定
51
路線データ読取
52
街路係数評価
53
接近係数評価
54
宅地係数評価
55
修 正
58
データ表作成、計算
56
路線価検討 修正
57
画地評価計算
59
END

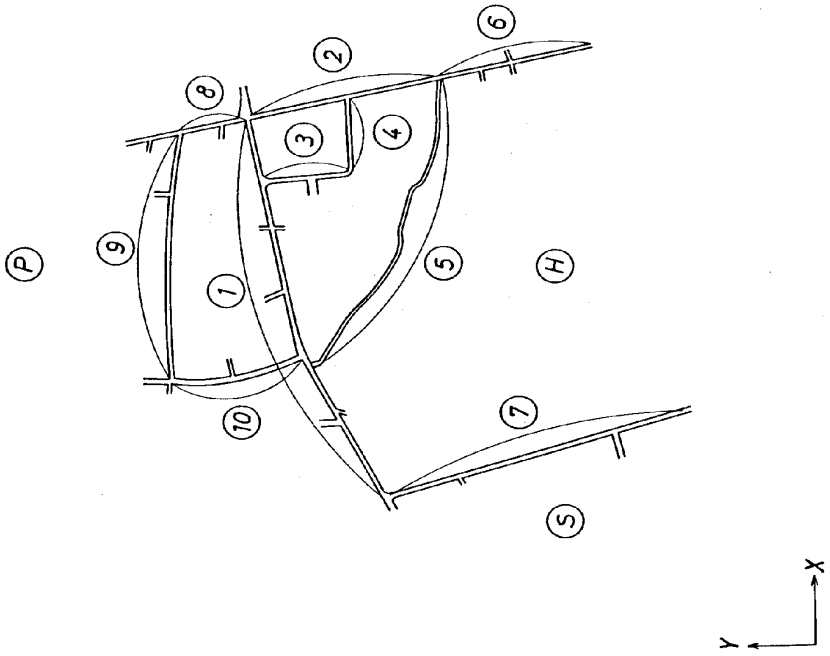
第 3 図



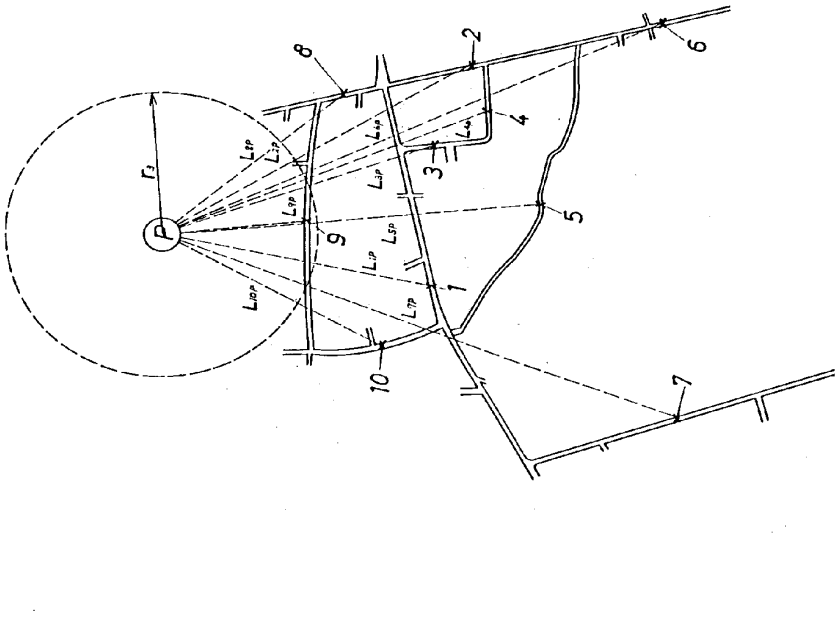
第5図



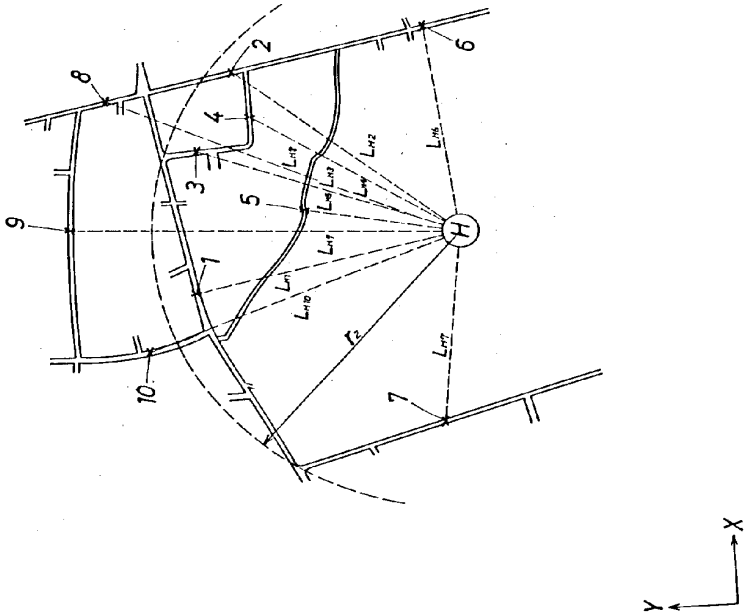
第4図



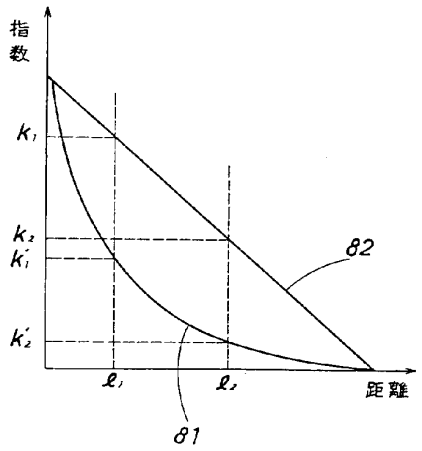
第7図



第6図



第 8 図



(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2012 年 8 月 23 日(23.08.2012)

WIPO | PCT

(10) 国際公開番号
WO 2012/111395 A1

(51) 国際特許分類:
G06Q 50/28 (2012.01) *G06Q 50/26* (2012.01)
B65G 61/00 (2006.01) *G08B 25/04* (2006.01)
G01C 21/34 (2006.01)

(21) 国際出願番号: PCT/JP2012/051508

(22) 国際出願日: 2012 年 1 月 25 日(25.01.2012)

(25) 国際出願の言語: 日本語

(26) 国際公開の言語: 日本語

(30) 優先権データ:
特願 2011-032820 2011 年 2 月 18 日(18.02.2011) JP

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(81) 指定国 (表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) 指定国 (表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[続葉有]

(54) **Title**: DISASTER ASSISTANCE SYSTEM AND DISASTER ASSISTANCE PROGRAM

(54) 発明の名称 : 災害支援システム及び災害支援プログラム

[図1]

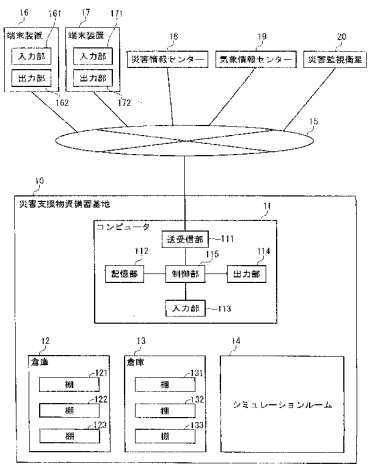


FIG. 1:
10 Disaster assistance material storage base
11 Computer
12, 13 Warehouse
14 Simulation room
16, 17 Terminal device
18 Disaster information center
19 Meteorological information center
20 Disaster monitoring satellite
111 Transceiver unit
112 Storage unit
113, 161, 171 Input unit
114, 162, 172 Output unit
115 Control unit
121, 122, 123, 131, 132, 133 Shelf

(57) **Abstract**: [Problem] To provide a disaster assistance system with which unified management is carried out at least from the management to the transport of disaster assistance materials. [Solution] A disaster assistance system (10) comprises: a storage unit (112) which stores residence-association information including populations by region, names and quantities of each type of disaster assistance material, and means of transport according to the transported quantities of the disaster assistance material; an input unit (113) wherein instructions are inputted via a user operation; a control unit (115) which determines names, quantities, and means of transport of disaster assistance material to be prepared; and an output unit (114) which outputs each type of information according to the instructions of the control unit (115). When a region name of a disaster region is inputted via the input unit (113), the control unit (115) substitutes values of each item of the residence-association information which corresponds to the name of the region into a prescribed formula, determines the names and quantities of each type of disaster assistance material to be prepared, and determines the means of transport from the names and quantities of each type of disaster assistance material to be prepared.

(57) 要約:

[続葉有]

WO 2012/111395 A1

添付公開書類:

— 国際調査報告（条約第 21 条(3)）

【課題】少なくとも災害支援物資の管理から輸送までを一元管理する災害支援システムを提供することである。【解決手段】災害支援システム１０は、地域毎の人口を含む居住関連情報と、各種災害支援物資の名称及び量と、災害支援物資の輸送量に応じた輸送手段とを記憶した記憶部１１２と、ユーザの操作により指示が入力される入力部１１３と、準備する災害支援物資の名称及び量と、輸送手段とを決定する制御部１１５と、制御部１１５の指示により各種情報を出力する出力部１１４と、を備え、入力部１１３で被災地域の地域名が入力された場合、制御部１１５は、該地域名に対応した前記居住関連情報の各項目の値を所定の式に代入して準備する各種災害支援物資の名称及び量を決定し、準備する各種災害支援物資の名称及び量から輸送手段を決定する。

明　細　書

発明の名称 ： 災害支援システム及び災害支援プログラム

技術分野

[0001] 本発明は、災害対策の助けとなる災害支援システム及び災害支援プログラムに関する。

背景技術

[0002] 近年、地震や水害などの自然災害が増加傾向にあり、災害時における人命救助、避難誘導、避難場所設営、物資の供給などの災害対策が急務事項となっている。そして、災害対策として様々な技術が提案されている。

[0003] 例えば特許文献１には、災害発生情報と避難誘導対象者の現在位置とに応じて避難誘導する避難誘導システムについて記されている。具体的には、各種災害の発生に関する災害発生情報を受信する受信装置と、前記受信装置で受信された災害発生情報により避難制御信号を生成する制御手段と、前記避難制御信号を送信する送信機と、避難誘導対象者によって所持され、生体センサにより前記避難誘導対象者の生体データ値を検出し、位置検出手段により前記避難誘導対象者の位置を検出し、前記位置を通知手段により前記制御手段に通知する生体データ検出端末装置と、室内各出入り口あるいは通路に配置され、前記避難制御信号を受信して避難誘導の表示あるいは音声出力を行う避難誘導部と、ユーザと通信を行う通信手段と、を備え、前記制御手段は、前記位置検出手段で検出された前記避難誘導対象者の現在位置に応じて、前記避難誘導部で避難誘導を行うよう前記避難制御信号を生成し、前記ユーザに対して承認を求める通知とともに、予め登録された知人の連絡先一覧とその現在地情報の一覧とを通知し、該ユーザからの承認が得られた場合、もしくは該ユーザからの応答がなかった場合に、避難制御信号を送信することを特徴とする避難誘導システムが開示されている。

[0004] また特許文献２には、緊急地震速報や各種災害情報などのデータを利用して動物あるいは避難誘導対象者を拘束しているロックを解除するとともに避

難誘導する避難誘導システムについて記されている。具体的には、災害情報センターからの災害発生情報を受信する受信装置と、動物の建物内における位置を検出する位置検出手段と、ユーザと通信を行う通信手段と、前記通信手段を介してユーザからの承認を得るとともに、前記受信装置で受信された災害発生情報とユーザからの前記承認とにより避難制御信号を生成する制御手段と、前記避難制御信号を生成する送信機と、動物の首輪もしくは鎖、または、檻もしくは柵のゲートをロックしており、前記避難制御信号を受信してロックが解除されるロック部と、室内各出入り口あるいは通路に配置され、前記避難制御信号を受信して避難誘導の表示あるいは音声出力を行う避難誘導部と、を備え、前記制御手段は、前記位置検出手段で検出された動物の現在位置に応じて、現在位置に近い出入り口から建物外へ至る通路と出入り口とについて避難誘導部から避難誘導の表示あるいは音声出力を行うように制御することを特徴とする避難誘導システムが開示されている。

先行技術文献

特許文献

[0005] 特許文献1：特許第４０９３３１９号公報

特許文献2：特許第３８９３４２８号公報

発明の概要

発明が解決しようとする課題

[0006] 特許文献１及び２で触れられていない災害対策における現状の一つに、各地域、州、又は県で備蓄物資の量に大きな格差があるという問題がある。この問題を解決するためには、地域、州、県の枠を超えて備蓄物資の管理・輸送・設営を一元化することが有効であると考えられる。ここで、備蓄物資の管理は民間企業で行うとしても、災害時の物資の輸送・設営は軍隊などの政府機関の協力が必要であり、政府及び民間が協同することが不可欠となる。その際、管理と輸送・設営とが別々の指示の元に行われると、無駄なく迅速に対応することが難しい。

[0007] そこで本発明者は上記の問題を解決するため、管理・輸送・設営の一元化をどのような形で行うのが有効であるかを考え、少なくとも管理から輸送までの一元管理を支援することができるシステムを構築することが有効であると考えた。

[0008] 本発明は、少なくとも災害支援物資の管理から輸送までを一元管理する災害支援システムを提供することを目的とする。また、その災害支援システムを稼働させる災害支援プログラムを提供することも目的とする。

課題を解決するための手段

[0009] 上記目的を達成するために本発明の災害支援システムは、地域毎の人口を含む居住関連情報と、各種災害支援物資の名称及び量と、災害支援物資の輸送量に応じた輸送手段とを記憶した記憶部と、ユーザの操作により指示が入力される入力部と、準備する災害支援物資の名称及び量と、輸送手段とを決定する制御部と、前記制御部の指示により各種情報を出力する出力部と、を備え、前記入力部で被災地域の地域名が入力された場合、前記制御部は、該地域名に対応した前記居住関連情報の各項目の値を所定の式に代入して準備する各種災害支援物資の名称及び量を決定し、準備する各種災害支援物資の名称及び量から輸送手段を決定することを特徴とする。

[0010] この構成によると、電気通信回線を介した端末装置の入力部又はコンピュータの入力部から地域名が入力されると、制御部は、人の手を介すことなく、該地域に必要な災害支援物資の名称及び量と輸送手段とを正確かつ迅速に決定することができる。

[0011] 上記の災害支援システムにおいて、前記記憶部は、災害支援物資の名称に応じた単位数量当たりの大きさ及び重さと、各種梱包形態に収容可能な大きさ及び重さと、各種梱包形態に応じた輸送手段の候補及び積載可能梱包数と、各輸送手段の優先順位と、各輸送手段の稼働可能台数とを記憶し、前記制御部は、準備する各種災害支援物資の名称及び量と、前記災害支援物資の名称に応じた単位数量当たりの大きさ及び重さと、前記各種梱包形態に収容可能な大きさ及び重さとから梱包形態と梱包数とを算出し、算出した梱包形態

と、各種梱包形態に応じた輸送手段の候補とから輸送手段の候補を算出し、算出した梱包数と、算出した輸送手段の候補と、前記各輸送手段の優先順位と、前記各輸送手段の稼働可能台数とから優先順位の高い順に輸送手段を決定するようにしてもよい。

[0012] この構成によると、決定された形態（例えば段ボール、コンテナ等）によって梱包することを可能にする。

[0013] また上記の災害支援システムにおいて、被災地域及び災害内容を含む被災情報を受信する被災情報受信部を備え、前記被災情報を受信した場合、前記制御部は、該地域名に対応した前記居住関連情報の各項目の値を所定の式に代入して準備する各種災害支援物資の名称及び量を決定し、準備する各種災害支援物資の名称及び量から輸送手段を決定するようにしてもよい。

[0014] また上記の災害支援システムにおいて、前記記憶部は、役割毎の出勤人数を算出するための人員シフト表と、災害支援物資の名称及び量に応じた梱包時間と、梱包形態及び梱包数に応じた積載時間と、出動の承認に要する承認時間とを記憶し、前記制御部は、前記人員シフト表から当日の準備係の出勤人数を算出し、前記梱包時間を前記出勤人数で除して最短梱包時間を算出し、前記積載時間を前記出勤人数で除して最短積載時間を算出し、前記最短梱包時間と前記最短積載時間と前記承認時間との和である最短準備時間を求めるようにしてもよい。

[0015] この構成によると、制御部は、人員シフト表を参照し、被災地へ輸送する災害支援物資の最短準備時間を求めることができる。

[0016] また上記の災害支援システムにおいて、前記記憶部は、地図情報と、前記各輸送手段の平均速度と、前記梱包形態及び梱包数に応じた引き渡し時間とを記憶し、前記制御部は、前記地図情報を用いて被災地域までの輸送経路を算出し、該輸送経路の距離を使用する輸送手段の平均速度で除して最短輸送時間を算出し、前記引き渡し時間を前記輸送手段毎の輸送係の出勤人数で除して最短引き渡し時間を算出し、前記最短輸送時間と前記最短引き渡し時間との和である最短供給時間を求めるようにしてもよい。

[0017] この構成によると、制御部は、最短輸送時間と最短供給時間とを求めることができる。それにより、災害発生日時と最短輸送時間とから最短準備完了日時を、災害発生日時と最短供給時間とから最短供給開始日時を決定できる。

[0018] これまで一刻を争う被災地では、情報の断絶と混乱によって、人（救急隊員、医師等）・物（病院のベット、食糧）の配分決定は、現場の指揮官による決断が基本とされてきた。しかし、災害支援物資（例えば救援隊）の到着予想日時については、災害規模や種類によって曖昧であり、指揮官の決断上大きな隘路となっていた。そこで、この災害支援システムによって、制御部が、必要な災害支援物資とその到着日時を自動的に計算することにより、現場の指揮官は、あとどれだけの期間、現場の人・物で対応せざるを得ないということが情報として取得できるため、より的確な判断を可能とする。

[0019] また上記の災害支援システムにおいて、災害発生後の被災地域の衛星画像を受信する衛星画像受信部を備え、前記記憶部は、災害発生前の各地域の衛星画像を記憶し、複数の被災地域について災害発生後の衛星画像を受信した場合、前記制御部は、それぞれ被災前後の衛星画像を照合して被災した建物数を算出し、被災した建物数が多い又は少ない被災地域順に優先順位を付けるようにしてもよい。

[0020] この構成によると、災害発生後、制御部は、電気通信回線を介して衛星から受け取った被災地の衛星画像と、災害発生前の被災地の衛星画像を照合することにより、輸送する救援物資の被災地の優先順位を決定する。その結果、人が判断するとされてきた被災地の輸送優先順位を、制御部が機械的に判断することにより、誤りなく災害支援物資を被災地に供給することが可能になる。

[0021] また上記の災害支援システムにおいて、前記記憶部は、地域毎の避難場所及びその優先順位を記憶し、前記制御部は、該優先順位にしたがって輸送する避難場所の順位を決定するようにしてもよい。

[0022] この構成によると、制御部が避難場所の優先順位を機械的に判断すること

により、より多くの被災者へ、より早く、災害支援物資を供給することが可能になる。

[0023] また上記の災害支援システムにおいて、気象情報を受信する気象情報受信部を備え、前記記憶部は、地図情報と、輸送経路として危険な場所を示す危険場所情報とを記憶し、気象情報及び被災情報を受信した場合、前記制御部は、前記地図情報を用いて被災地域までの輸送経路を算出する際、前記気象情報及び危険場所情報を加味するようにしてもよい。

[0024] この構成によると、制御部は、電気通信回線を介して収集された、災害情報センターからの被災情報、及び気象情報センターからの気象情報に基づき、記憶部に記憶された各種危険場所情報を特定後、危険場所を回避し、被災地までの輸送航路を決定する。その結果、危険場所を避けるとともに、気象状況に応じて輸送することができるため、ロスなく被災地まで災害支援物資を供給することが可能になり、なおかつ、輸送途中の事故発生リスクを極めて少なくすることを可能にする。

[0025] また上記の災害支援システムにおいて、前記記憶部は、地域毎の避難場所を記憶し、前記制御部は、被災地域の避難場所までの輸送経路を算出するようにしてもよい。

[0026] また上記の災害支援システムにおいて、前記記憶部は、前記避難場所の３次元画像及び設営配置画像を記憶し、前記制御部は、輸送先の避難場所の３次元画像及び設営配置画像を前記出力部に出力させるようにしてもよい。

[0027] また上記の災害支援システムにおいて、前記入力部が電気通信回線を介して前記制御部の遠隔地に設置され、前記入力部で被災地域の地域名が入力されることは、前記入力部の所定ボタンが押下されることであるとしてもよい。

[0028] この構成によると、制御部は、電気通信回線を介して、端末装置の入力部から送受信部に受信した特殊信号に基づき、記憶部に記憶された災害支援物資の輸送指示を出力部に表示することができる。その結果、制御部は、災害支援物資の輸送指示を、中央の災害対策本部を介すことなく、被災地の首長

（知事及び市区町村長）から、直接かつ迅速に災害支援物資備蓄基地に送ることを可能にする。

[0029] また上記の災害支援システムにおいて、前記電気通信回線が専用回線であることとしてもよい。

[0030] この構成によると、電気通信回線に専用回線を使うことにより、クラッカーによる悪意を持った行為を未然に防止することを可能にする。

[0031] また本発明の災害支援プログラムは、上記の何れかに記載の災害支援システムを稼働させるものである。

発明の効果

[0032] 本発明によると、準備する各種災害支援物資と輸送手段とを決定することで、災害支援物資の管理から輸送までを一元管理することができる。加えて、最短準備時間及び最短供給時間を決定することで、災害支援物資の管理から輸送、引き渡しまでを一元管理することができる。加えて、避難場所までの輸送経路や設営配置を示すことで、災害支援物資の管理から輸送、設営までを一元管理することができる。

図面の簡単な説明

[0033] [図1]本発明の災害支援システムの構成を示すブロック図である。

[図2]第１実施形態のコンピュータの動作を示すフローチャートである。

[図3]本発明の災害支援物資情報表の一例である。

[図4]本発明の梱包形態・輸送手段対応表の一例である。

[図5]本発明の輸送手段優先順位表の一例である。

[図6]本発明の倉庫・棚対応表の一例である。

[図7]本発明の出力部に表示される画面の一例である。

[図8]第２実施形態のコンピュータの動作を示すフローチャートである。

[図9]本発明の人員シフト表の一例である。

[図10]本発明の出力部に表示される画面の一例である。

[図11]第３実施形態のコンピュータの動作を示すフローチャートである。

[図12]本発明の避難場所情報の一例である。

[図13]本発明の出力部に表示される画面の一例である。

[図14]第４実施形態のコンピュータの動作を示すフローチャートである。

[図15]本発明の出力部に表示される画面の一例である。

[図16]本発明の出力部に表示される画面の一例である。

発明を実施するための形態

[0034] 図１は、本発明の災害支援システムの構成を含むブロック図である。災害支援物資備蓄基地１０には、災害支援システムであるコンピュータ１１と、各種災害支援物資を保管する倉庫１２、１３と、物資の梱包等のシミュレーションを行うためのシミュレーションルーム１４とが設けられている。そして、災害支援システム１１はインターネット等の電気通信回線１５を介して、各自治体等に設けられた端末装置１６、１７と、政府の災害を監視する部門、例えば、気象庁の災害情報センター１８と、政府の気象を監視する部門、例えば、気象庁の気象情報センター１９と、政府の災害監視衛生２０を管理運用する部門、例えば、宇宙航空研究開発機構（ＪＡＸＡ）等の災害監視衛星２０とに接続されている。なお、端末装置１６、１７は災害支援システムに含めて説明することもある。また、セキュリティーを向上させるため、コンピュータ１１と端末装置１６、１７とは専用回線で接続してもよい。

[0035] 災害支援物資備蓄基地１０は、物資の輸送手段と人員を迅速に確保する観点から、例えば空軍基地などのように輸送能力を持った政府機関の基地に隣接していることが望ましい。

[0036] 災害支援物資としては、水、食料（米、クラッカー、乾パン、おかゆ等）、毛布、医薬品、燃料、浄水器、投光器、テント、発電機、太陽光パネル、仮設住宅、簡易トイレなどがある。災害支援物資はその名称及び量に応じて、倉庫１２、１３の番号が付された各棚１２１～１２３、１３１～１３３に、十分な量が保管されていることを前提とし、在庫管理は他のコンピュータ、又はコンピュータ１１の他のプログラムで行っているものとする。

[0037] コンピュータ１１は、電気通信回線１５を介してデータの送受信を行う送受信部１１１と、各種情報を記憶したハードディスクドライブ等からなる記

憶部１１２と、ユーザの操作により指示が入力されるキーボード等からなる入力部１１３と、各種情報を出力する液晶ディスプレイ等からなる出力部１１４と、各部を制御する制御部１１５とを備えている。なお、送受信部１１１、記憶部１１２、入力部１１３、出力部１１４は制御部１１５と別体であってもよい。

[0038] 端末装置１６、１７は、ユーザの操作により指示が入力されるキーボード等からなる入力部１６１、１７１と、各種情報を出力する液晶ディスプレイ等からなる出力部１６２、１７２とを備えており、パソコン等のコンピュータであってもよい。なお、端末装置１６、１７が各自治体に設けられて最低限災害発生をコンピュータ１１に知らせることができればよいことを考えると、少なくとも電気通信回線１５に接続可能な非常ボタン等の所定ボタンであればよい。

[0039] 次に、災害支援システムであるコンピュータ１１の動作について実施形態毎に説明する。

[0040]（第１実施形態）

第１実施形態は、被災した地域をコンピュータ１１に手入力するものである。図２は、第１実施形態のコンピュータ１１の動作を示すフローチャートである。

[0041] コンピュータ１１が待機状態のとき、ステップＳ１０において制御部１１５は、入力部１１３（入力部１６１、１７１でもよい）で被災地域の地域名が入力されたか否かを判別する。国などからの指示によって地域名が入力されると、ステップＳ１１へ進んで制御部１１５は入力された地域名を抽出する。

[0042] そして、ステップＳ１２へ進んで制御部１１５は記憶部１１２から該地域名に対応した居住関連情報を読み出す。居住関連情報は、国の政府が行う全国的な調査、例えば国勢調査の結果等を用いて予め記憶部１１２に記憶されており、少なくとも地域毎の人口を含み、他に年齢別人口、男女別人口、世帯数、高齢者（例えば６０歳以上又は６５歳以上）の居る世帯数、住居の状

態などの項目を含めることができる。

[0043] ステップＳ１２からはステップＳ１３へ進んで、制御部１１５は被災地域への輸送のために準備する災害支援物資を算出する。具体的には、居住関連情報の各項目の値を災害支援物資毎に予め決められた所定の式に代入して準備する各種災害支援物資の名称とその量とを決定する。

[0044] 例えば、米又は乾パンの必要量は（その地域の人口）×０．４で算出する。また、おかゆの必要量は（その地域の高齢者人口）×０．４で算出する。また、毛布は（その地域の人口）－（その地域の６歳未満人口）で算出する。上記の０．４という係数は、平成１３年４月１日現在の「消防防災震災対策現況調査」（消防庁調べ）を参照し、東京都の人口１万人当たりの乾パン備蓄量（４１４０食）より割り出した値である。なお、他の係数を用いてもよい。

[0045] 次にステップＳ１４へ進んで、制御部１１５は災害支援物資を輸送する輸送手段を決定する。なお、輸送手段を決定するか否かをユーザが選択できるようにしてもよい。輸送手段は準備する（輸送する）各種災害支援物資の名称及び量から決定する。輸送手段とは、例えば、トラック、保冷車、冷凍車、冷蔵車、輸送艦（船）、輸送ヘリなどである。このとき、予め記憶部１１２に記憶されている災害支援物資情報表、梱包形態・輸送手段対応表、輸送手段優先順位表も用いる。

[0046] 図３に災害支援物資情報表の一例を、図４に梱包形態・輸送手段対応表の一例を、図５に輸送手段優先順位表の一例を示す。図３の支援物資情報表には、各災害支援物資の名称に対応して、保管の形態、入数（単位数量）、長さ・幅・高さ（大きさ）、内容量（重さ）が登録されている。図４の梱包形態・輸送手段対応表には、各梱包形態に対応して、梱包可能な長さ、幅、高さ及び内容量と、その梱包形態を輸送可能な輸送手段及び個数（積載可能梱包数）とが登録されている。図５の輸送手段優先順位表には、各輸送手段に対応して、積載量、保有台数、稼働可能台数、優先順位、割り当てフラグが登録されている。

[0047] 制御部１１５は、算出した準備する災害支援物資の名称及び量と、図３の災害支援物資情報表とを用い、算出した準備する災害支援物資の名称を支援物資情報表で検索し、該当する災害支援物資の各情報を読み出す。そして、準備する災害支援物資の量を検索した災害支援物資の名称に対応する入数で除して単位数量の災害支援物資がいくつ必要かを算出し、大きさ（長さ・幅・高さ）及び重さ（内容量）の合計を求める。そして、その合計と図４の梱包形態・輸送手段対応表とを用い、梱包形態と梱包数とを算出する。例えば、梱包形態は、小さな形態を優先して割り当て、小さな梱包形態で梱包数を多くするように算出する。図４では梱包形態の小さい順にボックス、カーゴ、コンテナである。

[0048] さらに制御部１１５は、図４から、算出した梱包形態に対応した輸送手段の候補を読み出す。そして、算出した梱包数と、算出した輸送手段の候補と、図５の各輸送手段の優先順位と、図５の各輸送手段の稼働可能台数とから優先順位の高い順に輸送手段を決定する。割り当てた輸送手段の台数を稼働可能台数から減算していき、梱包数が多く優先順位上位の輸送手段の稼働可能台数を超える場合は、その輸送手段の割り当てフラグ（図５参照）をオンにし、次順位の輸送手段の候補も使用する輸送手段に加える。

[0049] なお、準備する災害支援物資がどの倉庫及び棚に保管されているかは、予め記憶部１１２に倉庫・棚対応表を記憶しておけば以下のように算出できる。図６に倉庫・棚対応表の一例を示す。図６の倉庫・棚対応表には、各倉庫番号及び棚番号に対応して、保管されている災害支援物資の名称、数量、入数（単位数量）、割り当てフラグが登録されている。

[0050] 制御部１１５は、算出した準備する災害支援物資の名称及び量と、図６の倉庫・棚対応表とを用い、算出した準備する災害支援物資の名称を倉庫・棚対応表で検索し、該当する災害支援物資の数量×入数を算出して、準備する災害支援物資の量から差し引き、割り当て済みを示す割り当てフラグをオンにする（図６では米５００袋の割り当てが完了している）。準備する災害支援物資の量が全て割り当てられるまでこの処理を繰り返す。そして、図６の

倉庫・棚対応表で割り当てフラグがオンになっている倉庫番号及び棚番号を読み出すことで、準備する災害支援物資がどの倉庫及び棚に保管されているかを示すことができる。

[0051] ステップＳ１４からはステップＳ１５へ進んで、制御部１１５は出力部１１４に算出、決定した各種結果を表示する。図７に、出力部１１４に表示される画面の一例を示す。この例では、入力された被災地域が「大阪府大阪市中央区」である。記憶部１１２には、この地域の人口は６７０００人、６歳未満人口は２０００人、高齢者人口は９０００人と記憶されている。したがって、災害支援物資としては、毛布が６７０００－２０００＝６５０００枚、乾パンが６７０００×０．４＝２６８００食、おかゆが９０００×０．４＝３６００食となっている。そして、輸送手段は輸送ヘリ、梱包形態はコンテナとなっている。

[0052] このように、第１実施形態の災害支援システムによれば、災害が発生した地域名をユーザ（入力部１１３を操作する人）が入力することで、供給すべき災害支援物資とその量が自動的に決定され、輸送形態も自動的に決定される。したがって、災害支援システムで災害支援物資の管理から輸送までを一元管理することができる。

[0053] また、この災害支援システムは訓練にも用いることができる。すなわち、災害が発生したと仮定した地域名をユーザ（入力部１１３を操作する人）が入力することで、供給すべき災害支援物資とその量、輸送形態がわかるので、シミュレーションルーム１４で梱包作業や設営作業等の訓練を行うことができる。

[0054]（第２実施形態）

第２実施形態は、コンピュータ１１が災害情報センター１８から被災した地域等を自動的に受信するものである。図８は、第２実施形態のコンピュータ１１の動作を示すフローチャートである。

[0055] コンピュータ１１が待機状態のとき、ステップＳ２０において制御部１１５は、送受信部１１１が災害情報センター１８から被災情報を受信したか否

かを判別する。被災情報は、少なくとも被災地域名及び災害内容（例えば地震の場合、震度と津波情報）を含み、さらに道路状況、国が発表する各種防災情報、ライフラインに関する情報、公共交通機関の運行状況などを含んでいてもよい。被災情報を受信すると、ステップＳ２１へ進んで制御部１１５は被災情報から少なくとも被災地域及び災害内容を抽出する。

[0056] そして、ステップＳ２２へ進んで制御部１１５は記憶部１１２から災害種別・規模情報を読み出し、受信した災害内容と比較して災害支援物資の供給の要否を判別する。災害種別・規模情報は、予め記憶部１１２に記憶されており、少なくとも各種災害種別に対して災害支援物資の供給が必要となる災害の規模（大きさ）を含んでいる。よって、制御部１１５は発生した災害の規模がこの記憶されている規模以上である場合、災害支援物資の供給が必要と判断する。災害種別・規模情報としては、例えば、地震・震度５、津波・大津波、台風・最大風速５０ｍ、洪水・床上浸水などとすることができる。

[0057] ステップＳ２２で災害支援物資の供給が必要であると判別した場合、ステップＳ２３へ進んで制御部１１５は記憶部１１２から被災情報の被災地域名に対応した居住関連情報（第１実施形態と同様）を読み出す。

[0058] ステップＳ２３からはステップＳ２４へ進んで、制御部１１５は被災地域への輸送のために準備する災害支援物資を算出する。次に、ステップＳ２５へ進んで、制御部１１５は災害支援物資を輸送する輸送手段を決定する。次に、ステップＳ２６へ進んで、制御部１１５は出力部１１４に算出、決定した各種結果を表示する。ステップＳ２３～Ｓ２６は第１実施形態のステップＳ１２～Ｓ１５と同様の処理であるので詳細な説明は省略する。

[0059] ステップＳ２６からはステップＳ２７へ進んで、制御部１１５は最短準備時間を算出する。最短準備時間は最短梱包時間と最短積載時間と承認時間との和である。最短梱包時間は、役割毎の出勤人数を算出するための人員シフト表から当日の準備係の出勤人数を算出し、災害支援物資の名称及び量に応じた梱包時間を当日の準備係の出勤人数で除した値である。最短積載時間は、梱包形態及び梱包数に応じた積載時間を当日の準備係の出勤人数で除した

値である。承認時間は、指揮官が出動の承認を行うのに要する時間であり、予め所定値（例えば０．５時間）が記憶部１１２に記憶されている。

[0060] 人員シフト表は、予め記憶部１１２に記憶されており、登録されている人員の近日中の出勤予定が登録されたものである。図９に、人員シフト表の一例を示す。人員毎に付された人員コードに対応するように、人員氏名、役割、近日中の出勤・休暇の予定が登録されている。制御部１１５はこの表から当日の日付の役割毎の出勤人数を算出できる。なお、人員コードは必須の項目ではない。なお、人員シフト表には他に出勤時間、連絡先等を含めてもよい。

[0061] 上記の災害支援物資の名称及び量に応じた梱包時間は、予め記憶部１１２に記憶されており、災害支援物資毎に決められた梱包に要する想定時間であり、所定数（例えば１）のある災害支援物資を一人で梱包する場合に要する時間である。したがって、準備する災害支援物資それぞれの梱包時間を合計し、この値を梱包に関われる準備係の出勤人数で除した値が最短梱包時間となる。

[0062] 上記の梱包形態及び梱包数に応じた積載時間は、予め記憶部１１２に記憶されており、その形態で梱包された１つの梱包物を一人で輸送手段に積載するのに要する想定時間であり、梱包形態毎に想定される積載時間が記憶されている。したがって、梱包形態及び梱包数が決定されると、それぞれの梱包形態の積載時間を読み出してそれぞれの梱包数との積を算出し、それら積算した値を合計し、その合計値を積載に関われる準備係の出勤人数で除すれば最短積載時間となる。

[0063] ステップＳ２７からはステップＳ２８へ進んで、制御部１１５は最短供給時間を算出する。最短供給時間は最短輸送時間と最短引き渡し時間との和である。最短輸送時間は、輸送経路の距離を使用する輸送手段の平均速度で除した値である。最短引き渡し時間は、梱包形態及び梱包数に応じた引き渡し時間を輸送手段毎の輸送係の出勤人数で除した値である。

[0064] 輸送経路は、予め記憶部１１２に記憶されている全国の地図情報に災害支

援物資備蓄基地１０の位置と物資の輸送先である被災地域の位置とを重ね、陸海空それぞれの輸送手段に応じて最適な経路を算出する。これには、一般的なナビゲーション装置の経路案内の機能を制御部１１５に搭載しておけばよい。輸送経路が決定されると、地図上で輸送経路の距離が算出できる。

[0065] 輸送手段の平均速度は、輸送手段毎の想定される平均速度が予め記憶部１１２に記憶されている。したがって、輸送手段と輸送経路とが決定されると、使用する輸送手段の平均速度を読み出し、輸送経路の距離を算出し、輸送経路の距離を平均速度で除すれば最短輸送時間を算出できる。

[0066] 上記の梱包形態及び梱包数に応じた引き渡し時間は、予め記憶部１１２に記憶されており、その形態で梱包された１つの梱包物を一人で輸送手段から積み下ろすのに要する想定時間であり、梱包形態毎に想定される引き渡し時間が記憶されている。したがって、梱包形態及び梱包数が決定されると、それぞれの梱包形態の引き渡し時間を読み出してそれぞれの梱包数との積を算出し、それら積算した値を合計し、その合計値を積み下ろしに関われる輸送手段毎の輸送係の出勤人数で除すれば最短供給時間となる。

[0067] ステップＳ２８からはステップＳ２９へ進んで、制御部１１５は出力部１１４に算出、決定した各種結果を表示する。図１０に、出力部１１４に表示される画面の一例を示す。出力部１１４には図７の画面に続いて図１０の画面が表示される。図１０の画面において、時間情報の欄に災害発生日時と最短準備完了日時（最短準備時間）と最短供給開始日時（最短供給時間）とが記されている。災害発生日時は被災情報から抽出すればよい。最短準備完了日時は、ステップＳ２０で被災情報を受信した日時にステップＳ２７で算出した時間を加算して求めたものである。同様に最短供給開始日時も、ステップＳ２０で被災情報を受信した日時にステップＳ２７及びＳ２８で算出した時間を加算して求めたものである。

[0068] このように、第２実施形態の災害支援システムによれば、被災情報を自動的に受信することで、供給すべき災害支援物資とその量が自動的に決定され、輸送形態も自動的に決定され、最短準備時間及び最短供給時間も自動的に

決定される。したがって、災害支援システムで災害支援物資の管理から輸送、引き渡しまでを一元管理することができる。

[0069] なお、ステップＳ２６を省略し、ステップＳ２９で表示する画面においてステップＳ２６で表示する内容も合わせて表示するようにしてもよい。また、ステップＳ２７～Ｓ２９又はステップＳ２８を省略した形態も考えられる。

[0070] （第３実施形態）

第３実施形態は、災害発生前後の被災地域の衛星画像を利用するものである。図１１は、第３実施形態のコンピュータ１１の動作を示すフローチャートである。

[0071] コンピュータ１１が待機状態のとき、ステップＳ３０において制御部１１５は、送受信部１１１が災害情報センター１８から被災情報（第２実施形態と同様）を受信したか否かを判別する。被災情報を受信すると、ステップＳ３１へ進んで制御部１１５は被災情報から少なくとも被災地域及び災害内容を抽出する。大規模な災害の場合、複数の被災地域の被災情報を受信することになる。

[0072] そして、ステップＳ３２へ進んで制御部１１５は、送受信部１１１が災害監視衛星２０から災害発生後の被災地域の衛星画像を受信したか否かを判別する。被災地域が複数である場合はそれぞれの被災地域の衛星画像を受信したか否かを判別する。この衛星画像はコンピュータ１１からどの地域の画像が必要かを要求してもよいし、コンピュータ１１が要求しなくても災害監視衛星２０から自動的に送られてくるようにしてもよい。

[0073] 災害発生後の全ての被災地域の衛星画像を受信すると、ステップＳ３３へ進んで制御部１１５はそれぞれの被災地域に優先順位を付ける。具体的には、それぞれ被災前後の衛星画像を照合して被災した建物数を算出し、被災した建物数が多い被災地域順に優先順位（１位、２位、３位・・・）を付ける。被災前の衛星画像は予め記憶部１１２に全国の衛星画像を記憶しておく。建物数は画像解析によって判定すればよく、どのような解析法を用いるかは

特に限定はない。なお、被災した建物数が少ない被災地域順に優先順位（１位、２位、３位・・・）を付けるようにしてもよい。

[0074] そして、ステップＳ３４へ進んで制御部１１５は、優先順位が１位の被災地域について、記憶部１１２から災害種別・規模情報（第２実施形態と同様）を読み出し、受信した災害内容と比較して災害支援物資の供給の要否を判別する。

[0075] ステップＳ３４で災害支援物資の供給が必要であると判別した場合、ステップＳ３５へ進んで制御部１１５は、記憶部１１２から優先順位１位の被災地域名に対応した居住関連情報（第１実施形態と同様）を読み出す。

[0076] ステップＳ３５からはステップＳ３６へ進んで、制御部１１５は被災地域への輸送のために準備する災害支援物資を算出する。次に、ステップＳ３７へ進んで、制御部１１５は災害支援物資を輸送する輸送手段を決定する。次に、ステップＳ３８へ進んで、制御部１１５は出力部１１４に算出、決定した各種結果を表示する。ステップＳ３５～Ｓ３８は第１実施形態のステップＳ１２～Ｓ１５と同様の処理であるので詳細な説明は省略する。

[0077] ステップＳ３８からはステップＳ３９へ進んで、制御部１１５は優先順位が１位の被災地域において、どの避難場所に災害支援物資を輸送するかを決めるために避難場所の順位を決定する。具体的には、地域毎の避難場所及びその優先順位を記した避難場所情報を用い、該当する被災地域の避難場所の中から記された優先順位にしたがって輸送する避難場所の順位を決定する。なお、災害発生後の衛星画像で優先順位が１位の避難場所が崩壊していれば、２位の避難場所を１位に繰り上げる。

[0078] 図１２は、避難場所情報の一例である。避難場所の優先順位の決定の方法は、まず種別を優先する。優先順位が高い順に避難所、一次避難所である。そして、種別が同じ場合は次に収容人数の多い順に順位を付ける。図１２では鳥取市用瀬町用瀬の避難場所を示しており、避難場所の優先順位は１位が用瀬地区公民館、２位が用瀬小学校となっている。

[0079] ステップＳ３９からはステップＳ４０へ進んで、制御部１１５は出力部１

１４に算出、決定した各種結果を表示する。図１３に、出力部１１４に表示される画面の一例を示す。出力部１１４には図７の画面に続いて図１３の画面が表示される。図１３の画面において、優先順位の被災地域名の欄に、被災地域の優先順位（１位、２位、３位）が記されている。また、優先順位の避難場所の欄に、優先順位が１位の被災地域である大阪市中央区における避難場所の優先順位（１位、２位、３位）が記されている。

[0080] このように、第３実施形態の災害支援システムによれば、供給すべき災害支援物資とその量が自動的に決定され、輸送形態も自動的に決定され、さらに災害発生前後の被災地域の衛星画像を利用することで、災害支援物資の輸送先の優先順位を決定することができる。したがって、大規模な災害が発生した場合でも、災害支援システムで災害支援物資の管理から輸送までを一元管理することができる。

[0081] なお、ステップＳ３８を省略し、ステップＳ４０で表示する画面においてステップＳ３８で表示する内容も合わせて表示するようにしてもよい。なお、優先順位が２位以下の被災地域についても順次ステップＳ３４以下の処理を行って順に災害支援物資を供給することが望ましい。

[0082]（第４実施形態）

第４実施形態は、避難場所までの輸送経路を示すことができるものである。図１４は、第４実施形態のコンピュータ１１の動作を示すフローチャートである。

[0083] ステップＳ５０～Ｓ５６までは第２実施形態のステップＳ２０～Ｓ２６と同様の処理であるので詳細な説明は省略する。ステップＳ５６からはステップＳ５７へ進んで、制御部１１５は、送受信部１１１が気象情報センター１９から気象情報を受信したか否かを判別する。気象情報はコンピュータ１１からどの地域の情報が必要かを要求してもよいし、コンピュータ１１が要求しなくても災害監視衛星２０から自動的に送られてくるようにしてもよい。

[0084] 気象情報は、少なくとも各種警報を含み、さらに各種注意報、天気予報などを含んでいてもよい。被災情報を受信すると、ステップＳ５８へ進んで制

御部１１５は輸送経路を算出する。ここでの輸送経路の算出法は、第２実施形態のステップＳ２８の算出方法において、気象情報及び危険場所情報を輸送手段に応じて加味する。危険場所情報は、地図上の高い山、高圧電線、高層ビルなど輸送の際に注意しなければならない場所であり、予め記憶部１１２に記憶されている。輸送経路は災害支援物資備蓄基地１０から被災地域又は避難場所までの経路を算出すればよい。

[0085] 例えば、輸送ヘリで輸送する場合、気象情報として強風警報が出ている地域を避けた経路とし、経路上に危険場所がある場合は、経路を表示する際に危険場所も表示して注意を促す。この輸送経路の算出法は第２実施形態のステップＳ２８に適用してもよい。

[0086] ステップＳ５８からはステップＳ５９へ進んで、制御部１１５は輸送先の避難場所の３次元画像及び設営配置画像を記憶部１１２から読み出す。これらの画像は予め記憶部１１２に記憶されている。設営配置画像とは、避難場所におけるテント、休憩所、集会所、仮設診療所、炊き出し・調理場、風呂、簡易トイレ、ヘリポート、パーテーション、通信設備などの設営配置情報を画像で記したものである。

[0087] ステップＳ５９からはステップＳ６０へ進んで、制御部１１５は出力部１１４に算出、決定、読み出した各種結果を表示する。図１５に、出力部１１４に表示される画面の一例を示す。出力部１１４には図７の画面に続いて図１５の画面が表示される。図１５の画面において、輸送経路の欄に輸送経路上の危険場所と輸送経路の地図とが記されている。また、輸送先の避難場所の３次元画像（不図示）と、設営配置画像（不図示）とが記されている。

[0088] なお、設営配置画像は輸送人員が所持するタブレットＰＣ等の携帯端末に表示すれば、輸送人員がいつでも確認することができ、避難場所での設営をスムーズに行うことができる。

[0089] このように、第４実施形態の災害支援システムによれば、供給すべき災害支援物資とその量が自動的に決定され、輸送形態も自動的に決定され、さらに避難場所までの輸送経路や設営配置を示すことができる。したがって、災

害支援システムで災害支援物資の管理から輸送、設営までを一元管理することができる。

[0090] なお、気象情報及び危険場所情報は輸送手段を決定する際に加味してもよい。例えば、被災地域に洪水警報が出ていれば陸上輸送は無理なので輸送ヘリに決定するなどである。

[0091] なお、上記の各実施形態において、端末装置１６、１７が各自治体に設けられた非常ボタンである場合は、この非常ボタンが押されると、自治体（自治体の首長）から直接災害支援システムに支援要請することになるので、国を通らずに迅速に対応できる。図１６に、非常ボタンが押された場合にコンピュータ１１の出力部１１４に表示される画面の一例を示す。画面の受信状態の欄が「災害発生」を示しており、大阪市中央区長からの支援要請であることがわかる。

[0092] なお、上記の各実施形態において、輸送手段決定の際、輸送ヘリは夜間使えないとう条件を加えてもよい。この条件を加えると、輸送予定時刻が夜間になる場合には輸送ヘリを省いて輸送手段を決定することができる。

産業上の利用可能性

[0093] 本発明は、災害支援物資を備蓄基地で保管・管理し、災害発生時に被災地に迅速に災害支援物資を供給することを支援する災害支援システムに利用することができる。また、最短到着日時を明らかにすることは、特に被災地側の首長に対して、現地の限られたリソース（人、物、時間等）の配分を決定する上で大変有益な情報となる。

符号の説明

[0094] １０　災害支援物資備蓄基地
１１　災害支援システム
１２、１３　倉庫
１４　シミュレーションルーム
１５　電気通信回線
１６、１７　端末装置

１８　災害情報センター

１９　気象情報センター

２０　災害監視衛星

１１１　送受信部

１１２　記憶部

１１３　入力部

１１４　出力部

１１５　制御部

１２１～１２３、１３１～１３３　棚

１６１、１７１　入力部

１６２、１７２　出力部

請求の範囲

［請求項1］ 地域毎の人口を含む居住関連情報と、各種災害支援物資の名称及び量と、災害支援物資の名称に応じた単位数量当たりの大きさ及び重さと、各種梱包形態に収容可能な大きさ及び重さと、各種梱包形態に応じた輸送手段の候補及び積載可能梱包数と、各輸送手段の優先順位と、各輸送手段の稼働可能台数と、役割毎の出勤人数を算出するための人員シフト表と、災害支援物資の名称及び量に応じた梱包時間と、梱包形態及び梱包数に応じた積載時間と、出動の承認に要する承認時間とを記憶した記憶部と、

ユーザの操作により地域名が入力される入力部と、

準備する災害支援物資の名称及び量と、輸送手段とを決定する制御部と、

前記制御部の指示により各種情報を出力する出力部と、を備え、

前記入力部で被災地域の地域名が入力された場合、前記制御部は、該地域名に対応した前記居住関連情報の各項目の値を所定の式に代入して準備する各種災害支援物資の名称及び量を決定し、

前記準備する各種災害支援物資の名称及び量と、前記災害支援物資の名称に応じた単位数量当たりの大きさ及び重さと、前記各種梱包形態に収容可能な大きさ及び重さとから梱包形態と梱包数とを算出し、

算出した梱包形態と、各種梱包形態に応じた輸送手段の候補とから輸送手段の候補を算出し、

算出した梱包数と、算出した輸送手段の候補と、前記各輸送手段の優先順位と、前記各輸送手段の稼働可能台数とから優先順位の高い順に輸送手段を決定し、

前記人員シフト表から当日の準備係の出勤人数を算出し、前記梱包時間を前記出勤人数で除して最短梱包時間を算出し、前記積載時間を前記出勤人数で除して最短積載時間を算出し、前記最短梱包時間と前記最短積載時間と前記承認時間との和である最短準備時間を求めるこ

とを特徴とする災害支援システム。

［請求項2］ 前記記憶部は、地図情報と、前記各輸送手段の平均速度と、前記梱包形態及び梱包数に応じた引き渡し時間とを記憶し、

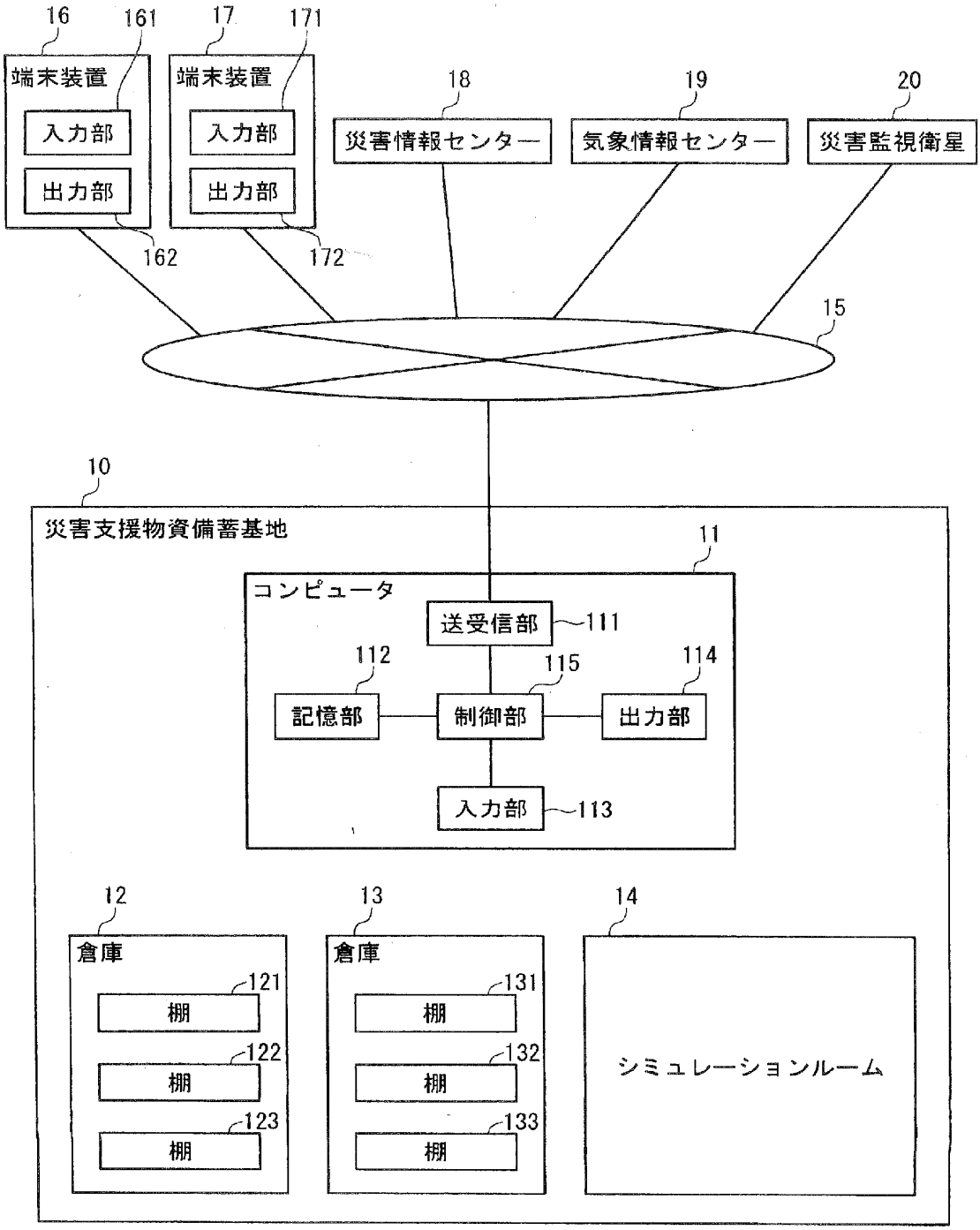
前記制御部は、前記地図情報を用いて被災地域までの輸送経路を算出し、該輸送経路の距離を使用する輸送手段の平均速度で除して最短輸送時間を算出し、前記引き渡し時間を前記輸送手段毎の輸送係の出勤人数で除して最短引き渡し時間を算出し、前記最短輸送時間と前記最短引き渡し時間との和である最短供給時間を求めることを特徴とする請求項１記載の災害支援システム。

［請求項3］ 被災地域及び災害内容を含む被災情報を受信する被災情報受信部を備え、

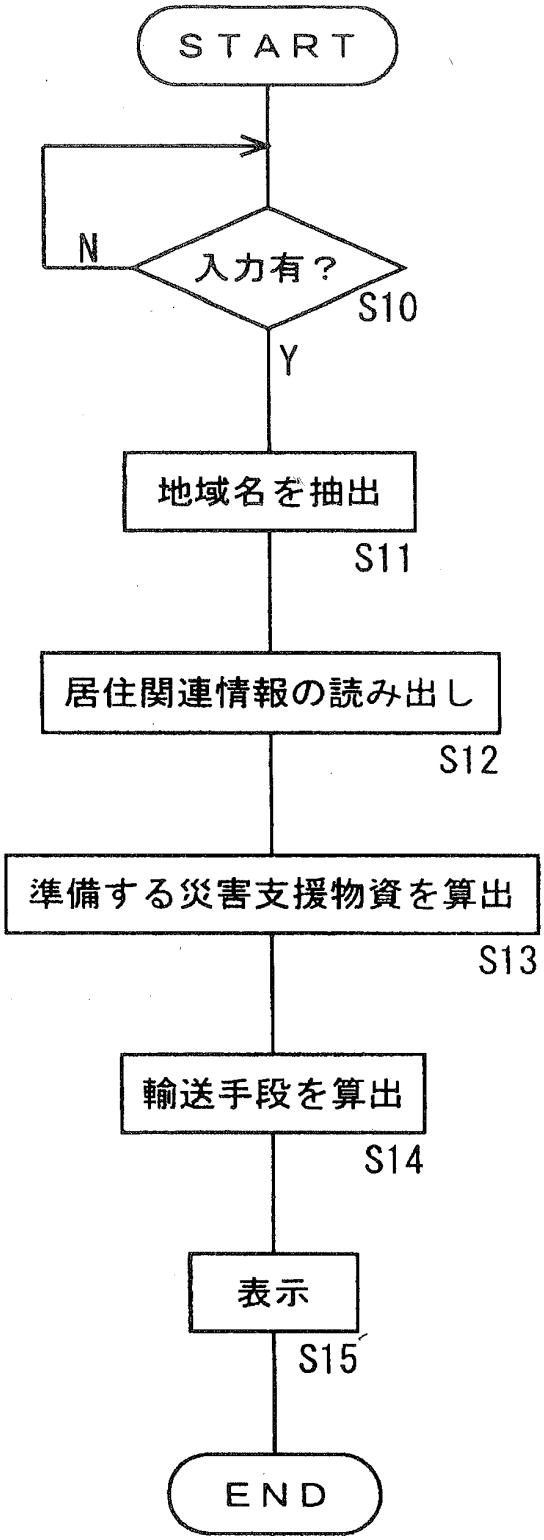
前記被災情報を受信した場合、前記制御部は、該地域名に対応した前記居住関連情報の各項目の値を所定の式に代入して準備する各種災害支援物資の名称及び量を決定し、準備する各種災害支援物資の名称及び量から輸送手段を決定することを特徴とする請求項１又は２記載の災害支援システム。

［請求項4］ 請求項１～３の何れかに記載の災害支援システムを稼働させる災害支援プログラム。

[図1]


16
161
17
171
端末装置
入力部
出力部
端末装置
入力部
出力部
18
災害情報センター
19
気象情報センター
20
災害監視衛星
162
172
15
10
災害支援物資備蓄基地
11
コンピュータ
送受信部
111
112
115
114
記憶部
制御部
出力部
入力部
113
12
13
14
倉庫
121
棚
122
棚
123
棚
倉庫
131
棚
132
棚
133
棚
シミュレーションルーム

[図2]


START
N
入力有？
S10
Y
地域名を抽出
S11
居住関連情報の読み出し
S12
準備する災害支援物資を算出
S13
輸送手段を算出
S14
表示
S15
END

[図3]

災害支援物資	形態	入数	長さ(mm)	幅(mm)	高さ(mm)	内容量(kg)
毛布	真空包装	10枚	500	500	500	20
乾パン	ビニール袋	10食	500	500	400	5
米	ビニール袋	1袋	1000	500	200	30

[図4]

梱包形態	長さ (mm)	幅 (mm)	高さ (mm)	内容量 (kg)	輸送手段 輸送ヘリ	輸送手段 大型トラック	輸送手段 輸送艦
ボックス	1000	1000	1000	500	輸送可 (4個まで)	輸送可 (6個まで)	輸送可 (500個まで)
カーゴ	2000	2000	2000	2000	輸送不可	輸送可 (2個まで)	輸送可 (200個まで)
コンテナ	5000	5000	5000	5000	輸送不可	輸送不可	輸送可 (30個まで)

[図5]

輸送手段	積載量	保有台数	稼働可能台数	優先順位	割り当てフラグ（オフ：0、オン：1）
輸送ヘリ	4.0t	10	10	1	0
大型トラック	6.0t	20	20	2	0
輸送艦	8,900t	1	1	3	0

[図6]

倉庫番号	棚番号	災害支援物資	数量	入数	割り当てフラグ（オフ：0、オン：1）
S0001	T000001	毛布	20	10枚	0
S0001	T000002	乾パン	100	10食	0
S0001	T000003	米	200	1袋	1
S0001	T000004	米	300	1袋	1

[図7]

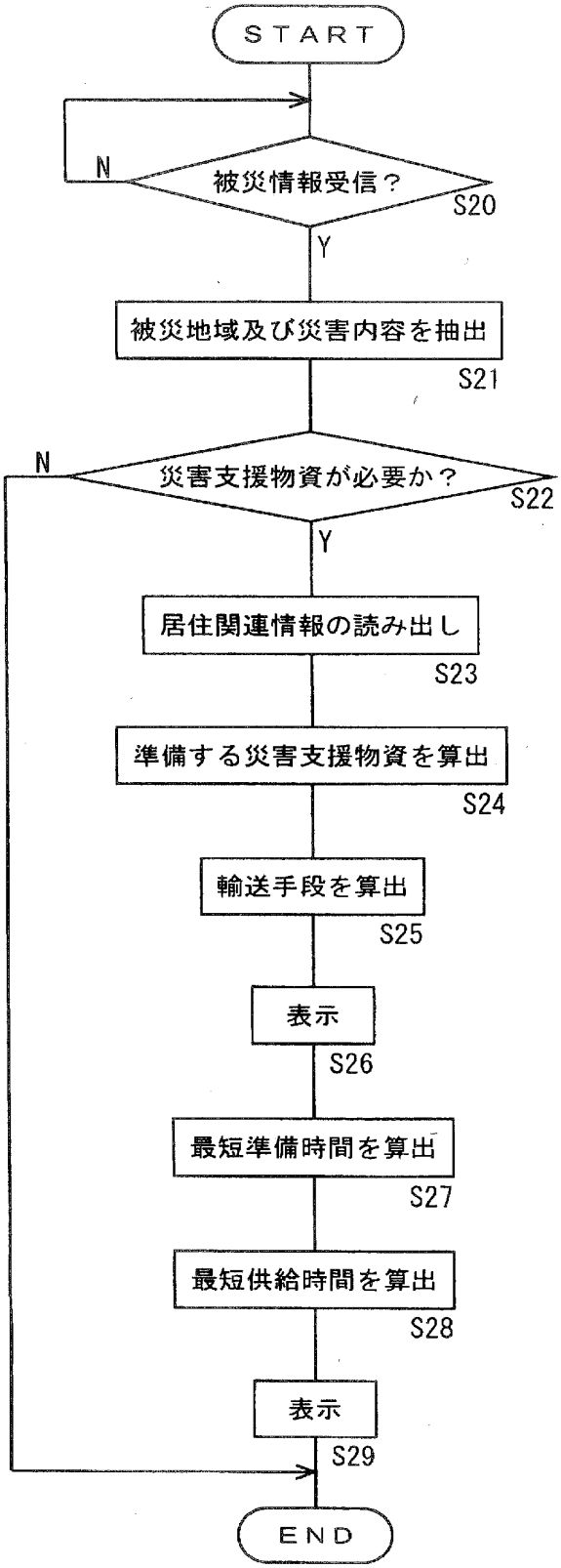
災害支援システム

被災地域名	大阪府大阪市中央区

災害支援物資	量
毛布	65,000枚
乾パン	26,800食
おかゆ	3,600食

輸送手段	輸送ヘリ
梱包形態	コンテナ、サイズ(長さ、幅、高さ、内容量)

[図8]


START
被災情報受信？
S20
N
Y
被災地域及び災害内容を抽出
S21
災害支援物資が必要か？
S22
N
Y
居住関連情報の読み出し
S23
準備する災害支援物資を算出
S24
輸送手段を算出
S25
表示
S26
最短準備時間を算出
S27
最短供給時間を算出
S28
表示
S29
END

[図9]

人員コード	人員氏名	役割	月	1日	2日	3日	4日	5日	・・・
J0001	鈴木一郎	準備係	1	出	休	出	出	出	・・・
J0002	鈴木二郎	輸送係 (パイロット)	1	出	出	休	出	出	・・・
J0003	鈴木三郎	輸送係 (トラック)	1	出	出	休	出	出	・・・
・ ・	・ ・	・ ・	・ ・	・ ・	・ ・	・ ・	・ ・	・ ・	・ ・

[図10]

災害支援システム

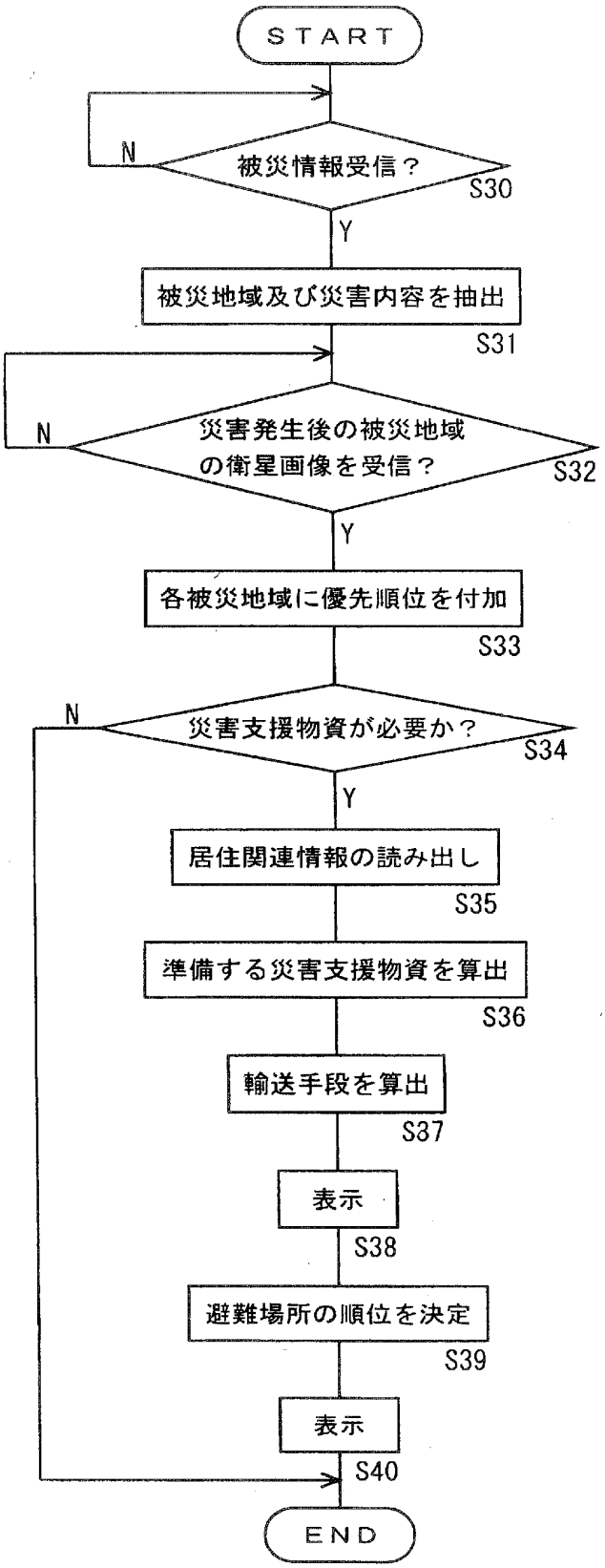
被災情報

被災地域名	大阪府大阪市中央区
災害内容	地震、震度6強

時間情報

災害発生日時	2010/01/06 11:30
最短準備完了日時	2010/01/07 11:30
最短供給開始日時	2010/01/07 13:30

[図11]


START
被災情報受信？
S30
N
Y
被災地域及び災害内容を抽出
S31
災害発生後の被災地域
の衛星画像を受信？
S32
N
Y
各被災地域に優先順位を付加
S33
災害支援物資が必要か？
S34
N
Y
居住関連情報の読み出し
S35
準備する災害支援物資を算出
S36
輸送手段を算出
S37
表示
S38
避難場所の順位を決定
S39
表示
S40
END

[図12]

名称	住所	種別	収容人数	優先順位
用瀬小学校	鳥取市用瀬町用瀬 75-1	一時避難所	700	2
用瀬地区公民館	鳥取市用瀬町用瀬 253	避難所	240	1

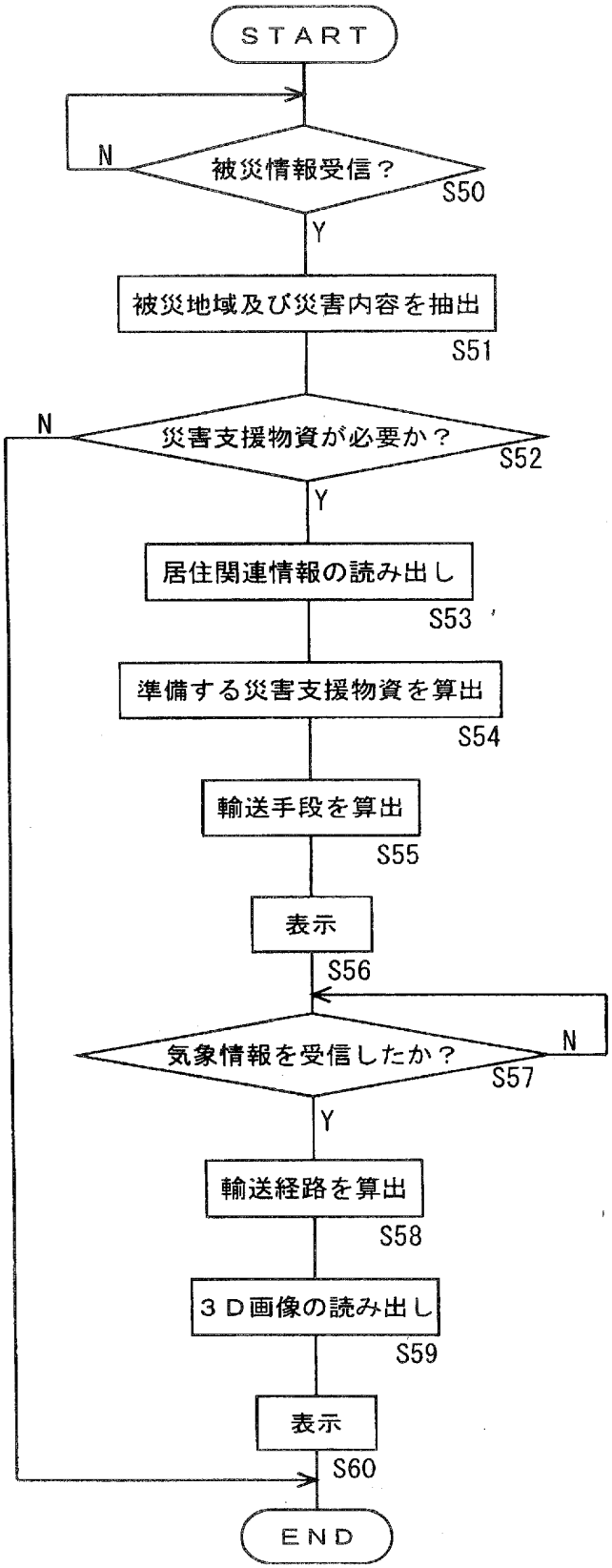
[図13]

災害支援システム

被災情報	
被災地域名	大阪府大阪市中央区
災害内容	地震、震度 6 強

優先順位	
被災地域名	1. 大阪市中央区　2. 大阪市西区　3. 大阪市港区
避難場所 大阪市中央区	1. 大手前高等学校（大手町 2-1-11） 2. 聴覚特別支援学校（上町 1-19-31） 3. 東商業高等学校（久太郎町 1-7-12）

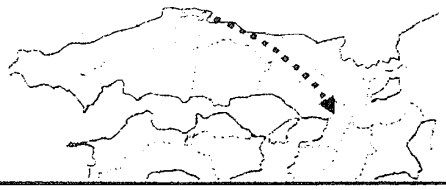
[図14]


START
被災情報受信？
S50
N
Y
被災地域及び災害内容を抽出
S51
災害支援物資が必要か？
S52
N
Y
居住関連情報の読み出し
S53
準備する災害支援物資を算出
S54
輸送手段を算出
S55
表示
S56
気象情報を受信したか？
S57
N
Y
輸送経路を算出
S58
３Ｄ画像の読み出し
S59
表示
S60
END

[図15]

災害支援システム

被災地情報	
被災地域名	大阪府大阪市中央区

避難場所輸送経路	
輸送手段	輸送ヘリ
輸送経路 危険場所 1. 大山 2. TheKitahama ビル	
3D 画像 (省略)	設営配置画像 (省略)

[図16]


災害支援システム
受信状態
災害
発生
輸送指示
輸送指示者
大阪市中央区長
輸送場所
大阪市中央区内の避難場所
支援物資・量
毛布、食料・大阪市中央区 全区民分

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/051508

A. CLASSIFICATION OF SUBJECT MATTER
G06Q50/28(2012.01)i, *B65G61/00*(2006.01)i, *G01C21/34*(2006.01)i, *G06Q50/26*(2012.01)i, *G08B25/04*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q50/28, B65G61/00, G01C21/34, G06Q50/26, G08B25/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-143350 A (Matsushita Joho Systems Co., Ltd.), 28 May 1999 (28.05.1999), paragraphs [0026] to [0027] (Family: none)	1-4
A	JP 2006-188331 A (Hitachi, Ltd.), 20 July 2006 (20.07.2006), paragraphs [0021] to [0033] (Family: none)	1-4
A	JP 2002-92264 A (The Tokyo Electric Power Co., Inc.), 29 March 2002 (29.03.2002), paragraph [0078] (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 21 February, 2012 (21.02.12)	Date of mailing of the international search report 06 March, 2012 (06.03.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/051508

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 10-334146 A (Hitachi, Ltd.), 18 December 1998 (18.12.1998), paragraph [0029] (Family: none)	1-4
A	JP 2008-201569 A (Hitachi, Ltd.), 04 September 2008 (04.09.2008), paragraph [0175] (Family: none)	1-4
A	JP 11-157617 A (Hitachi Engineering Co., Ltd.), 15 June 1999 (15.06.1999), paragraphs [0026] to [0031] (Family: none)	1-4
A	JP 2009-154986 A (Hitachi, Ltd.), 16 July 2009 (16.07.2009), paragraphs [0016] to [0034] (Family: none)	1-4
A	JP 2002-329286 A (Kawasaki Heavy Industries, Ltd.), 15 November 2002 (15.11.2002), entire text; all drawings (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

国際調査報告

国際出願番号　ＰＣＴ／ＪＰ２０１２／０５１５０８

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Int.Cl.　G06Q50/28(2012.01)i, B65G61/00(2006.01)i, G01C21/34(2006.01)i, G06Q50/26(2012.01)i, G08B25/04(2006.01)i

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Int.Cl.　G06Q50/28, B65G61/00, G01C21/34, G06Q50/26, G08B25/04

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２０１２年
日本国実用新案登録公報	１９９６－２０１２年
日本国登録実用新案公報	１９９４－２０１２年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
Ａ	JP 11-143350 A（松下情報システム株式会社）1999.05.28, 段落 0026-0027（ファミリーなし）	１－４
Ａ	JP 2006-188331 A（株式会社日立製作所）2006.07.20, 段落 0021-0033（ファミリーなし）	１－４
Ａ	JP 2002-92264 A（東京電力株式会社）2002.03.29, 段落 0078（ファミリーなし）	１－４

☑　Ｃ欄の続きにも文献が列挙されている。

☐　パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの
「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「Ｏ」口頭による開示、使用、展示等に言及する文献
「Ｐ」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「Ｔ」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「Ｘ」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
「Ｙ」特に関連のある文献であって、当該文献と他の１以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
「＆」同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
２１．０２．２０１２	０６．０３．２０１２

国際調査機関の名称及びあて先	特許庁審査官（権限のある職員）	
日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	川口　美樹	５Ｌ　３７９８
	電話番号　０３－３５８１－１１０１　内線　３５６２	

様式ＰＣＴ／ＩＳＡ／２１０（第２ページ）（２００９年７月）

Ｃ（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
A	JP 10-334146 A（株式会社日立製作所）1998.12.18，段落 0029（ファミリーなし）	１－４
A	JP 2008-201569 A（株式会社日立製作所）2008.09.04，段落 0175（ファミリーなし）	１－４
A	JP 11-157617 A（日立エンジニアリング株式会社）1999.06.15，段落 0026-0031（ファミリーなし）	１－４
A	JP 2009-154986 A（株式会社日立製作所）2009.07.16，段落 0016-0034（ファミリーなし）	１－４
A	JP 2002-329286 A（川崎重工業株式会社）2002.11.15，全文，全図（ファミリーなし）	１－４

Electronic Acknowledgement Receipt

EFS ID:	40338575
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Esther Carner
Filer Authorized By:	Natalie J. Grace
Attorney Docket Number:	474139US03
Receipt Date:	20-AUG-2020
Filing Date:	06-MAY-2020
Time Stamp:	14:26:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2020-08-20_474139US03_IDS-SB08.pdf	1034488 4558772ed70bcc5e003ae958407d6344f7132c56	no	4
Warnings:					

Information:					
2	Transmittal Letter	2020-08-20_474139US03_IDSTransmittal.pdf	95269 2cc1f487b314c8b270f6974cfe6a004770985010	no	1
Warnings:					
Information:					
3	Non Patent Literature	2020-02-20_2019-515883_JPOA.pdf	2307626 c9b230749ccd15474b6fb972321c80435c5517c1	no	11
Warnings:					
Information:					
4	Foreign Reference	JP2015184405A.pdf	1471678 f68d277d2c820233fbe04c09763ead5ae3b52abf	no	27
Warnings:					
Information:					
5	Foreign Reference	JPS62288963A.pdf	762631 8b0b76ed74ba9194a318edd51c052eff2e9f9eaa	no	10
Warnings:					
Information:					
6	Foreign Reference	WO2012111395.pdf	1549670 7114145ec670353e9e533ad09b0907cc9e03a53d	no	40
Warnings:					
Information:					
		Total Files Size (in bytes):	7221362		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16868113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	
Examiner Name	
Attorney Docket Number	474139US03

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20170061249		2017-03-02	Estrada et al.	
	2	20030182249		2003-09-25	Buczak	
	3	20170154425		2017-06-01	Pierce et al.	
	4	20170076438		2017-03-16	KOTTENSTETTE et al.	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

EFS Web 2.1.18

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

	1								

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2020-10-23
Name/Print	Natalie J. Grace	Registration Number	65,803

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	|
AON BENFIELD INC.	| EXAMINER: NOT YET ASSIGNED
APPLICATION NO.: 16/868,113	| GROUP ART UNIT: NOT YET ASSIGNED
FILED: MAY 6, 2020	| DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	|

INFORMATION DISCLOSURE STATEMENT

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

Applicant wishes to make of record the reference(s) listed on the attached PTO/SB/08a form. This Information Disclosure Statement is being submitted prior to the issuance of the first action of the merits in the above-referenced application. Consequently, no certification or fee is required. If, however, any fees are required, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Respectfully submitted,

Date: October 23, 2020

/Natalie J. Grace/
Natalie J. Grace
Attorney of Record
Registration No. 65,803

GARDELLA GRACE P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
Telephone: (703) 556-9600
Facsimile: (703) 740-4541

Electronic Acknowledgement Receipt

EFS ID:	40927007
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Anthony Gorney
Filer Authorized By:	Natalie J. Grace
Attorney Docket Number:	474139US03
Receipt Date:	23-OCT-2020
Filing Date:	06-MAY-2020
Time Stamp:	11:19:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	474139US03_IDS.pdf	1034277 cec48ef6b5cca71316782e9e7f79b3b4f144f391	no	4

Warnings:

Information:					
2	Transmittal Letter	2020-10-23_Aon_474139US03_IDS_Transmittal.pdf	14995 bdcfeaed1b1e3eb64f017ff16adcc6820407197d	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	1049272	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	|
AON BENFIELD INC.	| EXAMINER: TO BE ASSIGNED
APPLICATION NO.: 16/868,113	| GROUP ART UNIT: TO BE ASSIGNED
FILED: MAY 6, 2020	| DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	|

RESPONSE TO NOTICE TO FILE MISSING PARTS

MAIL STOP MISSING PARTS
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Notice to File Missing Parts dated May 13, 2020, please accept the petition for extension of time and fees submitted herewith.

An extension of time of five months is hereby petitioned to prevent abandonment of this application. Applicant does not believe that any fees, other than those submitted herewith, are due at this time. If, however, any additional fees are required, including fees for extensions of time, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Remarks begin on page **2** of this paper.

REMARKS

Notice to File Missing Parts

In response to the Notice to File Missing Parts dated May 13, 2020, Applicant submits herewith the basic filing fee, search fee, examination fee, and late submission surcharge. Additionally, the corresponding fee for a petition for a five-month extension of time is submitted herewith.

CONCLUSION

Favorable consideration of this application is respectfully requested. The Examiner is encouraged to contact Representative Natalie Grace at 703-740-4538 should any additional information be necessary to advance prosecution and accelerate allowance.

Respectfully submitted,

/Natalie J. Grace/

Natalie J. Grace
Attorney of Record
Registration No. 65,803

Ruth G. Davila
Agent of Record
Registration No. 73,956

Date: December 11, 2020

GARDELLA GRACE P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
Telephone: (703) 556-9600
Facsimile: (703) 740-4541

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/868,113	05/06/2020	Takeshi Okazaki	474139US03

CONFIRMATION NO. 5664

146018
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

FORMALITIES LETTER

OC000000116943869

Date Mailed: 05/13/2020

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.
  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $ **300** basic filing fee.
- $ **160** surcharge.
- $ **660** search fee.
- $ **760** examination fee.
- $(**0**) previous unapplied payment amount.
- $ **1880** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tnguyen/

Electronic Patent Application Fee Transmittal

Application Number:	16868113
Filing Date:	06-May-2020
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Filer:	Natalie J. Grace/Kristin Sims
Attorney Docket Number:	474139US03

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
Pages:				
Claims:				
Miscellaneous-Filing:				
LATE FILING FEE FOR OATH OR DECLARATION	1051	1	160	160
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 5 months with $0 paid	1255	1	3160	3160
Miscellaneous:				
		Total in USD ($)		**5140**

Electronic Acknowledgement Receipt	
EFS ID:	41359743
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Kristin Sims
Filer Authorized By:	Natalie J. Grace
Attorney Docket Number:	474139US03
Receipt Date:	11-DEC-2020
Filing Date:	06-MAY-2020
Time Stamp:	13:18:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$5140
RAM confirmation Number	E2020BAD19363222
Deposit Account	601484
Authorized User	Kristin Sims
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.20 (Post Issuance fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	474139US03_MP_Response.pdf	207851 294b391fe1d4aba9df82cc2ea115ce92d95e95d5	no	4
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	39104 5d80165fa11cb412a1f3a371d7eafbe33d284bec	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	246955		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/868,113	05/06/2020		1980	474139US03	1	1

CONFIRMATION NO. 5664

UPDATED FILING RECEIPT

146018
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

OC000000122010367

Date Mailed: 12/15/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Takeshi Okazaki, Tokyo, JAPAN;

Applicant(s)

Aon Benfield Inc., Chicago, IL;

Assignment For Published Patent Application

Aon Benfield Inc., Chicago, IL

Power of Attorney: The patent practitioners associated with Customer Number 146018

Domestic Priority data as claimed by applicant

This application is a CON of 16/733,888 01/03/2020 PAT 10650285
which is a CIP of 15/714,376 09/25/2017 PAT 10529029
which claims benefit of 62/398,665 09/23/2016

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/12/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/868,113**

Projected Publication Date: 03/25/2021

Non-Publication Request: No

Early Publication Request: No

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/868,113

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	1 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x 480 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/868,113	05/06/2020	Takeshi Okazaki	474139US03

CONFIRMATION NO. 5664

146018
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

PUBLICATION NOTICE

OC000000124372974

Title:PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

Publication No.US-2021-0089839-A1
Publication Date:03/25/2021

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	05/06/2020	Takeshi Okazaki	474139US03	5664

146018 7590 04/13/2021

Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

EXAMINER
NGUYEN, TIEN C

ART UNIT	PAPER NUMBER
3694	

NOTIFICATION DATE	DELIVERY MODE
04/13/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

eofficeaction@appcoll.com
info@gardellagrace.com
ngrace@gardellagrace.com

Office Action Summary	Application No. 16/868,113	Applicant(s) Okazaki, Takeshi	
	Examiner TIEN C NGUYEN	Art Unit 3694	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 5/6/2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

Status of the Claims

1. This action is in response to the application filed on 5/6/2020.

2. Claim 1 is pending and examined below.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit http://www.uspto.gov/forms/. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claim 1 of the claimed invention are rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 10,650,285 and claim 1 of U.S. Patent No. 10,529,029. Although the claims at issue are not identical, they are not patentably distinct from each other because they both disclose a method obtaining, by processing circuitry, an aerial image of a geographic region including the property; extracting, by the processing circuitry, one or more features of a plurality of features from the aerial image, wherein the one or more features are each represented by a set of pixel groupings, and the one or more features represent the characteristic of the property, wherein each pixel grouping of the set of pixel groupings comprises at least one of angles, outlines, or substantially homogenous pixel fields; applying, by the processing circuitry, a first portion of the set of pixel groupings to a first machine learning classifier to determine a characteristic classification of the characteristic from a plurality of potential classifications of the characteristic, wherein the first machine learning classifier is trained to identify at least a portion of the one or more features from the first portion of the set of pixel groupings; and applying, by the processing circuitry, a second portion of the set of pixel groupings to a second machine learning classifier to determine a condition classification of the characteristic from a plurality of potential condition classifications of the characteristic, wherein the second machine learning classifier is trained to identify, from the second portion of the set of pixel groupings, property characteristic conditions of the characteristic having the characteristic classification.

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to TIEN C. NGUYEN whose telephone number is 571-270-5108. The examiner can normally be reached on Monday-Thursday (6am-2pm EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bennett Sigmond can be reached on 303-297-4411. The fax phone number for the organization where this application or proceeding is assigned is 571-270-6108.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TIEN C NGUYEN/
Primary Examiner, Art Unit 3694

Notice of References Cited	Application/Control No. 16/868,113	Applicant(s)/Patent Under Reexamination Okazaki, Takeshi	
	Examiner TIEN C NGUYEN	Art Unit 3694	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6732120-B1	05-2004	Du; Mike	G01C21/20	715/764
*	B	US-8775219-B2	07-2014	Swanson; Aaron L.	G06Q50/16	705/4
*	C	US-20090265193-A1	10-2009	COLLINS; Dean	G06Q30/0185	705/4
*	D	US-20150325064-A1	11-2015	Downey; Jonathan	G07C5/004	701/29.3
*	E	US-9846915-B2	12-2017	Howe; Richard L.	G06K9/00637	1/1
*	F	US-20160086285-A1	03-2016	Jordan Peters; Julie A.	G08G1/096827	705/4
*	G	US-20130226667-A1	08-2013	Terrazas; Alex	G06Q30/0205	705/7.34
*	H	US-20050063563-A1	03-2005	Soliman, Samir S.	H04N1/00204	382/104
*	I	US-8731234-B1	05-2014	Ciarcia; Christopher Albert	G06K9/4604	382/100
*	J	US-20140032433-A1	01-2014	Eick; Stephen G.	G06Q50/163	705/314
*	K	US-20100215212-A1	08-2010	Flakes, JR.; Malcolm S.	G06K9/00637	382/100
*	L	US-8346578-B1	01-2013	Hopkins, III; John Chandler	G06Q50/16	705/4
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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	Art Unit
	TIEN C NGUYEN	3694

CPC - Searched*		
Symbol	**Date**	**Examiner**
G06Q	04/09/2021	/tn/

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**
G 06Q 40/08, G 06Q 40/02, G 06Q 10/10, G 06F19/328, G 06Q 30/02.	04/09/2021	/tn/

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
705	36	04/09/2021	/tn/
705	37	04/09/2021	/tn/
705	38	04/09/2021	/tn/
705	39	04/09/2021	/tn/
705	40	04/09/2021	/tn/

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
East and PALM.	04/09/2021	/tn/
Google search.	04/09/2021	/tn/
Assignee search.	04/09/2021	/tn/
Inventor search.	04/09/2021	/tn/
Search SN# 16/868113 and 15/714376.	04/09/2021	/tn/

/TIEN C NGUYEN/ Primary Examiner, Art Unit 3694	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	Art Unit
	TIEN C NGUYEN	3694

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/TIEN C NGUYEN/ Primary Examiner, Art Unit 3694	

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	16/868,113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	3694
	Examiner Name	Tien Nguyen
	Attorney Docket Number	474139US03

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10311302		2019-06-04	Kottenstette et al.	
	2	9141872		2015-09-22	Marchisio et al.	
	3	9569690		2017-02-14	Marchisio et al.	
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	5	9031325		2015-05-12	Ouzounis	
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	7	9589210		2017-03-07	Estrada et al.	
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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.C.N/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

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	11	9495618		2016-11-15	Tabb	
	12	9767565		2017-09-19	Estrada et al.	
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	15	9230168		2016-01-05	Gueguen	
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

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	35	20180089763		2018-03-29	Okazaki		

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	1	2017040691	WO		2017-03-09	CAPE ANALYTICS, INC.	Previously submitted in related appln. no. 15/714,376	
	2	2017151673	WO		2017-09-08	DIGITALGLOBE, INC.	Previously submitted in related appln. no. 15/714,376	
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	7	2014151122	WO		2014-09-25	EAGLE VIEW TECHNOLOGIES, INC.	Previously submitted in related appln. no. 15/714,376	

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	Examiner Name	
	Attorney Docket Number	474139US03

	8	2017142788	WO		2017-08-24	PICTOMETRY INTERNATIONAL CORP.	Previously submitted in related appln. no. 15/714,376	
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	13	2013123354	WO		2013-08-22	XACTWARE SOLUTIONS, INC.	Previously submitted in related appln. no. 15/714,376	
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	16	2016198873	WO		2016-12-15	SMITH, Alexis Hannah	Previously submitted in related appln. no. 16/733,888	

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

	1	International Search Report and Written Opinion issued in International Application No. PCT/US2017/053265 on December 11, 2017. (Previously submitted in related appln. no. 15/714,376)	
	2	International Patent Report on Patentability issued in International Application No. PCT/US2017/053265 on March 26, 2019. (Previously submitted in related appln. no. 15/714,376)	
	3	LIN et al., Network in Network, International Conference on Learning Representations, 2014, pp. 10. (Previously submitted in related appln. no. 15/714,376)	
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	6	Notice of Allowance mailed in U.S. Appln. No. 15/714,376, dated August 7, 2019. (Previously submitted in related appln. no. 16/733,888)	
	7	Notice of Allowance mailed in U.S. Appln. No. 15/714,376, dated November 20, 2019. (Previously submitted in related appln. no. 16/733,888)	
	8	Systems and Methods for Insurers to Monitor Continuously Structural Status of Insured Homes, IP.com Number: IPCOM000177511D, December 16, 2008. (Year: 2008) (Previously submitted in related appln. no. 15/714,376 by Examiner)	
	9	Non-Final Office Action mailed in U.S. Appln. No. 16/733,888, dated March 19, 2020. (Submitted herewith)	
	10	Notice of Allowance mailed in U.S. Appln. No. 16/733,888, dated April 3, 2020. (Submitted herewith)	
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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.C.N/

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	Examiner Name	
	Attorney Docket Number	474139US03

	12	KERLE et al., Urban Structural Damage Assessment With Oblique UAV Imagery, Object-Based Image Analysis And Semantic Reasoning, 35th Asian Conference On Remote Sensing, October 27, 2014. (Previously submitted in related appln. no. 16/733,888)	
	13	NIA et al., Building Damage Assessment Using Deep Learning and Ground-Level Image Data, 2017 14th Conference on Computer and Robot Vision (CRV), May 16, 2017, pages 95-102. (Previously submitted in related appln. no. 16/733,888)	
	14	RAKHA et al., Review Of Unmanned Aerial System (UAS) Applications In The Built Environment: Towards Automated Building Inspection Procedures Using Drones, Automation in Constructions 93, September 1, 2018, pages 252-264. (Previously submitted in related appln. no. 16/733,888)	
	15	PIERDICCA et al., Deep Convolutional Neural Network For Automatic Detection Of Damaged Photovoltaic Cells, The International Archives Of The Photogrammetry, Remote Sensing And Spetial Information Sciences, Volume 42-Number 2, May 30, 2018. (Previously submitted in related appln. no. 16/733,888)	
	16	THIELE et al., Building Recognition From Multi-Aspect High-Resolution InSAR Data In Urban Areas, IEEE Transactions on Geoscience And Remote Sensing, Volume 45, Issue 11, October 29, 2007, pages 3583-3593. (Previously submitted in related appln. no. 16/733,888)	
	17	BUSCOMBE et al., Landscape Classification With Deep Neural Networks, Geosciences, Volume 8, Issue 7, July 2018, page 244. (Previously submitted in related appln. no. 16/733,888)	
	18	SHEPPARD et al., Real-Time Scene Understanding For UAV Imagery Based On Deep Convolutional Neural Networks, 2017 IEEE International Geoscience And Remote Sensing Symposium (IGARSS), July 23, 2017, pages 2243-2246. (Previously submitted in related appln. no. 16/733,888)	
	19	"Drones Above: Meet the Flying Superintendent!" BuildWorlds. Accessed on January 16, 2020. 6 pages, <https://builtworlds.com/news/drones-meet-flying-superintendent/>. (Previously submitted in related appln. no. 16/733,888)	
	20	ZHANG et al., Thermal Infrared Inspection Of Roof Insulation Using Unmanned Aerial Vehicles, The International Archives Of The Photogrammetry, Remote Sensing And Spatial Informational Sciences, Volume 40-Number 1, September 2, 2015. (Previously submitted in related appln. no. 16/733,888)	
	21	HAM et al., Visual Monitoring Of Civil Infrastructure Systems Via Camera-Equipped Unmanned Aerial Vehicles (UAVs): A Review Of Related Works, Visualization In Engineering 4, Article 1 (2016), December 2016. (Previously submitted in related appln. no. 16/733,888)	
	22	YE et al., Automated Detection Of Damaged Areas After Hurricane Sandy Using Aerial Color Images, Computing In Civil And Building Engineering, June 17, 2014, pages 1796-1803. (Previously submitted in related appln. no. 16/733,888)	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.C.N/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	474139US03

CERTIFICATION STATEMENT

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☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2020-05-06
Name/Print	Natalie J. Grace	Registration Number	65,803

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16868113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	3694
Examiner Name	Tien Nguyen
Attorney Docket Number	474139US03

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	1	20170061249		2017-03-02	Estrada et al.	
	2	20030182249		2003-09-25	Buczak	
	3	20170154425		2017-06-01	Pierce et al.	
	4	20170076438		2017-03-16	KOTTENSTETTE et al.	

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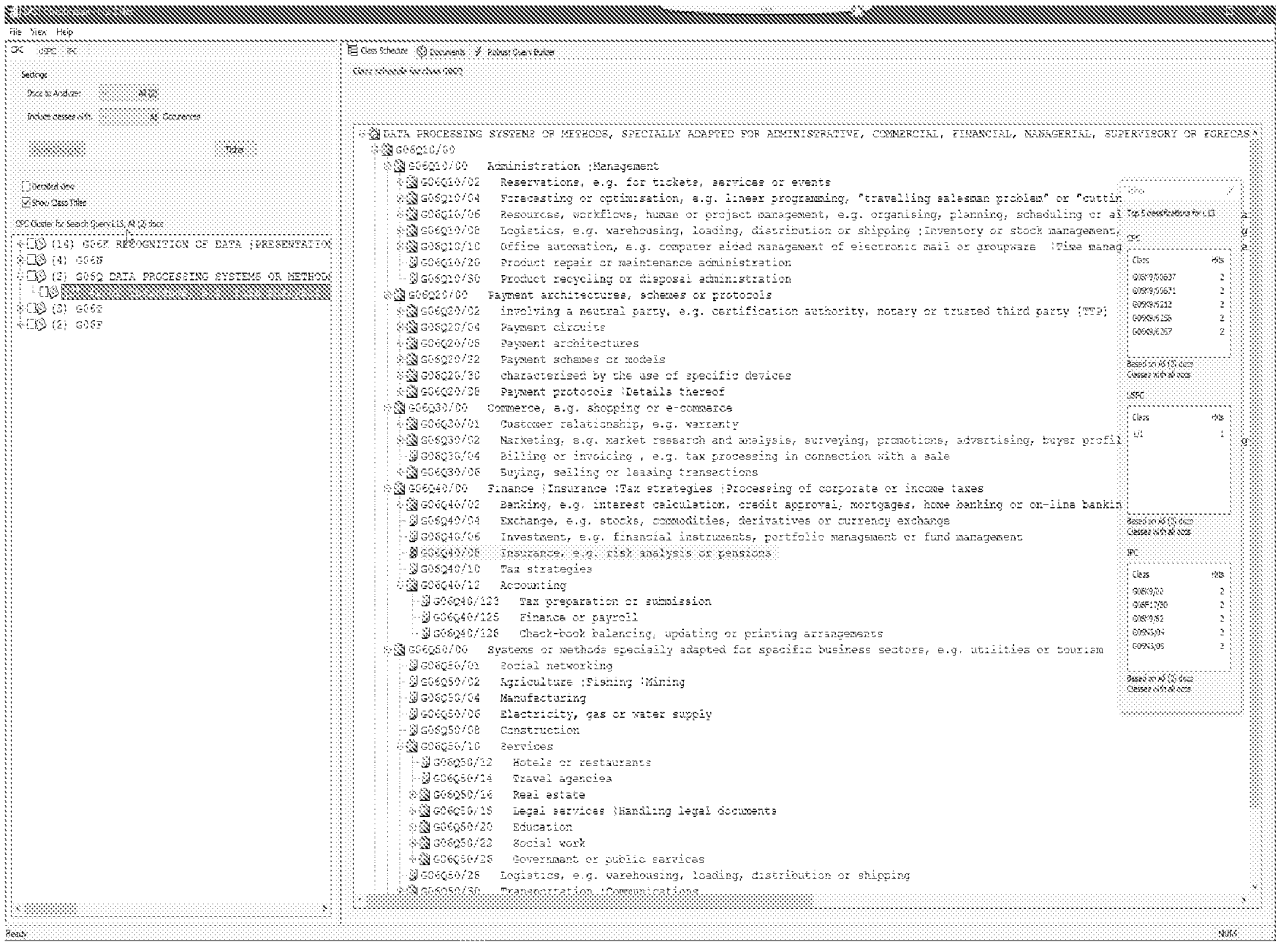
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Application Number	16/868,113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	3694
Examiner Name	Tien Nguyen
Attorney Docket Number	474139US03

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9928553		2018-03-27	Harvey et al.	
	2	10173773		2019-01-08	Flick	
	3	10137984		2018-11-27	Flick	
	4	10163164		2018-12-25	Tofte et al.	
	5	9501700		2016-11-22	Loveland et al.	
	6	9679227		2017-06-13	Taylor et al.	
	7	10453147		2019-10-22	Davis	
	8	6732120		2004-05-04	Du	

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	9	9846915		2017-12-19	Howe et al.	
	10	8346578		2013-01-01	Hopkins, III et al.	
	11	10275833		2019-04-30	Christopulos et al.	
	12	9152863		2015-10-06	Grant	
	13	10346687		2019-07-09	Pestun et al.	
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Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2020-05-06
Name/Print	Natalie J. Grace	Registration Number	65,803

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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BIB DATA SHEET

CONFIRMATION NO. 5664

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
16/868,113	05/06/2020	382	3694	474139US03

APPLICANTS
Aon Benfield Inc., Chicago, IL;

INVENTORS
Takeshi Okazaki, Tokyo, JAPAN;

**** CONTINUING DATA ***************************
This application is a CON of 16/733,888 01/03/2020 PAT 10650285
which is a CIP of 15/714,376 09/25/2017 PAT 10529029
which claims benefit of 62/398,665 09/23/2016

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
05/12/2020

Foreign Priority claimed ❑ Yes ☑ No 35 USC 119(a-d) conditions met ❑ Yes ☑ No Verified and Acknowledged /TIEN C NGUYEN/ Examiner's Signature	❑ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		JAPAN	15	1	1

ADDRESS
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
UNITED STATES

TITLE
PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

FILING FEE RECEIVED		
1980	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other _____ ❑ Credit

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16868113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	~~TBD~~ 3694
Examiner Name	~~TBD~~ Tien Nguyen
Attorney Docket Number	474139US03

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6732120		2004-05-04	Du	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2015184405	JP		2015-10-22	Zenrin Co Ltd	English abstract included	
	2	2012111395	WO		2012-08-23	Sawada	English abstract included	
	3	62-288963	JP		1987-12-15	Jiekuto KK	English abstract included	

EFS Web 2.1.18

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	474139US03

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Japanese Office Action mailed February 20, 2020 in Japanese Application No. 2019-515883.	X

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EXAMINER SIGNATURE

Examiner Signature	/TIEN C NGUYEN/	Date Considered	04/09/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	474139US03

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2020-08-20
Name/Print	Natalie J. Grace	Registration Number	65,803

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	17,639	(G06K9/6268 or G06K9/0063 or G06N20/20 or G06T7/0002 or G06N3/08 or G06K9/4671 or G06T2207/20084 or G06T2207/10032 or G06T2207/30184 or G06T2207/20081 or G06T2207/20076 or G06T7/00 or G06K9/6271 or G06K9/00637 or G06N3/0454).cpc.	USPAT	OR	ON	2021/04/09 08:40
L2	10,209	aerial$3 near7 imag$3	USPAT	OR	ON	2021/04/09 08:40
L3	62,053	(geographic$3) near7 (region$3 or boundar$3)	USPAT	OR	ON	2021/04/09 08:40
L4	1,124	L2 and L3	USPAT	OR	ON	2021/04/09 08:40
L5	498,951	receiv$3 near7 request$3	USPAT	OR	ON	2021/04/09 08:41
L6	163,204	(property or properties or house or houses or "real property" or resident$3) near7 (characteristic$3 or identification$3)	USPAT	OR	ON	2021/04/09 08:41
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EAST Search History

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S5	46,894	(geographic$3) near7 (region$3 or boundar$3)	USPAT	OR	ON	2021/04/09 05:30
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EAST Search History

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EAST Search History

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S24	41,745	pixel$3 near7 (group$3 or grouping$3)	USPAT	OR	ON	2021/04/09 10:33
S25	54	S23 and S24	USPAT	OR	ON	2021/04/09 10:33
S26	6,016	(property or properties or house or houses or "real property" or resident$3) near7 (classif$3)	USPAT	OR	ON	2021/04/09 10:34
S27	1	S25 and S26	USPAT	OR	ON	2021/04/09 10:34
S28	47,173	(risk$3 or damag$3) near7 (estimat$3 or determin$3)	USPAT	OR	ON	2021/04/09 10:35
S29	1	S27 and S28	USPAT	OR	ON	2021/04/09 10:35
S30	40	("20050251427" | "20060095304" | "20080103841" | "20090063234" | "20090265193" | "20090276708" | "20100179787" | "20100215212" |	US-PGPUB; USPAT; USOCR	OR	ON	2021/04/09 10:38

4/9/2021 7:43:39 AM
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EAST Search History

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EAST Search History

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S39	8,348	aerial$3 near7 imag$3	USPAT	OR	ON	2021/04/09 10:42
S40	49,314	(geographic$3) near7 (region$3 or boundar$3)	USPAT	OR	ON	2021/04/09 10:42
S41	849	S39 and S40	USPAT	OR	ON	2021/04/09 10:42
S42	6	("20060122776" | "20070025595" | "20130226667" | "20190050625" | "20190130641" | "9389084").PN. OR ("10339646").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2021/04/09 10:57
S43	7	("20060239537" | "20130141540" | "20150169723").PN. OR ("9389084").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2021/04/09 10:57
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S45	10	("2013/0226667").URPN.	USPAT	OR	ON	2021/04/09 10:57
S46	849	S39 and S40	USPAT	OR	ON	2021/04/09 10:58
S47	12	("20040239688" | "20050063563" | "20060267803" | "20120038633" | "20150317597" | "20160300375" | "20160366546" | "20170371897" | "7248285" | "7590259" | "9652681" | "9939813").PN. OR ("10290137").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2021/04/09 10:58
S48	10	("2012/0038633").URPN.	USPAT	OR	ON	2021/04/09 10:58
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4/9/2021 7:43:39 AM
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EAST Search History

S50	10	("2012/0038633").URPN.	USPAT	OR	ON	2021/04/09 10:59
S53	11	("2012/0038633").URPN.	USPAT	OR	ON	2021/04/09 06:32
S54	492	(extract$3) with ((aerial$3) near7 (imag$3))	USPAT	OR	ON	2021/04/09 06:33
S55	44,236	pixel$3 near7 (group$3 or grouping$3)	USPAT	OR	ON	2021/04/09 06:33
S56	59	S54 and S55	USPAT	OR	ON	2021/04/09 06:33
S57	95	("20020154174" | "20030014224" | "20030028393" | "20030115163" | "20030147553" | "20030171957" | "20030233310" | "20040047498" | "20040105090" | "20040105573" | "20040220906" | "20050201618" | "20050203768" | "20050288959" | "20060133699" | "20060137736" | "20060200311" | "20060232605" | "20060262112" | "20060265287" | "20070150366" | "20070179757" | "20070291994" | "20080021683" | "20080105045" | "20080123994" | "20080204570" | "20080221843" | "20080231700" | "20080262789" | "20080273753" | "20080310756" | "20090096884" | "20090097744" | "20090132210" | "20090132436" | "20090141020" | "20090304227" | "20100034483" | "20100110074" | "20100114537" | "20100296693" | "20110096083" | "20110187713" | "5247356" | "5633995" | "6323885" | "6333749" | "6385541" | "6396491" | "6446053" | "6496184" | "6636803" | "6836270" | "6980690" | "7003400" | "7006977" | "7133551" | "7305983" | "7324666" | "7343268" | "7424133" | "7787659" | "7873238" | "7991226" | "7995799" | "8068643" | "8078436" | "8233666").PN. OR ("8731234").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2021/04/09 06:33
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S61	54,432	(geographic$3) near7 (region$3 or boundar$3)	USPAT	OR	ON	2021/04/09 15:22
S62	950	S60 and S61	USPAT	OR	ON	2021/04/09 15:22
S63	22	("10339646" | "10346725" | "20060122776" | "20070025595" | "20090177458" | "20130170694" | "20130226667" | "20150221079" | "20150269720" | "20150302253" | "20160180197" | "20160275801" | "20170200090" | "20170337524" | "20170358068" | "20180218214" | "20180239991" | "20180260626" | "20190050625" | "20190130641" | "7336078" | "9389084").PN. OR ("10467473").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2021/04/09 15:53
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4/9/2021 7:43:39 AM
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16868113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	3694
Examiner Name	NGUYEN, TIEN C
Attorney Docket Number	474139US03

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9704054		2017-07-11	Tappen et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20210142123		2021-05-13	Okazaki	
	2	20170193297		2017-07-06	Michini et al.	

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	1							

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	3694
	Examiner Name	NGUYEN, TIEN C
	Attorney Docket Number	474139US03

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Non-Final Office Action mailed in U.S. Application No. 17/155,633, dated March 23, 2021.	
	2	Notice of Allowance mailed in U.S. Application No. 17/155,633, dated April 9, 2021.	

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	3694
	Examiner Name	NGUYEN, TIEN C
	Attorney Docket Number	474139US03

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2021-05-24
Name/Print	Natalie J. Grace	Registration Number	65803

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	
AON BENFIELD INC.	EXAMINER: NGUYEN, TIEN C.
APPLICATION NO.: 16/868,113	GROUP ART UNIT: 3694
FILED: MAY 6, 2020	DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

INFORMATION DISCLOSURE STATEMENT

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

Applicant wishes to make of record the reference(s) listed on the attached PTO/SB/08a form. This Information Disclosure Statement is being submitted after issuance of the first action of the merits in the above-referenced application. Consequently, a fee of $260 is due pursuant to 37 C.F.R. § 1.17(p). If any additional fees are required, then the Commissioner is authorized to charge such fees or credit any overpayment to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Respectfully submitted,

Date: May 24, 2021

/Natalie J. Grace/
Natalie J. Grace
Attorney of Record
Registration No. 65,803

GARDELLA GRACE P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
Telephone: (703) 556-9600
Facsimile: (703) 740-4541

Electronic Patent Application Fee Transmittal

Application Number:	16868113
Filing Date:	06-May-2020
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Filer:	Natalie J. Grace/Anthony Gorney
Attorney Docket Number:	474139US03

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt	
EFS ID:	42804286
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Anthony Gorney
Filer Authorized By:	Natalie J. Grace
Attorney Docket Number:	474139US03
Receipt Date:	24-MAY-2021
Filing Date:	06-MAY-2020
Time Stamp:	16:51:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$260
RAM confirmation Number	E20215NG52234665
Deposit Account	601484
Authorized User	Anthony Gorney
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2021-05-24_Aon_474139US03_IDS.pdf	1034360 f524ebf3c09d6beb01379dacb02364788982a361	no	4
Warnings:					
Information:					
2	Transmittal Letter	2021-05-24_Aon_474139US03_IDS_transmittal.pdf	15353 6dcd1ebb92da4154ff05ed412fbd01ef72abca61	no	1
Warnings:					
Information:					
3	Non Patent Literature	NPL_17155633_NFOA_03-23-2021.pdf	5951550 754d5fdc1d95a30a8a2a152dabf465120960923b	no	11
Warnings:					
Information:					
4	Non Patent Literature	NPL_17155633_NOA_2021-04-09.pdf	6744894 cf395fe3d860d5463119d739199c7c9aba1fe2ad	no	8
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	30592 341caf713ce93f11a0b64e141da5b5426ef7ae98	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	13776749		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/868,113	Filing Date 05/06/2020	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/13/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	Team Leader
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JASMINE C GLENN/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	|
AON BENFIELD INC.	| EXAMINER: TIEN C. NGUYEN
APPLICATION NO.: 16/868,113	| GROUP ART UNIT: 3694
FILED: MAY 6, 2020	| DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	|

AMENDMENT UNDER 37 C.F.R. § 1.111

MAIL STOP AMENDMENTS
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Non-Final Office Action dated April 13, 2021, please amend the above-identified application as follows.

A two-month extension of time is hereby petitioned. If additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned. If any additional fees are required, including fees for extensions of time, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Amendments to the Claims begin on page **2** of this paper.

Remarks begin on page **8** of this paper.

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (Cancelled)

2. (New) A system for automatically assessing features of a property location comprising a structure, the system comprising:

a non-volatile computer readable medium storing

a set of property characteristic profiles, each property characteristic profile of the set of property characteristic profiles being developed through training one or more machine learning algorithms using first property images to identify one or more characteristics of at least one property feature of one or more property features, and

a set of property condition profiles, each property condition profile of the set of property condition profiles being developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and

processing circuitry configured to

receive, from a user at a remote computing device via a network, a request comprising identification of a property location,

access aerial imagery of the property location,

classify a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features,

identifying the respective feature from at least one image obtained from the aerial imagery,

applying one or more property characteristic profiles of the set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein

a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and

applying one or more property condition profiles of the set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, and

responsive to receiving the request, cause presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

3. (New) The system of claim 2, wherein identifying the respective feature from the at least one image comprises extracting, from the at least one image, one or more pixel groupings representing the respective feature.

4. (New) The system of claim 3, wherein each pixel grouping of the one or more pixel groupings comprises angles, outlines, and/or substantially homogenous pixel fields.

5. (New) The system of claim 2, wherein the aerial imagery comprises at least one aerial image of a geographic region including the property.

6. (New) The system of claim 2, wherein the one or more characteristics of a first feature of the one or more property features comprises a shape characteristic and a material characteristic.

7. (New) The system of claim 2, wherein the information regarding a first feature of the at least one property feature comprises identification of at least one of a shape or a material of the first feature.

8. (New) The system of claim 2, wherein the information regarding a first feature of the at least one property feature comprises a condition classification indicating at least one of: a good condition, an acceptable condition, a needs repair condition, or a needs replacement condition.

9. (New) The system of claim 2, wherein the at least one property feature comprises a rooftop and a chimney.

10. (New) The system of claim 2, wherein at least one profile of the one or more property condition profiles includes a convolutional neural network (CNN).

11. (New) The system of claim 2, wherein the processing circuitry is further configured to compare a current condition classification of the property characteristic to a historic condition classification of the property characteristic.

12. (New) The system of claim 2, wherein at least one profile of the one or more property condition profiles includes a deep learning algorithm for identifying the respective feature within a given image.

13. (New) The system of claim 2, wherein applying the one or more property characteristic profiles of the set of property characteristic profiles to at least the portion of each image of the at least one image to determine the plurality of characteristics of the respective feature comprises approximating a size of the respective feature.

14. (New) A method for automatically assessing features of a property location comprising a structure, the system comprising:

receiving, from a user at a remote computing device via a network, a request comprising identification of a property location;

accessing, by processing circuitry, aerial imagery of the property location;

classifying, by the processing circuitry, a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features,

identifying the respective feature from at least one image obtained from the aerial imagery,

applying one or more property characteristic profiles of a set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein

each property characteristic profile of the set of property characteristic profiles is developed through training one or more machine learning algorithms

using first property images to identify one or more characteristics of at least one property feature of one or more property features, and

a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and

applying one or more property condition profiles of a set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, wherein

each property condition profile of the set of property condition profiles is developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and

responsive to receiving the request, causing presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

15. (New) The method of claim 14, wherein a given feature of the one or more features of the property location comprises a natural feature.

16. (New) The method of claim 14, wherein causing presentation of the graphical user interface comprises causing presentation of an interactive user interface.

17. (New) The method of claim 14, wherein accessing the aerial imagery comprises accessing the aerial imagery via a network from non-volatile storage media.

18. (New) The method of claim 14, wherein a first property condition profile of a set of property condition profiles includes a color histogram machine learning analysis model.

19. (New) The method of claim 14, wherein the set of property characteristic profiles are part of a neural network.

20. (New) The method of claim 14, wherein:

the property location comprises multiple structures; and

classifying the condition of one or more features of the property location comprises

classifying the condition of one or more features of each structure of the multiple structures.

21. (New) The method of claim 14, further comprising, prior to classifying the condition, adjusting color of the at least one image.

REMARKS

Status of the Claims

Claims 2-21 are currently pending. Claim 1 is hereby cancelled without prejudice or disclaimer. Claims 2-21 are new. The present amendments introduce no new matter.

Double Patenting Rejection

In the Office Action dated April 13, 2021 ("Office Action"), claim 1 is rejected on the ground of nonstatutory double patenting as being allegedly unpatentable over claim 1 of U.S. Patent No. 10,650,285 and claim 1 of U.S. Patent No. 10,529,029. *Office Action* at pp. 2-3. Applicant hereby cancels claim 1, rendering the rejection moot.

No Disclaimers or Disavowals

Although this paper may amend the specification or claims, identify claimed features not taught or suggested in the prior art, or otherwise distinguish the claimed subject matter from the prior art, Applicant(s) are not conceding that the subject matter of any previously pending claim is not patentable over the prior art. Applicant(s) reserve the right to later pursue claims covering any of the subject matter embraced by the previously pending claims or supported by the specification and drawings as filed. Accordingly, the Office should not infer from this paper any disclaimer or disavowal of any subject matter.

CONCLUSION

In view of the above, it is believed that the claims, as amended, are in condition for allowance. Favorable reconsideration of this application is respectfully requested. Examiner Nguyen is encouraged to contact Representative Natalie Grace at 703-740-4538 should any additional information be necessary to advance prosecution and accelerate allowance.

Respectfully submitted,

/Natalie J. Grace/

Natalie J. Grace
Attorney of Record
Registration No. 65,803

Date: September 13, 2021

GARDELLA GRACE P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
Telephone: (703) 556-9600
Facsimile: (703) 740-4541

Electronic Patent Application Fee Transmittal

Application Number:	16868113
Filing Date:	06-May-2020
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Filer:	Natalie J. Grace/Anthony Gorney
Attorney Docket Number:	474139US03

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 2 months with $0 paid	1252	1	640	640
Miscellaneous:				
			Total in USD ($)	**640**

Electronic Acknowledgement Receipt	
EFS ID:	43748824
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Anthony Gorney
Filer Authorized By:	Natalie J. Grace
Attorney Docket Number:	474139US03
Receipt Date:	13-SEP-2021
Filing Date:	06-MAY-2020
Time Stamp:	15:58:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$640
RAM confirmation Number	E20219CF59343147
Deposit Account	601484
Authorized User	Anthony Gorney
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.20 (Post Issuance fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-09-13_Aon_474139US03_ResponseNFOA.pdf	293366 e2adc3eb062a893c4fc5da981ca491bd1f31f2f5	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	9

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	38659 9f24907c2aa32d765b12250609b3933beca334a4	no	2

Warnings:

Information:

Total Files Size (in bytes):	332025

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New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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NOTICE OF ALLOWANCE AND FEE(S) DUE

146018 7590 10/01/2021

Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

EXAMINER	
NGUYEN, TIEN C	
ART UNIT	PAPER NUMBER
3694	

DATE MAILED: 10/01/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	05/06/2020	Takeshi Okazaki	474139US03	5664

TITLE OF INVENTION: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/03/2022

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

146018 7590 10/01/2021
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	05/06/2020	Takeshi Okazaki	474139US03	5664

TITLE OF INVENTION: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/03/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, TIEN C	3694	382-224000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

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❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	05/06/2020	Takeshi Okazaki	474139US03	5664

146018 7590 10/01/2021

Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

EXAMINER	
NGUYEN, TIEN C	
ART UNIT	PAPER NUMBER
3694	

DATE MAILED: 10/01/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/868,113	Applicant(s) Okazaki, Takeshi	
	Examiner TIEN C NGUYEN	Art Unit 3694	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 9/13/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 2-21 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TIEN C NGUYEN/
Primary Examiner, Art Unit 3694

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Examiner's Statement of Reasons for Allowance

1. The following an Allowance in response filed on 9/13/2021.

2. Claims 2-21 are newly added.

3. Claim 1 is canceled.

4. Therefore, claims 2-21 are pending and allowed below.

Reasons for Allowance

5. The following is an examiner's statement of reasons for allowance:

Regarding the 35 USC 101 in view of Alice rejections, Applicant's claims recite the additional limitations of "…storing a set of property characteristic profiles, each property characteristic profile of the set of property characteristic profiles being developed through training one or more machine learning algorithms using first property images to identify one or more characteristics of at least one property feature of one or more property features, and a set of property condition profiles, each property condition profile of the set of property condition profiles being developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; receive, from a user at a remote computing device via a network, a request comprising identification of a property location, access aerial imagery of the property location, classify a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features, identifying the respective feature from at least one image obtained from the aerial imagery, applying one or more property characteristic profiles of the set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein a first

characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and applying one or more property condition profiles of the set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, and responsive to receiving the request, cause presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature", when viewed as an ordered combination, these additional limitations of the claims are significantly more than automatically assessing features of a property location and categorizing a condition of a characteristic of a property. Thus, the claims are patent eligible.

Regarding the 35 USC 103 rejections, Swanson et al. (8,775,219) teaches a method and a system relates to using remote sensing capabilities like hyperspectral imaging to identify roof characteristics for insurance purposes. Downey et al. (2015/0325064) teaches methods, systems, and apparatus, including computer programs encoded on computer storage media, for unmanned aerial vehicle authorization and geofence envelope determination. Cuttell et al. (2015/0310558) teaches a computer implemented method for linking an underwriting action to a customer is presented. The method receives an inspection model corresponding to a geographic location associated with a structure and determines that a virtual inspection is necessary based on the inspection model. The method also retrieves a first aerial image corresponding to the geographic location and a second aerial image corresponding to the geographic location and a time threshold. The method further receives a comparison data value corresponding to the first and second aerial image, determines an underwriting action based on the comparison data and links the underwriting action to a customer account. Swanson, Downey and Cuttell does not teach a method and a system for automatically assessing features of a property location comprising a structure, the method and the system comprising:

a non-volatile computer readable medium storing a set of property characteristic profiles, each property characteristic profile of the set of property characteristic profiles being developed through training one or more machine learning algorithms using first property images to identify one or more characteristics of at least one property feature of one or more property features, and a set of property condition profiles, each property condition profile of the set of property condition profiles being developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and processing circuitry configured to receive, from a user at a remote computing device via a network, a request comprising identification of a property location, access aerial imagery of the property location, classify a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features, identifying the respective feature from at least one image obtained from the aerial imagery, applying one or more property characteristic profiles of the set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and applying one or more property condition profiles of the set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, and responsive to receiving the request, cause presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the

issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to TIEN C. NGUYEN whose telephone number is 571-270-5108. The examiner can normally be reached on Monday-Thursday (6am-2pm EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ben Sigmond can be reached on 303-297-4411. The fax phone number for the organization where this application or proceeding is assigned is 571-270-6108.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TIEN C NGUYEN/
Primary Examiner, Art Unit 3694

Notice of References Cited	Application/Control No. 16/868,113	Applicant(s)/Patent Under Reexamination Okazaki, Takeshi	
	Examiner TIEN C NGUYEN	Art Unit 3694	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6732120-B1	05-2004	Du; Mike	G01C21/20	715/764
*	B	US-8775219-B2	07-2014	Swanson; Aaron L.	G06Q50/16	705/4
*	C	US-20090265193-A1	10-2009	COLLINS; Dean	G06Q30/0185	705/4
*	D	US-20150325064-A1	11-2015	Downey; Jonathan	G07C5/004	701/29.3
*	E	US-9846915-B2	12-2017	Howe; Richard L.	G06K9/00637	1/1
*	F	US-20160086285-A1	03-2016	Jordan Peters; Julie A.	G08G1/096827	705/4
*	G	US-20130226667-A1	08-2013	Terrazas; Alex	G06Q30/0205	705/7.34
*	H	US-20050063563-A1	03-2005	Soliman, Samir S.	H04N1/00204	382/104
*	I	US-8731234-B1	05-2014	Ciarcia; Christopher Albert	G06K9/4604	382/100
*	J	US-20140032433-A1	01-2014	Eick; Stephen G.	G06Q50/163	705/314
*	K	US-20100215212-A1	08-2010	Flakes, JR.; Malcolm S.	G06K9/00637	382/100
*	L	US-8346578-B1	01-2013	Hopkins, III; John Chandler	G06Q50/16	705/4
*	M	US-20100179787-A2	07-2010	Pershing; Chris	G06Q40/08	702/156

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Extracting information from remote sensing data for applications to flood monitoring and damage evaluation; 2012 Tyrrhenian Workshop on Advances in Radar and Remote Sensing (TyWRRS) (Page(s): 275-282); S. B. Serpico, S. Dellepiane, G. Moser, E. Angiati, G. Boni, R. Rudari, L. Candela, 1-Sep-2012. (Year: 2012).
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	Art Unit
	TIEN C NGUYEN	3694

CPC - Searched*		
Symbol	**Date**	**Examiner**
G06Q	09/22/2021	/tn/

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**
G 06Q 40/08, G 06Q 40/02, G 06Q 10/10, G 06F19/328, G 06Q 30/02.	09/22/2021	/tn/

/TIEN C NGUYEN/ Primary Examiner, Art Unit 3694	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	Art Unit
	TIEN C NGUYEN	3694

US Classification - Searched*			
Class	Subclass	Date	Examiner
705	36	09/22/2021	/tn/
705	37	09/22/2021	/tn/
705	38	09/22/2021	/tn/
705	39	09/22/2021	/tn/
705	40	09/22/2021	/tn/
705	4	09/22/2021	/tn/
705	5	09/22/2021	/tn/
705	2	09/22/2021	/tn/
705	3	09/22/2021	/tn/
705	26.4	09/22/2021	/tn/
705	27.1	09/22/2021	/tn/
706	25	09/22/2021	/tn/
706	45	09/22/2021	/tn/
318	611	09/22/2021	/tn/
715	708	09/22/2021	/tn/
235	375	09/22/2021	/tn/
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235	451	09/22/2021	/tn/
340	540	09/22/2021	/tn/
358	1.14	09/22/2021	/tn/
719	328	09/22/2021	/tn/
717	108	09/22/2021	/tn/
709	226	09/22/2021	/tn/
715	704	09/22/2021	/tn/
715	753	09/22/2021	/tn/
709	227	09/22/2021	/tn/

/TIEN C NGUYEN/ Primary Examiner, Art Unit 3694	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	Art Unit
	TIEN C NGUYEN	3694

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
East and PALM.	09/22/2021	/tn/
Google search.	09/22/2021	/tn/
Assignee search.	09/22/2021	/tn/
Inventor search.	09/22/2021	/tn/
Search SN# 16/868113 and 15/714376.	09/22/2021	/tn/
Updated East and PALM.	09/22/2021	/tn/
IP Plus. com NPL searches.	09/22/2021	/tn/

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
G06Q	4/ 40/00	09/22/2021	/tn/
G06Q	4/ 40/06	09/22/2021	/tn/
G06Q	4/ 40/08	09/22/2021	/tn/

/TIEN C NGUYEN/ Primary Examiner, Art Unit 3694	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	**Art Unit**
	TIEN C NGUYEN	3694

CPC						
Symbol					**Type**	**Version**
G06K	/	9	/	6268	F	2013-01-01
G06K	/	9	/	0063	I	2013-01-01
G06N	/	20	/	20	I	2019-01-01
G06T	/	7	/	0002	I	2013-01-01
G06N	/	3	/	08	I	2013-01-01
G06K	/	9	/	4671	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/TIEN C NGUYEN/ Art Unit 3694	22 September 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20210403

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	**Art Unit**
	TIEN C NGUYEN	3694

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06Q	/	40	/	00
NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
705	4

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					
705	2	3	5			
705	39					
705	37					
705	38					
709	217	218				
706	25	45				
719	328					
717	108					
715	704					
709	227					
726	9	6				
235	375					
235	380	379	451			
715	700					
463	25	20				
446	268	431				
700	236					
700	245					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/TIEN C NGUYEN/ Art Unit 3694	22 September 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20210403

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/868,113	Okazaki, Takeshi
	Examiner	**Art Unit**
	TIEN C NGUYEN	3694

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1	9	10	18	19										
1	2	10	11	19	20										
2	3	11	12	20	21										
3	4	12	13												
4	5	13	14												
5	6	14	15												
6	7	15	16												
7	8	16	17												
8	9	17	18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/TIEN C NGUYEN/ Art Unit 3694	22 September 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20210403

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16868113
Filing Date	2020-05-06
First Named Inventor	Takeshi Okazaki
Art Unit	3694
Examiner Name	NGUYEN, TIEN C
Attorney Docket Number	474139US03

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9704054		2017-07-11	Tappen et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20210142123		2021-05-13	Okazaki	
	2	20170193297		2017-07-06	Michini et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	3694
	Examiner Name	NGUYEN, TIEN C
	Attorney Docket Number	474139US03

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Non-Final Office Action mailed in U.S. Application No. 17/155,633, dated March 23, 2021.	
	2	Notice of Allowance mailed in U.S. Application No. 17/155,633, dated April 9, 2021.	

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Examiner Signature	/TIEN C NGUYEN/	Date Considered	09/22/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16868113
	Filing Date	2020-05-06
	First Named Inventor	Takeshi Okazaki
	Art Unit	3694
	Examiner Name	NGUYEN, TIEN C
	Attorney Docket Number	474139US03

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Natalie J. Grace/	Date (YYYY-MM-DD)	2021-05-24
Name/Print	Natalie J. Grace	Registration Number	65803

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Main Concept Text
==========
Analyze aerial imagery, automatically extract characteristics of individual properties and classify the repair conditions of individual properties.

(No Concept Modifiers)
==========

Filters (2)
==========
Publication Date: To 2016-09-23

Body Text+Related Terms limited to: storing a set of property characteristic profiles, each property characteristic profile of the set of property characteristic profiles being developed through training one or more machine learning algorithms using first property images to identify one or more characteristics of at least one property feature of one or more property features.

Body Text+Related Terms limited to: developed condition profiles through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features.

Body Text+Related Terms limited to: receive a request comprising identification of a property location, access aerial imagery of the property location, classify a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features, identifying the respective feature from at least one image obtained from the aerial imagery, applying one or more property characteristic profiles of the set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature.

Body Text+Related Terms limited to: receive a request comprising a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and applying one or more property condition profiles of the set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, and responsive to receiving the request, cause presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

Options

=======
De-dup: None
Cut-off: None
Sort: Relevance

Content: Non-Patent Literature (23)
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IEEE Xplore Publications: IEEE Periodicals
IEEE Xplore Publications: IEEE Conferences
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IEEE Xplore Publications: IEEE Early Access
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CONFIRMATION NO. 5664

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
16/868,113	05/06/2020	382	3694	474139US03

APPLICANTS
Aon Benfield Inc., Chicago, IL;

INVENTORS
Takeshi Okazaki, Tokyo, JAPAN;

**** CONTINUING DATA ***************************
This application is a CON of 16/733,888 01/03/2020 PAT 10650285
which is a CIP of 15/714,376 09/25/2017 PAT 10529029
which claims benefit of 62/398,665 09/23/2016

**** FOREIGN APPLICATIONS ***************************

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05/12/2020

Foreign Priority claimed ❑ Yes ☑ No 35 USC 119(a-d) conditions met ❑ Yes ☑ No Verified and Acknowledged /TIEN C NGUYEN/ Examiner's Signature	❑ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		JAPAN	15	1	1

ADDRESS
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003
UNITED STATES

TITLE
PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

FILING FEE RECEIVED		
1980	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other _____ ❑ Credit

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	17,639	(G06K9/6268 or G06K9/0063 or G06N20/20 or G06T7/0002 or G06N3/08 or G06K9/4671 or G06T2207/20084 or G06T2207/10032 or G06T2207/30184 or G06T2207/20081 or G06T2207/20076 or G06T7/00 or G06K9/6271 or G06K9/00637 or G06N3/0454).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:40
L2	10,209	aerial$3 near7 imag$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:40
L3	62,053	(geographic$3) near7 (region$3 or boundar$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:40
L4	1,124	L2 and L3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:40
L5	498,951	receiv$3 near7 request$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:41
L6	163,204	(property or properties or house or houses or "real property" or resident$3) near7 (characteristic$3 or identification$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2021/09/22 08:41

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L8	9,672	L7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:41
L9	43	8 and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:42
L10	10	9 and 1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:42
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L12	422	("2009/0265193").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 08:42
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S1	399,871	receiv$3 near7 request$3	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2021/09/22 05:27

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S2	142,259	(property or properties or house or houses or "real property" or resident$3) near7 (characteristic$3 or identification$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:29
S3	7,105	S1 and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:29
S4	8,039	aerial$3 near7 imag$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:29
S5	46,894	(geographic$3) near7 (region$3 or boundar$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:30
S6	791	S4 and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:30
S7	30	S3 and S6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2021/09/22 05:30

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S8	4	("5519809" | "5559707" | "5966135" | "6732120").PN. OR ("9760649").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:31
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S10	26,181	(property or properties or house or houses or "real property" or resident$3) near7 (damag$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:33
S11	106	(property or properties or house or houses or "real property" or resident$3) near7 (damag$3) with disaster$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:33
S12	4	S11 and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:33
S13	2	("20180089763").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:34
S14	0	("2018/0089763").URPN.	US-PGPUB;	OR	ON	2021/09/22 05:35

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S17	174	("2009/0265193").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:37
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		("9513635").URPN.				
S19	16	("2015/0325064").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:39
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S21	80	("20080059068" | "20090265193" | "20100012776" | "20100215212" | "20100228418" | "20100268409" | "20100286859" | "20110270470" | "20120170797" | "20120197461" | "20120250010" | "20120271461" | "20130206915" | "20130216089" | "20130238168" | "20140061376" | "20140259549" | "20140267627" | "20140277842" | "20140316614" | "20140316616" | "20140324405" | "20140336928" | "20150325064" | "20150343644" | "20150344136" | "20150377405" | "20160004795" | "20160176542" | "4818990" | "5575438" | "7400384" | "7496226" | "7872794" | "7929125" | "8060270" | "8207484" | "8212995" | "8346578" | "8818572" | "8830485" | "8872818" | "8874283" | "8896819" | "8997362" | "9009000" | "9129355" | "9152863" | "9162753" | "9256225" | "9256994" | "9273981" | "9310221" | "9329599" | "9340283" | "9403593" | "9406237").PN. OR ("9609288").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 05:40
S22	8	"8775219"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 06:19
S23	449	(extract$3) with ((aerial$3) near7 (imag$3))	US-PGPUB; USPAT;	OR	ON	2021/09/22 10:32

9/22/2021 5:45:39 AM
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EAST Search History

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S27	1	S25 and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 10:34
S28	47,173	(risk$3 or damag$3) near7 (estimat$3 or determin$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 10:35
S29	1	S27 and S28	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/09/22 10:35

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S41	849	S39 and S40	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 10:42
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S45	10	("2013/0226667").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 10:57
S46	849	S39 and S40	US-PGPUB;	OR	ON	2021/09/22 10:58

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S53	11	("2012/0038633").URPN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 06:32
S54	492	(extract$3) with ((aerial$3) near7 (imag$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2021/09/22 06:33

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S56	59	S54 and S55	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 06:33
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S60	9,051	aerial$3 near7 imag$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 15:22
S61	54,432	(geographic$3) near7 (region$3 or boundar$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/09/22 15:22

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	|
AON BENFIELD INC.	| EXAMINER: TIEN C. NGUYEN
APPLICATION NO.: 16/868,113	| GROUP ART UNIT: 3694
FILED: MAY 6, 2020	| DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	|

AMENDMENT AFTER ALLOWANCE UNDER 37 CFR § 1.312

MAIL STOP ISSUE FEE
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Notice of Allowance dated October 1, 2021, please amend the above-identified application as follows.

Applicant does not believe that any fees are due at this time. If, however, any fees are required, including fees for extensions of time, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Amendments to the Specification begin on page **2** of this paper.

Amendments to the Claims begin on page **3** of this paper.

Remarks begin on page **9** of this paper.

AMENDMENTS TO THE SPECIFICATION

Please amend the Specification as follows:

In accordance with 37 CFR §§ 1.121(b)(3), and 1.125, please amend paragraphs **[0002]**, **[0045]**, **[0048]**, **[0053]**, **[0059]**, **[0068]**, **[0083]**, **[0086]**, **[0087]** and **[00101]** of the Specification as indicated in the attached marked-up version of the substitute specification. An accompanying clean version of the specification, incorporating changes of the marked-up version of the substitute specification, is also attached herewith. The substitute specification includes no new matter.

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (Cancelled)

2. (Allowed) A system for automatically assessing features of a property location comprising a structure, the system comprising:

a non-volatile computer readable medium storing

a set of property characteristic profiles, each property characteristic profile of the set of property characteristic profiles being developed through training one or more machine learning algorithms using first property images to identify one or more characteristics of at least one property feature of one or more property features, and

a set of property condition profiles, each property condition profile of the set of property condition profiles being developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and

processing circuitry configured to

receive, from a user at a remote computing device via a network, a request comprising identification of a property location,

access aerial imagery of the property location,

classify a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features,

identifying the respective feature from at least one image obtained from the aerial imagery,

applying one or more property characteristic profiles of the set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein

a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and

applying one or more property condition profiles of the set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, and

responsive to receiving the request, cause presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

3. (Allowed) The system of claim 2, wherein identifying the respective feature from the at least one image comprises extracting, from the at least one image, one or more pixel groupings representing the respective feature.

4. (Allowed) The system of claim 3, wherein each pixel grouping of the one or more pixel groupings comprises angles, outlines, and/or substantially homogenous pixel fields.

5. (Allowed) The system of claim 2, wherein the aerial imagery comprises at least one aerial image of a geographic region including the property.

6. (Allowed) The system of claim 2, wherein the one or more characteristics of a first feature of the one or more property features comprises a shape characteristic and a material characteristic.

7. (Allowed) The system of claim 2, wherein the information regarding a first feature of the at least one property feature comprises identification of at least one of a shape or a material of the first feature.

8. (Allowed) The system of claim 2, wherein the information regarding a first feature of the at least one property feature comprises a condition classification indicating at least one of: a good condition, an acceptable condition, a needs repair condition, or a needs replacement condition.

9. (Allowed) The system of claim 2, wherein the at least one property feature comprises a rooftop and a chimney.

10. (Allowed) The system of claim 2, wherein at least one profile of the one or more property condition profiles includes a convolutional neural network (CNN).

11. (Allowed) The system of claim 2, wherein the processing circuitry is further configured to compare a current condition classification of the property characteristic to a historic condition classification of the property characteristic.

12. (Allowed) The system of claim 2, wherein at least one profile of the one or more property condition profiles includes a deep learning algorithm for identifying the respective feature within a given image.

13. (Allowed) The system of claim 2, wherein applying the one or more property characteristic profiles of the set of property characteristic profiles to at least the portion of each image of the at least one image to determine the plurality of characteristics of the respective feature comprises approximating a size of the respective feature.

14. (Allowed-Currently Amended) A method for automatically assessing features of a property location comprising a structure, the ~~system~~ method comprising:

receiving, from a user at a remote computing device via a network, a request comprising identification of a property location;

accessing, by processing circuitry, aerial imagery of the property location;

classifying, by the processing circuitry, a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features,

identifying the respective feature from at least one image obtained from the aerial imagery,

applying one or more property characteristic profiles of a set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein

each property characteristic profile of the set of property characteristic profiles is developed through training one or more machine learning algorithms

using first property images to identify one or more characteristics of at least one property feature of one or more property features, and

a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and

applying one or more property condition profiles of a set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, wherein

each property condition profile of the set of property condition profiles is developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and

responsive to receiving the request, causing presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

15. (Allowed) The method of claim 14, wherein a given feature of the one or more features of the property location comprises a natural feature.

16. (Allowed) The method of claim 14, wherein causing presentation of the graphical user interface comprises causing presentation of an interactive user interface.

17. (Allowed-Currently Amended) The method of claim 14, wherein accessing the aerial imagery comprises accessing the aerial imagery via a second network from non-volatile storage media.

18. (Allowed-Currently Amended) The method of claim 14, wherein a first property condition profile of [[a]] the set of property condition profiles includes a color histogram machine learning analysis model.

19. (Allowed) The method of claim 14, wherein the set of property characteristic profiles are part of a neural network.

20. (Allowed-Currently Amended) The method of claim 14, wherein:

the property location comprises multiple structures; and

classifying the condition of the one or more features of the property location comprises classifying the condition of one or more features of each structure of the multiple structures.

21. (Allowed) The method of claim 14, further comprising, prior to classifying the condition, adjusting color of the at least one image.

REMARKS

Status of the Claims

Claims 2-21 are currently allowed. Claims 14, 17, 18 and 20 are currently amended. The present amendments introduce no new matter.

Amendment to the Specification

The specification as filed is hereby amended to correct minor typographical errors. No new matter has been added.

Amendments to the Claims

The claims are hereby amended to correct minor typographical and antecedent basis errors. No new matter has been added.

No Disclaimers or Disavowals

Although this paper may amend the specification or claims, identify claimed features not taught or suggested in the prior art, or otherwise distinguish the claimed subject matter from the prior art, Applicant(s) are not conceding that the subject matter of any previously pending claim is not patentable over the prior art. Applicant(s) reserve the right to later pursue claims covering any of the subject matter embraced by the previously pending claims or supported by the specification and drawings as filed. Accordingly, the Office should not infer from this paper any disclaimer or disavowal of any subject matter.

CONCLUSION

It is believed that the application, as amended, is in condition for issuance. Favorable reconsideration of this application is respectfully requested. Examiner Nguyen is encouraged to contact Representative Natalie Grace at 703-740-4538 should any additional information be necessary.

Respectfully submitted,

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In the United States Patent and Trademark Office

Application for United States Patent

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

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474139US03

RELATED APPLICATIONS

[0001] This application is a continuation of and claims priority to U.S. Patent Application Serial No. 16/733,888 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Conditions Through Aerial Imagery Analysis" and filed January 3, 2020, which is a continuation-in-part of and claims priority to U.S. Patent Application Serial No. 15/714,376 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis" and filed September 25, 2017, which claims priority to U.S. Provisional Patent Application Serial No. 62/398, 665, entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis," filed September 23, 2016. All above identified applications are hereby incorporated by reference in their entireties.

BACKGROUND

[0002] A risk exposure database contains a compilation of as many building properties or characteristics relevant to insurance as possible. These properties can include characteristics like location coordinates, address, slope, and elevation. Other characteristics include construction type, occupancy type, year built and/or year of renovation, building height, soft stories, number of stories, and floor area. Further characteristics can include roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding (distance to closest building). Some of these characteristics can only be assessed by on-site inspections or by official documentation, but others can be measured using visual imagery.

[0003] Characteristics addressed in this disclosure include roof shape and roof condition. In one example, roof shapes can be broken into five categories: gambrel roof, gable roof, hipped

roof, square roof, and flat roof. Each roof shape has a unique response and damage vulnerability to different natural perils like earthquake or wind.

[0004] Deep learning involves computational models composed of multiple processing layers to learn representations of data with multiple levels of abstractions. These models can be thought of as a way to automate predictive analytics. Representation learning is a set of methods that allows a machine to be fed with raw data and to automatically discover the representations needed for detection or classification. Use cases for deep learning include voice recognition, motion detection, translation, and medical diagnosis. By using deep learning algorithms and sample datasets, computers can learn to distinguish and classify a wide range of characteristics to high levels of accuracy, often surpassing the recognition levels of human beings.

[0005] One model used for deep learning is the Network in Network model described in the paper "Network In Network" by M. Lin et al. and published in the International Conference on Learning Representations, 2014 (arXiv:1409.1556), the contents of which are hereby incorporated by reference in its entirety. Using the Network in Network model, a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification.

[0006] When applied to visual recognition, deep learning algorithms can break down an observation (e.g., an image) in a number of different ways to characterize features of the observation. In some examples, deep learning algorithms can be applied to review images as a set of intensity values per pixel, or in a more abstract way as a set of edges, regions of particular shape, etc. Some representations may demonstrate superior performance to others based upon the particular learning task. One of the promises of deep learning is replacing

human identification of features with efficient algorithms for unsupervised or semi-supervised feature learning and hierarchical feature extraction.

[0007] The inventors recognized that deep learning methodology could be applied to risk exposure database population to analyze aerial imagery and automatically extract characteristics of individual properties, providing fast and efficient automated classification of building styles and repair conditions. In combining location-based vulnerabilities with individual property vulnerabilities identified in part through classification of repair conditions of one or more property features, risk of damage due to disaster can be more accurately estimated.

SUMMARY OF ILLUSTRATIVE EMBODIMENTS

[0008] The forgoing general description of the illustrative implementations and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure, and are not restrictive.

[0009] Systems, methods, and computing system platforms described herein support matching aerial image features of one or more properties to corresponding property conditions (e.g., maintenance levels of property features, including structural features, manmade features included within a vicinity of a structure (e.g., on a property lot, within a property parcel, or a geographic region of the property), and/or natural features included within the vicinity of the structure) through machine learning analysis. In a preferred application, the property condition analysis may be used in estimating damage risk in light of one or more disaster conditions, such as severe storms. The analysis may further aid in estimating costs of repair or replacement of each property, in one example, should a disaster cause the estimated damage. In another example, the analysis may be used to confirm that a property has been repaired.

[0010] In one aspect, the present disclosure relates to a method for automatically categorizing a repair condition or maintenance condition of a property characteristic, including obtaining an aerial image of a geographic region including the property; identifying features of the aerial image corresponding to the property characteristic; analyzing the features to determine a property characteristic classification; analyzing a region of the aerial image including the property characteristic to determine a condition classification; and determining, using the property characteristic classification and the condition classification, a risk estimate of damage to the property due to one or more disasters. The property characteristic of a structure such as a house, factory, or barn, in some examples, can include a rooftop, porch, chimney, or skylights. Property characteristics of manmade structures within a property location, in some examples, can include a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, equipment or vehicles, or greenhouse. Property characteristics of natural features within a property location, in some examples, include trees, ponds, marshes, rivers, lakes, grasses, cliffs, or ocean shore. Further, property characteristic classifications can include shapes, materials, size (breadth and/or height, relative or actual), and/or distance of the property characteristic from other features. In some embodiments, the property characteristic classification may include existing versus not existing (e.g., in the event of determining replacement or removal of a manmade feature at a property location such as a fence). The property characteristic classification, in a particular illustration, may be a rooftop shape. Analyzing the features to determine a property characteristic may include applying a deep learning analysis model to the features. The deep learning analysis model may be NIN.

[0011] In some embodiments, analyzing the region of the aerial image including the property characteristic to determine the condition classification includes applying a machine learning analysis model to image pixels within the region. The machine learning analysis model may

include a color histogram analysis model. The condition classification may encompass classifications good and bad. Determining the risk estimate may include applying a disaster risk profile corresponding to a first disaster of the at least one disaster and the property characteristic.

[0012] In one aspect, the present disclosure relates to a system for automatically categorizing a repair condition of a property characteristic, the system including processing circuitry and a non-transitory computer-readable medium having instructions stored thereon. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to obtain an aerial image of a geographic region including the property; identify features of the aerial image corresponding to the property characteristic; analyze the features to determine a property characteristic classification; analyze a region of the aerial image including the property characteristic to determine a condition classification; and determine, using the property characteristic classification and the condition classification, a replacement cost for replacing the property characteristic. The aerial image may be a two-dimensional aerial image.

[0013] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to identifying the features, obtain a shape map image including the property; overlay the aerial image with the shape map image; and determine whether a boundary of the property as identified by the shape map matches a boundary of the property as illustrated in the aerial image. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, upon determining that the shape map does not match the boundary of the corresponding property, obtain an alternate aerial image of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, prior to identifying the features, assess orthogonality of the aerial imagery. The property may be a single family home.

[0014] In one aspect, the present disclosure relates to a non-transitory computer readable medium having instructions stored thereon, where the instructions, when executed by processing circuitry, cause the processing circuitry to receive identification of a property and at least one property characteristic; obtain an aerial image of a geographic region including the property; and identify respective features of the aerial image corresponding to each property characteristic of the at least one property characteristic. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, for each property characteristic, analyze the corresponding features to determine a respective property characteristic classification, and analyze a region of the aerial image including the respective property characteristic to determine a respective condition classification. The instructions, when executed by the processing circuitry, may cause the processing circuitry to determine, using the property characteristic classification of each property characteristic and the condition classification of each property characteristic, at least one risk estimate representing risk of damage due to disaster.

[0015] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to obtaining the aerial image of the geographic region, determine, based upon the at least one property characteristic, a preferred image type corresponding to each property characteristic of the at least one property characteristic. The at least one property characteristic may include two or more property characteristics. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, responsive to determining the preferred image type corresponding to a first property characteristic of the at least one property characteristic is a terrestrial image, obtain a terrestrial image of the geographic region including the property.

[0016] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to access one or more known property characteristics.

Determining the at least one risk estimate may include determining the at least one risk estimate further based on the one or more known property characteristics. The one or more known property characteristics may include at least one of a property age, a property elevation, a property slope, a year built, a year renovated, and a building height.

[0017] In some embodiments, receiving identification of the property and the at least one property characteristic includes receiving, via a network from a remote computing device, the identification of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to provide, via the network to the remote computing device in real-time responsive to receiving the at least one property characteristic, the at least one risk estimate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one or more embodiments and, together with the description, explain these embodiments. The accompanying drawings have not necessarily been drawn to scale. Any values dimensions illustrated in the accompanying graphs and figures are for illustration purposes only and may or may not represent actual or preferred values or dimensions. Where applicable, some or all features may not be illustrated to assist in the description of underlying features. In the drawings:

[0019] FIG. 1 is a flow diagram of an example system operational flow for matching aerial image features to corresponding property maintenance levels;

[0020] FIG. 2A illustrates example characteristic classifications and corresponding risk profile data;

[0021] FIG. 2B illustrates examples of condition characteristics and corresponding example histograms;

[0022] FIG. 2C illustrates an example condition profile corresponding to an example property characteristic type;

[0023] FIG. 2D is an example error rate graph comparing training data with test data in conducting matching aerial image features to corresponding rooftop shapes;

[0024] FIG. 3 is a block diagram of an example environment for matching aerial image topographical features to corresponding property maintenance levels;

[0025] FIG. 4 is a flow chart of an example method for classifying condition characteristics of a property based on aerial image analysis;

[0026] FIG. 5A illustrates an example structure shape map of a geographic area;

[0027] FIG. 5B illustrates an example two-dimensional aerial image of the geographic area of FIG. 5A;

[0028] FIG. 5C illustrates an example overlay map image of a section of the structure shape map of FIG. 5A overlaying a corresponding section of the aerial image of FIG. 5B;

[0029] FIG. 6 is a block diagram of an example computing system;

[0030] FIG. 7 is a block diagram of an example distributing computing environment including a cloud computing environment; and

[0031] FIGs. 8A, 8B, and 8C illustrate a series of example user interface screen shots for reviewing property characteristic and maintenance level information.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0032] The description set forth below in connection with the appended drawings is intended to be a description of various, illustrative embodiments of the disclosed subject matter. Specific features and functionalities are described in connection with each illustrative embodiment; however, it will be apparent to those skilled in the art that the disclosed embodiments may be practiced without each of those specific features and functionalities.

[0033] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments. Further, it is intended that embodiments of the disclosed subject matter cover modifications and variations thereof.

[0034] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context expressly dictates otherwise. That is, unless expressly specified otherwise, as used herein the words "a," "an," "the," and the like carry the meaning of "one or more." Additionally, it is to be understood that terms such as "left," "right," "top," "bottom," "front," "rear," "side," "height," "length," "width," "upper," "lower," "interior," "exterior," "inner," "outer," and the like that may be used herein merely describe points of reference and do not necessarily limit embodiments of the present disclosure to any particular orientation or configuration. Furthermore, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components, steps, operations, functions, and/or points of reference as disclosed herein, and likewise do not necessarily limit embodiments of the present disclosure to any particular configuration or orientation.

[0035] Furthermore, the terms "approximately," "about," "proximate," "minor variation," and similar terms generally refer to ranges that include the identified value within a margin of 20%, 10% or preferably 5% in certain embodiments, and any values therebetween.

[0036] All of the functionalities described in connection with one embodiment are intended to be applicable to the additional embodiments described below except where expressly

stated or where the feature or function is incompatible with the additional embodiments. For example, where a given feature or function is expressly described in connection with one embodiment but not expressly mentioned in connection with an alternative embodiment, it should be understood that the inventors intend that that feature or function may be deployed, utilized or implemented in connection with the alternative embodiment unless the feature or function is incompatible with the alternative embodiment.

[0037] Turning to FIG. 1, a flow diagram of an example system operational flow 100 for matching aerial image features to corresponding property maintenance levels obtains images (104) at property locations 102b is illustrated. In some implementations, commencement of at least a portion of the operational flow 100 by the system may be triggered by a property classification request submitted by a user, such as an insurance carrier or real estate investment broker at a dashboard interface screen on a computing device connected to the system via a network. For example, as illustrated in FIG. 8A, a particular property or, alternatively, a neighborhood of properties, may be selected within a map view user interface 800. The operational flow 100 may be used to analyze the condition of features of each property at each property location 102b based on aerial imagery 102c. In some implementations, the operational flow 100 may aid in estimating costs of repair or replacement of each property characteristic detected in the aerial images, for example. In another example, the operational flow 100 may be used to confirm that a property location 102b has been repaired.

[0038] The property locations 102b may represent, in some examples, locations of properties insured by a particular insurer, locations of properties recently affected by a disaster such as a tornado, hurricane, earthquake, fire, storm surge, or explosion, locations of properties held in an investment portfolio, or locations of properties considered for addition to an investment

portfolio. The property locations 102b may be identified, in some examples, by a street address, global positioning system coordinates, or other geographic coordinates.

[0039] In some implementations, the operational flow 100 obtains images (104) at each property location 102b. The images can include aerial imagery 102c stored by the system or accessed by the system from a remote networked location. The aerial imagery 102c, for example, may include a three-dimensional or two-dimensional image of a geographic location including at least one of the property locations 102b. In one example, based upon street address or geographic coordinates, the system may query a remote database to obtain recent aerial imagery 102c including an image of at least one of the property locations 102b. The remote database, in some examples, can include private industry databases such as Google® Earth images by Google, Inc. of Mountain View, CA or NTT Geospace Corporation of Japan. In other examples, the remote database can include one or more databases of publicly owned organizations such as the Geospatial Information Authority (GSI) of Japan, the United States Geological Survey, or the Federal Agency for Cartography and Geodesy of Germany. Aerial imagery can be collected from one or more remote network locations, in some embodiments, using an Open Source Geographic Information System (GIS) such as QGIS by the Open Source Geospatial Foundation (OSGeo). The format for the images of the property locations 102b, in some embodiments, depends upon the format accepted by the various sources available for aerial imagery 102c. An example aerial image 510 of multiple property locations 102b is illustrated in FIG. 5B.

[0040] In some embodiments, the system may be configured to query multiple remote database systems to obtain at least two aerial images of a given property location 102b. The aerial images available at the various databases, for example, may differ in resolution and recency of capture. Through collecting two or more images of a particular property, for example, the system may analyze each image to determine a best quality image for use in

condition analysis. The condition analysis can include balancing of multiple factors such as, in some examples, clarity, completeness, and recency.

[0041] Further, in some embodiments, the system may be configured to query multiple remote database systems to obtain both a two-dimensional aerial image and a three-dimensional aerial image. Different property characteristics may be discerned based upon whether the aerial image is captured in two-dimensional or three-dimensional format. Two-dimensional aerial images, in some examples, can be used to determine location coordinates of the property, street name, occupancy type, floor area, existence of skylights, existence of chimneys, roof condition, roof shape, roof covering, roof anchors, roof equipment, and/or pounding. Three-dimensional aerial images, in comparison, can be used to determine location coordinates, street name, construction type, occupancy type, year built, building height, soft stories, number of stories, roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding. Where there is an overlap in characteristics identifiable using either a two-dimensional image or a three-dimensional image, in some embodiments, machine learning analysis of both images can be combined to provide increase confidence in identification of the individual characteristics.

[0042] In some implementations, the system obtains (104) shape map images 102a of each of the property locations 102b. The shape map images 102a, for example, include a block shape layout of existing properties in a municipality, such as urban planning maps used in urban planning and development. The shape map images 102a, in another example, can include block shape layout maps used in presenting information to a user of a computer-based navigation system. The shape map images 102a, in one example, can be obtained from Geospatial Information Authority of Japan or Zenrin Co. Ltd. of Japan. An example of an urban planning map 500 is illustrated in FIG. 5A (image obtained from the Geospatial Information Authority of Japan, Digital Map 2500 (Spatial Data Framework)).

[0043] The shape map images 102a, in some embodiments, are used to confirm location of a particular property. The shape map image 102a of a geographical area, for example, can be overlaid with a corresponding aerial image 102c to match properties with images. An example overlaid image 520 of planning map image 500 of FIG. 5A with aerial image 510 of FIG. 5B is illustrated in FIG. 5C. In some embodiments, the shape map image 102a may not match in shape or location with the aerial image 102c. As illustrated in FIG. 5C, for example, a shape map outline (illustrated in a thickened line) for a location 522 may not be rectangular, while a rooftop shape beneath the outline may be rectangular in shape. In some embodiments, analyzing multiple aerial images 102c to determine the best quality image may include identifying one or more aerial images 102c that substantially align with the corresponding shape map image 102a. The overlay of the aerial image 102c with the shape map image 102a, further, can be used in aiding in cropping the aerial image 102c to focus analysis on a particular property location 102b. For example, turning to FIG. 5C, property location 524 is substantially aligning with the corresponding planning map image, and the general outline can be used in aiding in cropping of the property location 524. In some examples, the property location 524 may be identified within the overlaid image 520 when the property location 524 aligns with a property in the overlaid image 520 within a predetermined tolerance in order to account for renovations that may have been made to the property 524, such as property additions that may alter an overall shape of the property.

[0044] Returning to FIG. 1, in some embodiments, the shape map images 102a may be used to correct or compensate for alignment errors or inconsistencies of the corresponding two-dimensional aerial images 102c. For example, an aerial image representing a normal orthophoto angle may not be directly centered upon the planning map block. Using the planning map block as a guide, for example, the aerial image can be geometrically corrected to obtain a true orthophoto version of the aerial image.

[0045] As illustrated in FIG. 1, in some implementations, the system identifies (106) features of each aerial image 102c to classify property characteristics. Using machine learning for analysis, for example, the system can extract features of the aerial image of a particular property location 102b. Groupings of extracted features, such as angles, outlines, substantially homogenous fields, etc. can be used to identify property features such as rooftop, swimming pool, chimney, and sky lights. The groupings of extracted features, for example, may include pixel groupings obtained through filtering, cropping, or otherwise adjusting the original image. Upon extracting image-related features identifiable as a property feature (e.g., rooftop), the extracted features may be analyzed to determine one or more property characteristics of that feature (e.g., type of rooftop). In one example, a swimming pool may be identified as the property feature of a pool (e.g., various shapes of outlines of a particular size or greater bordering a substantially homogenous field of blue), then characterized as a particular shape (e.g., rectangular, round, or kidney bean, etc.), type (e.g., above ground or in-ground), and/or size (e.g., approximate area). The machine learning classifier used in the machine learning analysis, in some embodiments, includes a convolutional neural network (CNN) to preprocess the aerial image 102c of the particular property location 102b and to classify the property features as property characteristics 110. Using CNN technology, for example, the biological process of visually reviewing and identifying an object or feature of an object is mimicked through a feed-forward artificial neural network where multilayer artificial perception minimizes preprocessing. CNN is a well-established and popular machine-learning methodology. An example of a CNN processing model is Alexnet. (See Krizhevksy et al. "ImageNet Classification with Deep Convolutional Neural Networks", Advances in neural information processing systems, 2012, the entire contents of which has been incorporated herein by reference). In other embodiments, the machine learning classifier may include a Network in Network (NIN)

where a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification. NIN has demonstrated superior performance outcome to conventional CNN processing. Additionally, NIN processing is less storage-intensive than CNN processing.

[0046] In some implementations, property characteristic profiles 108 are used in classifying property features. The property characteristic profiles 108, for example, may be developed through training the machine learning algorithms using aerial images (and, in some embodiments, terrestrial images 102d) of known property characteristics. Each property feature, for example, may be broken down into multiple classifications. In an illustrative example involving a classification of terrestrial images, cladding can include stone, brick, stucco, shingles, vertical boards, horizontal boards, or metal. The machine learning algorithms, for example, may generate a percentage confidence in a match between a new aerial image 102c including a gambrel rooftop and the characteristic profile 108 of gambrel rooftops.

[0047] In an illustrative example, turning to FIG. 2A, extracted angular and outline features of aerial images 204 may be used to classify a roof shape 202 of the particular property location 102b. In a first example, a gable roof 202b includes a central peak upon a generally rectangular outline, as depicted in corresponding aerial image 204b. A gambrel roof 202a includes these features of the gable roof 202b but, as illustrated in aerial image 204a, the gambrel roof additionally includes a "skirt" region surrounding the central gable-shaped portion. The "skirt" region can be identified, in part, based upon its corner edges extending from the four corners of the gable-shaped portion. A hipped roof 202c, as shown in aerial image 204c, includes a central peak and two opposing triangular ends extending from either end of the central peak. The central peak forms a top edge of two trapezoidal sections. A

square roof 202d, in contrast, has no central peak. Instead, as illustrated in aerial image 204d, the square roof includes four triangular portions meeting at a central point. Finally, a flat roof 202e, as shown in aerial image 204e, is represented by a substantially flat surface outlined by a rectangle.

[0048] Turning to FIG. 2D, an example error rate graph 240 compares training data 242 with accuracy of matching test data 244 in matching aerial image rooftop characteristics to corresponding rooftop type (e.g., shape). A test was conducted using NIN deep learning algorithms to classify rooftop shape in two-dimensional aerial images including a mix of gambrel, gable, hipped, square, and flat roof shapes of assorted colors. Further tests involved differing image sizes and mini-batch sizes. In particular, images were scaled using a formula of $y = w * (x\text{-}100) + z$, where x represents a property size (e.g., building with a small border surrounding the area of the rooftop), y represents pixel size, w ranged from 0.33 to 0.40 and z ranged from 90 to 110. The error rates ranged, among initial test cases involving mini batches from 5 to 20, from about 4.3% to about 10%. As shown by the error rate graph 240, in a test situation involving 2,250 sample images in a training dataset 242 and 250 test images in a test dataset 244, the minimum error rate in determining rooftop condition was 6%, corresponding to an accuracy rate of 94%.

[0049] To improve accuracy rate, in some implementations, the image can be cropped and/or resized prior to analyzing. For example, the image may be cropped to include the property of interest, or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Resizing to a standard image size, in another example, can contribute to accuracy improvement.

[0050] Further to roof shape, in some embodiments, feature analysis can be used to discern additional roof features such as, in some examples, roof covering, roof anchors, roof

equipment, skylights, widow's walks, turrets, towers, dormers, and/or chimneys. Furthermore, upon identifying the outline of the roof, a footprint of the property location 102b (e.g., size of the roof) can be calculated based upon a scale of the aerial image 102c.

[0051] Returning to FIG. 1, rather than exclusively analyzing the particular property locations 102b individually, in some implementations, the particular property locations 102b are each classified based in part upon nearby structures. For example, based upon property location 102b dimensions, which may include lot dimensions, machine learning can be used to identify additional structures at the property location 102b such as, in some examples, a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, or greenhouse. Further, the particular property locations 102b may be classified in part based upon distance from neighboring structures and/or natural features (e.g., pounding).

[0052] In some implementations, terrestrial images 102d may be used to classify features difficult to recognize using aerial imagery 102c. The terrestrial images 102d, in some examples, can include street view images obtained from a street view service or real estate listing. In some examples, street view images including a street-facing view of the property location 102b may be obtained from Google® Street View by Google, Inc., Bing® Maps Streetside by Microsoft Corp. of Redmond, WA, or Mapillary by Mapillary AB of Sweden. Using a terrestrial image, for example, the system can identify features such as construction type, cladding, building height, number of soft stories, number of floors, location coordinates, street name, slope, elevation, year built, and/or occupancy type. Where the characteristics identifiable via the terrestrial imagery 102d overlap with characteristics identifiable via two-dimensional or three-dimensional aerial imagery 102c, analysis of terrestrial imagery 102d can be combined with analysis of aerial imagery, in some embodiments, to increase confidence in identification of the particular characteristic(s). For example, house siding

features may be more easily detected in terrestrial imagery 102d and/or three-dimensional aerial imagery 120c than in two-dimensional aerial imagery 102c.

[0053] In some implementations, a condition of each property feature may be classified (112) as a corresponding condition characteristic 116. New properties are in good condition, but property feature conditions can deteriorate over time due to normal wear-and-tear on the property. Further, property features can suffer damage due to external forces such as storms and natural disasters. Eventually, conditions of housing features can deteriorate to the point where repair and/or replacement may be necessary. As with property characteristics described above at block ~~106~~110, machine learning algorithms can be used to classify a present condition of individual detected property features. Using machine learning for analysis, for example, the system can extract pixel intensity distributions of previously identified property features of the aerial image of the particular property location 102b. In some examples, newly constructed property features generally have sharp contrast and well-defined features in machine learning image analysis. Conversely, weathered or damaged property features can have softened edges, blurred contrasts, and asymmetrical patches of wear. The machine learning classifier used in the machine learning condition analysis, in some embodiments, includes a machine learning analysis to process the aerial image 102c of the particular property location 102b and to classify the condition of previously identified property characteristics 110 as condition characteristics 116. The machine learning analysis, in some examples, can include two-dimensional color histogram analysis or three-dimensional color histogram analysis. In other embodiments, the machine learning analysis may be performed using pattern recognition algorithms (e.g., determining missing fence posts or missing/misaligned rooftop shingles). In other embodiments, the machine learning classifier includes deep learning analysis such as CNN or NIN. For example, CNN analysis may leverage feature maps created during the training process to assess the condition through

extracting meaningful features within a given image through convolution and pooling layers. Other machine learning models and algorithms are possible.

[0054] In an illustrative example, turning to FIG. 2B, examples of condition characteristics of aerial images of hipped rooftops and corresponding example histograms generated through machine learning analysis of pixel intensity are presented. For example, a set of good condition aerial images 210a through 214a, are presented alongside corresponding good condition histograms 210b through 214b. The good condition histograms 210b through 214b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 210c through 214c demonstrates the peak probability of grayscale color distribution of a good condition roof. The values, for example, can range from 0 (total black) to 255 (total white).

[0055] Conversely, a set of poor condition aerial images 216a through 220a, are presented alongside corresponding poor condition histograms 216b through 220b. The poor condition histograms 216b through 220b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 216c through 220c demonstrates the peak probability of grayscale color distribution of a good condition roof. The maximum values 216c through 220c corresponding to the poor condition rooftops 216a through 220a are markedly lower than corresponding maximum values 210c through 214c of good condition rooftops 210a through 214a. In addition, a width of the distributions of the poor condition histograms 216b through 220b may be markedly wider than a width of the distributions of the good condition histograms 210b through 214b. As can be seen of the aerial images of the poor condition rooftops 216a through 220a, the color distribution is patchy and bleached out, while the edges of the rooftops have lost their crisp lines. Conversely, looking to the aerial images of the good condition rooftops 210a through 214a, the rooftops are more substantially uniform in color with crisp lines on the edges.

[0056] Turning to FIG. 2C, a condition profile 230 for a rooftop condition is illustrated. In some implementations, pixel value distribution histograms such as the histograms 210b through 220b, in some implementations, can be combined to generate an example condition profile 230 corresponding to rooftop condition. The condition profile 230, for example, may be included as one of the condition profiles 114 of FIG. 1. Example reference bars 232a, 232b on the condition profile 230 illustrate values corresponding to a non-deteriorated hipped roof 214a and the deteriorated hipped roof 216a, respectively. In some examples, the closer the value of a reference bar 232 comes to 1 on the Y-axis, the better the condition of the roof, while values close to 0 represent poor condition rooftops. In one example, the reference bars 232 of the example condition profile 230 correspond to a test conditions sample data set including 2,500 images). The reference bars 232 can be combined, in some embodiments, in a logistic regression to generate a roof condition profile graph 236. The accuracy rate of the image histogram is 80% based on some validation.

[0057] Although illustrated as a single condition profile 230 corresponding to different types of rooftops (e.g., at least the hipped rooftop 216a and the gable rooftop 234), in other embodiments, individual condition profiles 114 can be generated for each property characteristic (e.g., profiles specific to gabled, gambrel, flat, hipped, square, etc.). In further refinements, in certain embodiments, individual condition profiles 114 can be generated for combinations of property characteristics (e.g., a gabled, shingled roof, a gabled, clay tiled roof, a gabled, metal roof, etc.) to increase accuracy rate based upon pixel densities corresponding to the combined characteristics. Many combinations of characteristics of property features may be used singly or in combination to generate a condition profile 114 designed to accurately identify the condition of the corresponding property feature.

[0058] Returning to FIG. 1, in some implementations, the property characteristics 110 and/or condition characteristics 116 may be analyzed to calculate (120) a risk estimate 122

corresponding to a risk of damage based upon one or more types of disasters. The types of disasters can include, in some examples, earthquake, hurricane, tornado, storm surge, fire, straight line winds, or explosion. The types and estimated severity of disasters, in some embodiments, may depend upon the particular property location 102b. For example, properties near active fault lines may be more susceptible to earthquakes, while coastal properties may be more susceptible to storm surge damage. The risk estimate 122, in some examples, can include an actuarial percentage indicating a likelihood of damage based upon the particular property characteristics. Different property characteristics, for example, may be more susceptible than others to certain types of damage. For example, flatter rooftops may be more susceptible to damage from excessive snow build-up, while peaked rooftops may be more vulnerable to strong winds.

[0059] In some embodiments, in calculating damage risk, one or more disaster risk profiles 118 can be applied based upon property characteristics. Vulnerability to damage due to disaster can vary, in some examples, by location, altitude, slope, rooftop shape, rooftop condition, cladding type, cladding condition, and/or pounding. In a particular example, as shown in FIG. 2A, a graphical risk profile 206 ranks types of rooftops by their vulnerability to strong winds. [[ ]]Vulnerability to wind damage increases from lowest vulnerability (flat rooftop 202e) to square roof 202d, to hipped roof 202c, to gable roof 202b, with the greatest wind damage vulnerability in gambrel roofs 202a._Vulnerability may be mathematically modeled based upon statistical information built from past damage results due to varying types and/or severity of disaster. In combining location-based vulnerabilities with individual property characteristic-based vulnerabilities, risk of damage due to disaster can be more accurately estimated.

[0060] Referring back to FIG. 1, the risk estimates 122, in some embodiments, can be used in insurance assessments. For example, the risk estimate 122 may be used in determining

whether a property is adequately insured against potential damage. Further, when tracking an impending natural disaster, an insurance company may use the risk estimates 122 to estimate claims based upon the forecast path and severity of the storm. Additionally, the risk estimates 122 may be applied by investors when selecting investment properties for an investment portfolio.

[0061] In some implementations, repair or replacement costs can be calculated (126) to determine a cost estimate 128 to place one or more property characteristics in good or "like new" condition. The cost estimates 128, in some embodiments, can be based in part on one or more replacement cost profiles 120. Replacement costs, in some examples, may vary based upon type of materials (e.g., rooftop materials, cladding materials, etc.), size of the job (e.g., estimated area of the roof, estimated length of fence, etc.), and/or additional property characteristics (e.g., contributing to the complexity of the work). The replacement profiles 120, in further examples, may be based in part on location (e.g., varying costs of material and labor regionally). In some implementations, the cost estimates 128 for repair or replacement of the property characteristics may be output to a dashboard interface screen at a remote computing device of a requester, such as an insurance carrier or real estate investment broker.

[0062] In some embodiments, cost estimates 128 can be used in automatically analyzing insurance claims. The cost estimate 128, further, may be combined with the risk estimate 122 in analyzing adequacy of insurance coverage for a particular property location 102b. Further, the cost estimates 128 may be used by investors in determining cost of maintaining/upgrading a particular investment property.

[0063] Although the operational flow is illustrated as a series of computational stages, in other implementations, more or fewer computational stages may be included. For example, aerial imagery 102c may be analyzed after an insurance claim has been paid to verify that the insured property has been repaired and/or to upgrade the estimated value of the property (e.g.,

in the circumstance where the owner upgraded the property rather than applying a straight repair/replacement of the damaged property characteristics.

[0064] Additionally, in other implementations, certain computational stages may be performed in a different order. For example, cost estimates 128 may be calculated prior to risk estimates 122. Other modifications of the operational flow 100 are possible.

[0065] FIG. 3 is a block diagram of an example environment 300 for matching aerial image topographical features to corresponding property maintenance levels. The example environment 300, for example, can be used to implement the operational flow 100 described in relation to FIG. 1. The example environment 300 includes a property characteristic classification and condition analysis system 302 in communication with client computing system(s) 306, a number of cost data and/or risk data source computing system(s) 308, and a number of shape map, aerial imagery, and/or terrestrial imagery source computing system(s) 304. The communication connection may be wired or wireless, over a variety of network types. In a general overview, the system 302 obtains property identifier(s) 340 from client computing system(s) 306, accesses images of a property identified by the property identifier 340 from the imagery source computing system(s) 304, and analyzes the images to determine property characteristic(s) 342 and condition characteristic(s) 344. Using cost and/or risk data obtained from cost and risk data source computing system(s) 308, the system 302 may determine replacement cost estimate data 350 and/or disaster risk estimate data 352 based upon the property characteristics and their condition.

[0066] In some implementations, a user of a particular client computing system 306 submits a request to the system 302 through a graphical user interface supplied by a graphical user interface engine 334. The request, for example, may include at least one property identifier 340 as well as one or more property characteristics 342 and/or identification of at least one of a replacement or repair cost estimate, a disaster risk estimate, and a confirmation of repair

assessment. The property identifier 340, in some examples, may include location information (e.g., address, geolocation coordinates, lot boundaries, etc.). The location information, for example, may conform with property location information 102b described in relation to FIG. 1. In other embodiments, the property identifier 340 may be a unique property identifier (e.g., number or string) used to look up property location information in a data store 310. In another embodiment, rather than submitting a property identifier, the user may submit a unique user identifier used to look up one or more properties associated with the user (e.g., properties insured by an insurance client, properties held by an investment client, etc.).

[0067] In one example, turning to FIG. 8A, a user may identify locations of one or more properties by selecting the properties within a graphical map interface 800. A number of properties are identified within the map view user interface 800 as indicated with an associated pin, such as pin 804. The pins, in some examples, may indicate properties insured by a particular insurance carrier, a type of property (e.g., commercial, industrial, residential, etc.), and/or properties of a value range (e.g., within a range, above a threshold, etc.). The pins, for example, may be displayed based upon filtering options supplied by the user or otherwise associated with a user profile (e.g., insurance carrier identification). In a particular example, a user may select three properties associated with three dialogue bubbles 802. As illustrated, each dialogue bubble identifies a replacement value associated with the property and invites the user to review details regarding the selected property via a details control.

[0068] In some implementations, the user enters property characteristics associated with each selected property. In other implementations, the characteristics may be accessed upon identification of the property (e.g., selection of a pin identifying a property, as illustrated in FIG. 8A). For example, the property characteristics 342 may be obtained from the data store 310, as illustrated in FIG. 3. Turning to FIG. 8B, an example property characteristics user interface 820 presents building area characteristics 822 (e.g., building area 822a, stories 822b,

and total building area ~~824~~822c) and structure characteristics 824 (e.g., structure material 824a, construction class 824b). As described within, different or additional characteristics may vary per implementation. In some embodiments, the user may be provided the ability via the user interface 820 to edit the building area characteristics 822 and/or the structure characteristics 824, for example via an edit control 828a or 828b. For example, in the circumstance of recent development or renovation (e.g., construction of an addition), the user may modify previously stored characteristics values. The property characteristics user interface 820, for example, may be presented to a user upon selection of a details control of one of the dialogue bubbles 802 illustrated in the user interface of FIG. 8A.

[0069] The user interface 820 further presents, in some implementations, premium characteristics 826 such as a replacement value. The premium information, for example, may relate to an insurance policy purchased for the property or parameters for insuring the property (e.g., based upon upgraded or new characteristics). The user, in some embodiments, may be provided to update the premium information via an edit control 828c.

[0070] In some implementations, upon identification of property location information, the system 302 accesses imagery of the property from the imagery source computing system(s) 304 using an image acquisition engine 336. The images can include, in some examples, a shape map (e.g., such as the shape maps 102a described in relation to FIG. 1), two-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), three-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), and/or terrestrial imagery (e.g., such as the terrestrial imagery 102d described in relation to FIG. 1). The images obtained by the image acquisition engine 336, in some embodiments, depend upon the property characteristic(s) identified by the user. For example, certain types of images are preferred for analyzing certain types of property

characteristics. Housing siding, for example, is more easily perceived from a terrestrial image or three-dimensional aerial image than from a two-dimensional aerial image.

[0071] In some implementations, an image quality analysis and preparation engine 326 analyzes the acquired image(s) to confirm the acquired image(s) contains an adequately clear and detailed image of the property identified by the property identifier 340. In some embodiments, the image quality analysis and preparation engine 326 crops and/or resizes the acquired image(s). For example, the image quality analysis and preparation engine 326 may extract a portion of an acquired image based upon the property (e.g., building size). In some implementations, the image quality analysis and preparation engine 326 resizes each acquired image to a standard size. The standard size, in a particular example, may be 256 by 256 pixels per image. Resizing to a standard size, for example, may increase accuracy in later classification analysis. The image quality analysis and preparation engine 326, in some embodiments, may be configured to apply corrections to the acquired image(s). For example, the image quality analysis and preparation engine 326 may be configured to adjust an aerial image from a normal orthophoto angle, to a true orthophoto version as described above.

[0072] In some implementations, the image quality analysis and preparation engine 326 uses shape outlines as part of the analysis. For example, a composite image generation engine 318 may overlay an aerial image with a shape map image, as described in relation to FIG. 5C. Using the resultant composite image, the image quality analysis and preparation engine 326 may confirm the aerial image conforms with an urban planning map or other property placement guide (e.g., navigational map data, etc.). Further, the image quality analysis and preparation engine 326 may use the overlaid shape map as a guide in determining whether an aerial image requires correction to a true orthophoto angle and/or how closely to crop the image to capture the property (and, optionally, its immediate surroundings such as its lot or a portion of the proximate neighborhood).

[0073] In some implementations, if the image quality analysis and preparation engine 326 determines that the acquired image is insufficient, the image quality analysis and preparation engine 326 may request a replacement image from the image acquisition engine 336. For example, the image acquisition engine 336 may obtain images based upon a variety of factors including, in some examples, recency of capture, resolution, cost, and/or applicability to a particular property characteristic analysis. Upon determination by the image quality analysis and preparation engine 326 that the first obtained image is insufficient, for example, the image acquisition engine 336 may determine a next best source for obtaining an image of the property.

[0074] In some implementations, once an image has been approved (and, optionally, prepared and/or corrected) by the image quality analysis and preparation engine 326, a feature identification engine 320 extracts features from the property image(s) related to the identified property characteristics 342. In the circumstance of a fence, for example, the feature identification engine 320 may identify a perimeter enclosure or partial perimeter enclosure abutting and extending from the property as indicative of a fence.

[0075] In some implementations, upon identification of features by the feature identification engine 320, a property characteristic classification engine 322 classifies the property characteristic. For example, the features may be classified using one or more machine learning techniques as described in relation to computational stage 106 (classify features of each image) of FIG. 1. The property characteristic classification engine 322, for example, may generate property characteristics 342 representing a grouping, type, or other characterization of a particular property feature. Continuing with the particular example of a fence, the extracted features may be analyzed and classified in relation to height and/or material. Upon classifying the property characteristics, the property characteristic

classifications may be stored in the data store 310 as property characteristics 342 (e.g., similar to property characteristics 110 of FIG. 1).

[0076] In some implementations, the property characteristic classification engine 322 uses characteristic profile(s) 360 in classifying property characteristics. The property characteristic classification engine 322, for example, may obtain, for each property characteristic being analyzed, a particular characteristic profile 360 from a profile data store 314. The characteristic profiles, for example, may be similar to the characteristic profiles 108 described in relation to FIG. 1.

[0077] In some implementations, the property characteristic profiles 360 are generated by a characteristic classification learning engine 328. The characteristic classification learning engine 328, for example, may generate characteristic profiles 360 through a sample data set and learning process as described, generally, in relation to FIG. 2A. In a particular example, the characteristic classification learning engine 328 may analyze JPG (lossy compression digital image standard developed by the Joint Photographic Experts Group) to recognize varying rooftop shapes.

[0078] While certain property characteristic classifications are done by analysis, in some implementations, one or more feature classifications may be obtained from previously stored property characteristics 342. For example, based upon tax records, real estate records, etc. some basic materials and structure information regarding a property may be readily available through local and/or remote database system(s). In other examples, the previously stored property characteristics 342 may also be obtained from previous condition assessments performed for a property location by the system 302.

[0079] In some implementations, once the property characteristic classification engine 322 has classified the property characteristic(s), a characteristic condition classification engine 324 classifies the condition of each property characteristic. For example, the property

characteristics may be classified as described in relation to computational stage 112 (classify condition of each feature) of FIG. 1. The characteristic condition classification engine 324, for example, may generate condition characteristics 344 representing a rating, qualification, or ranking of the condition of the particular characteristic. In some examples, the characteristic condition classification engine 324 may qualify a characteristic as a) "good" or "bad", b) "like new", "acceptable", "needs repair", or "needs replacement", c) rated on a numeric scale such as a scale from 1 to 5 where 5 may correspond to "like new" and 1 may correspond to "needs replacement." In other implementations, particular problems may be identified by the characteristic condition classification engine 324 such as, in some examples, a fence feature is partially fallen, or a roof feature shows signs of structural damage.

[0080] In some implementations, the characteristic condition classification engine 324 uses condition profile(s) 362 in classifying property characteristic conditions. The characteristic condition classification engine 324, for example, may obtain, for each property characteristic being analyzed, a particular condition profile 362 from the profile data store 314. The condition profiles 362, for example, may be similar to the condition profiles 114 described in relation to FIG. 1.

[0081] In some implementations, the condition profiles 362 are generated by a condition classification learning engine 330. The condition classification learning engine 330, for example, may generate condition profiles 362 through a sample data set and learning process as described, generally, in relation to FIG. 2B. In a particular example, color histogram analysis may be used to identify peak pixel values of the images in gray scale. Using the group of calculated peak pixel values, the learning engine can classify property condition into certain categories.

[0082] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a risk

calculation engine 316 may estimate risk of damage based upon one or more types of disaster. For example, the disaster risk estimate data 352 may be calculated as described in relation to computational stage 120 (calculate damage risk) of FIG. 1. The disaster risk estimate data 350, in one example, can include a percentage likelihood of damage due to each particular type of risk based upon the particular property characteristics and/or property conditions, as described in relation to the risk estimates 122 of FIG. 1. Further, in some embodiments, the disaster risk estimate data 350 may include a set of risk estimates based upon, in some examples, a number of severities of disaster, a particular path of disaster, and/or hazard intensity of disaster. The disaster severities, in some examples, may correspond to the Richter scale of seismic activity magnitude or the Saffir-Simpson Hurricane Wind Scale category. The path of the disaster, in some examples, can include geographical direction such as northeasterly, etc. or angle of impact with respect to the property characteristic(s). The hazard intensity of disaster, in some examples, can relate to wind speed or rainfall amount. Repair costs, for example, may be more accurately estimated when the roof condition is known. Due to poor condition of a rooftop in one particular example, the roof may be more vulnerable to damage requiring replacement. In another particular example, due to a poor condition rooftop, the likelihood for interior property damage (e.g., water damage due to breach of the roof) may increase at a set level of severity of disaster and above.

[0083] In some embodiments, the risk calculation engine 316 accesses one or more risk profiles 364 from the data store 314 based upon property characteristics and/or condition characteristics. The risk profiles, for example, may be similar to the disaster risk profiles 118 described in relation to FIG. 1. The risk profiles 364, for example, may be obtained from one or more risk data sources ~~306~~308 by a cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate risk profiles 364 (e.g., using risk data obtained

from one or more cost and risk data sources ~~306~~308 and a risk data analysis engine (not illustrated)).

[0084] The risk estimate data 352, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use risk estimate data in making insurance assessments. In another example, a real estate investment broker or firm client 306 may apply risk estimate data 352 when selecting investment properties for an investment portfolio.

[0085] Turning to FIG. 8C, an example disaster risk user interface 840 presents risk assessment information based upon risk profiles 364 related to the selected property (e.g., one of the properties identified via the dialogue bubbles 802c of FIG. 8A). The user interface 840, for example, may be accessed by scrolling downward from the user interface 820. The user interface 840 illustrates a number of disaster risk factors 842 and associated risk estimate data 844 for the selected property. As illustrated, the disaster risk factors 842 include a fire factor 842a, a wind factor 842b, a flood factor 842c, an earthquake factor 842d, a tsunami factor 842e, and a landslide factor 842f. In some embodiments, only a subset of the risk estimate data is determined via risk assessment techniques described herein. For example, flood data 844c may be generated based upon governmental flood map evaluation rather than via aerial imaging assessment, while fire risk 844a may be determined at least in part based upon proximity to neighboring properties as derived via imaging analysis and/or construction properties derived via image analysis. Further, wind risk data 842b may be derived via rooftop analysis as described in greater detail herein.

[0086] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a cost calculation engine ~~336~~332 calculates repair or replacement costs for improving problems identified by the characteristic condition classification engine 324 and generates replacement

cost estimate data 350. For example, the replacement cost estimate data ~~352~~350 may be calculated as described in relation to computational stage 126 (calculate repair or replacement costs) of FIG. 1. The replacement cost estimate data 350, for example, may be similar to the cost estimates 128 described in relation to FIG. 1.

[0087] In some implementations, the cost calculation engine ~~336~~332 based calculations in part on one or more cost profiles 366 (e.g., similar to the cost profiles 120 of FIG. 1). In some embodiments, the cost calculation engine ~~336~~332 accesses one or more cost profiles 366 from the data store 314 based upon property characteristics and/or condition characteristics. The cost profiles 366, in some embodiments, are obtained from one or more cost data sources ~~306~~308 by the cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate cost profiles 366 (e.g., by a cost data analysis engine (not illustrated) using cost data obtained from one or more cost and risk data sources ~~306~~308).

[0088] The cost estimate data 350, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use cost estimate data in determining adequacy of insurance coverage for a particular property. In another example, a real estate investment broker or real estate investment firm client 306 may apply cost estimate data 350 in determining cost of maintaining/upgrading a particular investment property.

[0089] In some implementations, the cost estimate data 350 and/or risk estimate data 352 is provided to a requesting client 306, responsive to receiving identification of one or more properties, in real-time or near real-time. For example, a client 306 accessing a dashboard interface, may format a request for a risk estimate or cost estimate related to an identified property within a dashboard interface and submit the request via a network to the system 302. Responsive to the request, the system 302 may conduct the analysis described generally above and respond, in real time or near-real time to the client 306 with a risk analysis or cost

analysis. For example, risk analysis information is presented in user interface 840 of FIG. 8C.

[0090] In some implementations, the system may identify, through updated meteorological data, one or more properties within a client real estate portfolio affected by a disaster. The system, further to identification of the affected properties, may proactively prepare a repair estimate to provide to the client corresponding to the real estate portfolio shortly after the disaster took effect. In one example, the Japan Meteorological Agency may update observation data via a web site interface within an hour or so of observation. In this example, the system may provide repair cost estimates to clients between one and two hours after a disaster has taken place.

[0091] Rather than sharing cost estimate data 350 and/or risk estimate data 352 directly with the clients 306, in other embodiments, the system 302 may include a report generation engine (not illustrated) that prepares reports regarding condition, damage, and risk assessments of one or more properties. Further, in some embodiments, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to confirm whether a property owner made repairs to a property (e.g., based upon payment of an insurance claim), replaced one or more features of a property, or removed one or more features of a property (e.g., removed a hazardous collapsing structure, cut back brush encroaching a fire risk distance to a home, etc.). In another illustration, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to determine whether a repair or replacement is an upgrade (e.g., replacement using superior materials) or a downgrade (e.g., replacing an in-ground pool with an above-ground pool) to the property characteristic. Other modifications of the system 302 are possible.

[0092] FIG. 4 is a flow chart of an example method 400 for classifying condition characteristics of a property based on aerial image analysis. The flow chart, for example,

may represent computational stages 104 through 112 as described in relation to FIG. 1. The method 400 may be performed, for example, by the system 302 of FIG. 3.

[0093] In some implementations, the method 400 begins with accessing a two-dimensional shape map including the shape of a property (402). The shape map, for example, may be accessed by the image acquisition engine 336 from a shape map imagery source 304, as described in relation to FIG. 3. The two-dimensional shape map, for example, may take a form of any of the shape maps 102a described in relation to FIG. 1. In a particular example, the shape map may be in a form similar to the shape map 500 described in relation to FIG. 5A.

[0094] In some implementations, two-dimensional and/or three-dimensional aerial imagery including an image of the property is accessed (404). The two-dimensional and/or three-dimensional aerial imagery, for example, may be accessed by the image acquisition engine 336 from an aerial imagery source 304, as described in relation to FIG. 3. The two-dimensional and/or three-dimensional aerial imagery, for example, may take a form of any of the aerial imagery 102c described in relation to FIG. 1. In a particular example, the two-dimensional aerial imagery may be in a form similar to the aerial image 510 described in relation to FIG. 5B.

[0095] In some implementations, the aerial imagery is overlaid with the shape map (406). The composite image generation engine 318 of FIG. 3, for example, may overlay the aerial imagery with the shape map to generate a composite image. The composite image, for example, may be in a form similar to the composite image 520 described in relation to FIG. 5C.

[0096] If a shape match is not identified (408), in some implementations, the method 400 accesses alternate two-dimensional or three-dimensional aerial imagery (410). In some embodiments, the image quality analysis and preparation engine 326 of FIG. 3 determines

whether the composite image presents an adequate shape match of the property(s) of interest. Upon determining the image does not match, the image acquisition engine 336 of FIG. 3, for example, may obtain an alternative two-dimensional or three-dimensional aerial image from the aerial imagery source(s) 304. As described in relation to FIG. 3, for example, For the image acquisition engine 336 may determine a next best source for obtaining an image of the property based upon one or more factors. Conversely, the method 400, in other implementations (not illustrated), could proceed without matching the shape map to the aerial imagery.

[0097] If a shape match is identified (408), in some implementations, the formatting of the aerial imagery is prepared (411). In some embodiments, the image is cropped to include the property of interest or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Cropping may be based, for example, on the correlation of the shape map to the property. In illustration, the image may be cropped to include the shape map outline of the property plus a border region. In some embodiments, cropping may include cropping to a set shape (e.g., X by X pixels square, X by Y pixels rectangle, etc.). In some embodiments, in addition to cropping the image, the image may be resized. For example, depending upon the resolution of the aerial imagery, the image resolution may be reduced, for example, to fit within an X by X pixels square or an X by Y pixels rectangle. Resizing to a standard image size, for example, can contribute to analysis consistency and improvement in classification accuracy. In further embodiments, the color depth and/or color mapping of the aerial imagery may be adjusted. For consistent color histogram analysis of the imagery, for example, the color depth and color mapping may be made consistent across analyzed images. In a particular example, color images may be converted to grayscale for grayscale image analysis.

Adjustments to the imagery, for example, may be effected by the image quality analysis and preparation engine 326, described in relation to FIG. 3.

[0098] In some implementations, orthogonality of the aerial imagery is assessed (412). For example, the image quality analysis and preparation engine 326 may assess orthogonality of the aerial imagery. The image quality analysis and preparation engine 326, in one example, may determine that orthogonality correction is desired. In another example, if the image represents a normal orthophoto rather than a true orthophoto, the image quality analysis and preparation engine 326 may notify further modules which may compensate for the angle of capture of the aerial image. In other implementations (not illustrated), orthogonality may be assessed without use of an overlaid shape map.

[0099] Returning to FIG. 4, in some implementations, if the aerial imagery is not orthogonal (414), an orthogonal version of the aerial imagery is generated (416). The image quality analysis and preparation engine 326 of FIG. 3, for example, may correct a normal orthophoto form to generate a true orthophoto form. The true orthophoto form, for example, may better match the shape map overly.

[0100] In some implementations, one or more property characteristics of the property are classified (418). The property, in some embodiments, is analyzed based on the portion of the aerial image substantially bounded by the shape map of the property. In other embodiments, the property analysis encompasses a surrounding of the property (e.g., features proximate the property upon the property lot, nearby properties, etc.). The property characteristic(s), for example, may be classified by the property characteristic classification engine 322, as described in relation to FIG. 3. In a particular example, a rooftop property feature may be classified as one of a variety of rooftop shapes, as illustrated in FIG. 2A.

[0101] In some implementations, if a property characteristic classification is identified (420), a condition of each of the property characteristics can be classified (422). The property

characteristic condition(s), for example, may be classified by the characteristic condition classification engine 324, as described in relation to FIG. 3. In a particular example, a hipped classification of the rooftop feature may be classified as one of a good condition and a poor condition, as illustrated in FIG. 2B. In some implementations, the classifications of the condition of each of the property characteristics may by output to a computing device of a requester (~~424~~422) via a dashboard interface screen. In some examples, in addition to providing the condition classification for the property characteristics, the dashboard interface screen may include replacement costs for replacing the property characteristics, risk cost estimates due to damage from natural disasters, or confirmation of whether or not repairs have been made to the property characteristics.

[0102] If, instead, a classification match was not identified (420), in some implementations, alternate two-dimensional or three-dimensional aerial imagery is accessed (410) and the method 400 restarts with overlaying the replacement aerial imagery with the shape map (406). Alternatively, in some embodiments, even if a classification match is not identified, condition may be assessed based upon a default profile associated with the property feature (not illustrated). For example, if the rooftop shape does not match one of the shapes trained into the system, the condition of the rooftop may still be assessed based upon a general condition profile trained with a variety of rooftop shapes. In some examples, the condition of the rooftop may be assessed by comparing the current rooftop conditions to stored historic condition characteristics for the property from a previous condition assessment.

[0103] Although the method 400 is illustrated as a series of steps, in other implementations, more or fewer steps may be included. For example, in some implementations, terrestrial images are obtained and used to classify the same and/or different property characteristics, as described in relation to the operational flow 100 of FIG. 1.

[0104] Additionally, in other implementations, certain steps may be performed in a different order. For example, in some implementations, property characteristics and condition characteristics may be classified (418, 422) in parallel. Other modifications of the operational flow 100 are possible.

[0105] Aspects of the present disclosure may be directed to computing systems for categorizing a repair condition of a property characteristic in order to provide dynamic, real-time property condition assessments in response to requests received from users such as insurance carriers or real estate investment brokers using aerial imagery. The implementations described herein improve upon conventional methodologies by applying deep learning analysis models to detected property characteristics of the obtained imagery in order to assess whether a condition of the property characteristics is degraded to a point of needing repair or replacement and determine an amount of risk exposure of the property due to the detected condition of the property characteristics. The implementations described herein improve processing efficiency of the system to reduce an amount of time it takes to perform the condition assessments and automate a condition assessment process.

[0106] Next, a hardware description of the computing device, mobile computing device, or server according to exemplary embodiments is described with reference to Figure 6. In Figure 6, the computing device, mobile computing device, or server includes a CPU 600 which performs the processes described above. The process data and instructions may be stored in memory 602. These processes and instructions may also be stored on a storage medium disk 604 such as a hard drive (HDD) or portable storage medium or may be stored remotely. Further, the claimed advancements are not limited by the form of the computer-readable media on which the instructions of the inventive process are stored. For example, the instructions may be stored on CDs, DVDs, in FLASH memory, RAM, ROM, PROM, EPROM, EEPROM, hard disk or any other information processing device with which the

computing device, mobile computing device, or server communicates, such as a server or computer.

[0107] Further, a portion of the claimed advancements may be provided as a utility application, background daemon, or component of an operating system, or combination thereof, executing in conjunction with CPU 600 and an operating system such as Microsoft Windows 6, UNIX, Solaris, LINUX, Apple MAC-OS and other systems known to those skilled in the art.

[0108] CPU 600 may be a Xenon or Core processor from Intel of America or an Opteron processor from AMD of America, or may be other processor types that would be recognized by one of ordinary skill in the art. Alternatively, the CPU 600 may be implemented on an FPGA, ASIC, PLD or using discrete logic circuits, as one of ordinary skill in the art would recognize. Further, CPU 600 may be implemented as multiple processors cooperatively working in parallel to perform the instructions of the inventive processes described above.

[0109] The computing device, mobile computing device, or server in FIG. 6 also includes a network controller 606, such as an Intel Ethernet PRO network interface card from Intel Corporation of America, for interfacing with network 6X. As can be appreciated, the network 628 can be a public network, such as the Internet, or a private network such as an LAN or WAN network, or any combination thereof and can also include PSTN or ISDN sub-networks. The network 628 can also be wired, such as an Ethernet network, or can be wireless such as a cellular network including EDGE, 3G and 4G wireless cellular systems. The wireless network can also be Wi-Fi, Bluetooth, or any other wireless form of communication that is known.

[0110] The computing device, mobile computing device, or server further includes a display controller 608, such as a NVIDIA GeForce GTX or Quadro graphics adaptor from NVIDIA Corporation of America for interfacing with display 610, such as a Hewlett Packard

HPL2445w LCD monitor. A general purpose I/O interface 612 interfaces with a keyboard and/or mouse 614 as well as a touch screen panel 616 on or separate from display 610. General purpose I/O interface also connects to a variety of peripherals 618 including printers and scanners, such as an OfficeJet or DeskJet from Hewlett Packard.

[0111] A sound controller 620 is also provided in the computing device, mobile computing device, or server, such as Sound Blaster X-Fi Titanium from Creative, to interface with speakers/microphone 622 thereby providing sounds and/or music.

[0112] The general purpose storage controller 624 connects the storage medium disk 604 with communication bus 626, which may be an ISA, EISA, VESA, PCI, or similar, for interconnecting all of the components of the computing device, mobile computing device, or server. A description of the general features and functionality of the display 610, keyboard and/or mouse 614, as well as the display controller 608, storage controller 624, network controller 606, sound controller 620, and general purpose I/O interface 612 is omitted herein for brevity as these features are known.

[0113] One or more processors can be utilized to implement various functions and/or algorithms described herein, unless explicitly stated otherwise. Additionally, any functions and/or algorithms described herein, unless explicitly stated otherwise, can be performed upon one or more virtual processors, for example on one or more physical computing systems such as a computer farm or a cloud drive.

[0114] Reference has been made to flowchart illustrations and block diagrams of methods, systems and computer program products according to implementations of this disclosure. Aspects thereof are implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other

programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0115] These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means which implement the function/act specified in the flowchart and/or block diagram block or blocks.

[0116] The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0117] Moreover, the present disclosure is not limited to the specific circuit elements described herein, nor is the present disclosure limited to the specific sizing and classification of these elements. For example, the skilled artisan will appreciate that the circuitry described herein may be adapted based on changes on battery sizing and chemistry, or based on the requirements of the intended back-up load to be powered.

[0118] The functions and features described herein may also be executed by various distributed components of a system. For example, one or more processors may execute these system functions, where the processors are distributed across multiple components communicating in a network. The distributed components may include one or more client and server machines, which may share processing, as shown on Fig. 8, in addition to various human interface and communication devices (e.g., display monitors, smart phones, tablets, personal digital assistants (PDAs)). The network may be a private network, such as a LAN or

WAN, or may be a public network, such as the Internet. Input to the system may be received via direct user input and received remotely either in real-time or as a batch process. Additionally, some implementations may be performed on modules or hardware not identical to those described. Accordingly, other implementations are within the scope that may be claimed.

[0119] In some implementations, as illustrated in FIG. 7, the innovations described herein may interface with a cloud computing environment 730, such as Google Cloud Platform™ to perform at least portions of methods or algorithms detailed above. The processes associated with the methods described herein can be executed on a computation processor, such as the Google Compute Engine by data center 734. The data center 734, for example, can also include an application processor, such as the Google App Engine, that can be used as the interface with the systems described herein to receive data and output corresponding information. The cloud computing environment 730 may also include one or more databases 738 or other data storage, such as cloud storage and a query database. In some implementations, the cloud storage database 738, such as the Google Cloud Storage, may store processed and unprocessed data supplied by systems described herein.

[0120] The systems described herein may communicate with the cloud computing environment 730 through a secure gateway 732. In some implementations, the secure gateway 732 includes a database querying interface, such as the Google BigQuery platform.

[0121] The cloud computing environment 102 may include a provisioning tool 740 for resource management. The provisioning tool 740 may be connected to the computing devices of a data center 734 to facilitate the provision of computing resources of the data center 734. The provisioning tool 740 may receive a request for a computing resource via the secure gateway 732 or a cloud controller 736. The provisioning tool 740 may facilitate a connection to a particular computing device of the data center 734.

[0122] A network 702 represents one or more networks, such as the Internet, connecting the cloud environment 730 to a number of client devices such as, in some examples, a cellular telephone 710, a tablet computer 712, a mobile computing device 714, and a desktop computing device 716. The network 702 can also communicate via wireless networks using a variety of mobile network services 720 such as Wi-Fi, Bluetooth, cellular networks including EDGE, 3G and 4G wireless cellular systems, or any other wireless form of communication that is known. In some embodiments, the network 702 is agnostic to local interfaces and networks associated with the client devices to allow for integration of the local interfaces and networks configured to perform the processes described herein.

[0123] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present disclosures. Indeed, the novel methods, apparatuses and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods, apparatuses and systems described herein can be made without departing from the spirit of the present disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the present disclosures.

In the United States Patent and Trademark Office

Application for United States Patent

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

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474139US03

RELATED APPLICATIONS

[0001] This application is a continuation of and claims priority to U.S. Patent Application Serial No. 16/733,888 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Conditions Through Aerial Imagery Analysis" and filed January 3, 2020, which is a continuation-in-part of and claims priority to U.S. Patent Application Serial No. 15/714,376 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis" and filed September 25, 2017, which claims priority to U.S. Provisional Patent Application Serial No. 62/398, 665, entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis," filed September 23, 2016. All above identified applications are hereby incorporated by reference in their entireties.

BACKGROUND

[0002] A risk exposure database contains a compilation of as many building properties or characteristics relevant to insurance as possible. These properties can include characteristics like location coordinates, address, slope, and elevation. Other characteristics include construction type, occupancy type, year built and/or year of renovation, building height, soft stories, number of stories, and floor area. Further characteristics can include roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding (distance to closest building). Some of these characteristics can only be assessed by on-site inspections or by official documentation, but others can be measured using visual imagery.

[0003] Characteristics addressed in this disclosure include roof shape and roof condition. In one example, roof shapes can be broken into five categories: gambrel roof, gable roof, hipped

roof, square roof, and flat roof. Each roof shape has a unique response and damage vulnerability to different natural perils like earthquake or wind.

[0004] Deep learning involves computational models composed of multiple processing layers to learn representations of data with multiple levels of abstractions. These models can be thought of as a way to automate predictive analytics. Representation learning is a set of methods that allows a machine to be fed with raw data and to automatically discover the representations needed for detection or classification. Use cases for deep learning include voice recognition, motion detection, translation, and medical diagnosis. By using deep learning algorithms and sample datasets, computers can learn to distinguish and classify a wide range of characteristics to high levels of accuracy, often surpassing the recognition levels of human beings.

[0005] One model used for deep learning is the Network in Network model described in the paper "Network In Network" by M. Lin et al. and published in the International Conference on Learning Representations, 2014 (arXiv:1409.1556), the contents of which are hereby incorporated by reference in its entirety. Using the Network in Network model, a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification.

[0006] When applied to visual recognition, deep learning algorithms can break down an observation (e.g., an image) in a number of different ways to characterize features of the observation. In some examples, deep learning algorithms can be applied to review images as a set of intensity values per pixel, or in a more abstract way as a set of edges, regions of particular shape, etc. Some representations may demonstrate superior performance to others based upon the particular learning task. One of the promises of deep learning is replacing

human identification of features with efficient algorithms for unsupervised or semi-supervised feature learning and hierarchical feature extraction.

[0007] The inventors recognized that deep learning methodology could be applied to risk exposure database population to analyze aerial imagery and automatically extract characteristics of individual properties, providing fast and efficient automated classification of building styles and repair conditions. In combining location-based vulnerabilities with individual property vulnerabilities identified in part through classification of repair conditions of one or more property features, risk of damage due to disaster can be more accurately estimated.

SUMMARY OF ILLUSTRATIVE EMBODIMENTS

[0008] The forgoing general description of the illustrative implementations and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure, and are not restrictive.

[0009] Systems, methods, and computing system platforms described herein support matching aerial image features of one or more properties to corresponding property conditions (e.g., maintenance levels of property features, including structural features, manmade features included within a vicinity of a structure (e.g., on a property lot, within a property parcel, or a geographic region of the property), and/or natural features included within the vicinity of the structure) through machine learning analysis. In a preferred application, the property condition analysis may be used in estimating damage risk in light of one or more disaster conditions, such as severe storms. The analysis may further aid in estimating costs of repair or replacement of each property, in one example, should a disaster cause the estimated damage. In another example, the analysis may be used to confirm that a property has been repaired.

[0010] In one aspect, the present disclosure relates to a method for automatically categorizing a repair condition or maintenance condition of a property characteristic, including obtaining an aerial image of a geographic region including the property; identifying features of the aerial image corresponding to the property characteristic; analyzing the features to determine a property characteristic classification; analyzing a region of the aerial image including the property characteristic to determine a condition classification; and determining, using the property characteristic classification and the condition classification, a risk estimate of damage to the property due to one or more disasters. The property characteristic of a structure such as a house, factory, or barn, in some examples, can include a rooftop, porch, chimney, or skylights. Property characteristics of manmade structures within a property location, in some examples, can include a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, equipment or vehicles, or greenhouse. Property characteristics of natural features within a property location, in some examples, include trees, ponds, marshes, rivers, lakes, grasses, cliffs, or ocean shore. Further, property characteristic classifications can include shapes, materials, size (breadth and/or height, relative or actual), and/or distance of the property characteristic from other features. In some embodiments, the property characteristic classification may include existing versus not existing (e.g., in the event of determining replacement or removal of a manmade feature at a property location such as a fence). The property characteristic classification, in a particular illustration, may be a rooftop shape. Analyzing the features to determine a property characteristic may include applying a deep learning analysis model to the features. The deep learning analysis model may be NIN.

[0011] In some embodiments, analyzing the region of the aerial image including the property characteristic to determine the condition classification includes applying a machine learning analysis model to image pixels within the region. The machine learning analysis model may

include a color histogram analysis model. The condition classification may encompass classifications good and bad. Determining the risk estimate may include applying a disaster risk profile corresponding to a first disaster of the at least one disaster and the property characteristic.

[0012] In one aspect, the present disclosure relates to a system for automatically categorizing a repair condition of a property characteristic, the system including processing circuitry and a non-transitory computer-readable medium having instructions stored thereon. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to obtain an aerial image of a geographic region including the property; identify features of the aerial image corresponding to the property characteristic; analyze the features to determine a property characteristic classification; analyze a region of the aerial image including the property characteristic to determine a condition classification; and determine, using the property characteristic classification and the condition classification, a replacement cost for replacing the property characteristic. The aerial image may be a two-dimensional aerial image.

[0013] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to identifying the features, obtain a shape map image including the property; overlay the aerial image with the shape map image; and determine whether a boundary of the property as identified by the shape map matches a boundary of the property as illustrated in the aerial image. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, upon determining that the shape map does not match the boundary of the corresponding property, obtain an alternate aerial image of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, prior to identifying the features, assess orthogonality of the aerial imagery. The property may be a single family home.

[0014] In one aspect, the present disclosure relates to a non-transitory computer readable medium having instructions stored thereon, where the instructions, when executed by processing circuitry, cause the processing circuitry to receive identification of a property and at least one property characteristic; obtain an aerial image of a geographic region including the property; and identify respective features of the aerial image corresponding to each property characteristic of the at least one property characteristic. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, for each property characteristic, analyze the corresponding features to determine a respective property characteristic classification, and analyze a region of the aerial image including the respective property characteristic to determine a respective condition classification. The instructions, when executed by the processing circuitry, may cause the processing circuitry to determine, using the property characteristic classification of each property characteristic and the condition classification of each property characteristic, at least one risk estimate representing risk of damage due to disaster.

[0015] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to obtaining the aerial image of the geographic region, determine, based upon the at least one property characteristic, a preferred image type corresponding to each property characteristic of the at least one property characteristic. The at least one property characteristic may include two or more property characteristics. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, responsive to determining the preferred image type corresponding to a first property characteristic of the at least one property characteristic is a terrestrial image, obtain a terrestrial image of the geographic region including the property.

[0016] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to access one or more known property characteristics.

Determining the at least one risk estimate may include determining the at least one risk estimate further based on the one or more known property characteristics. The one or more known property characteristics may include at least one of a property age, a property elevation, a property slope, a year built, a year renovated, and a building height.

[0017] In some embodiments, receiving identification of the property and the at least one property characteristic includes receiving, via a network from a remote computing device, the identification of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to provide, via the network to the remote computing device in real-time responsive to receiving the at least one property characteristic, the at least one risk estimate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one or more embodiments and, together with the description, explain these embodiments. The accompanying drawings have not necessarily been drawn to scale. Any values dimensions illustrated in the accompanying graphs and figures are for illustration purposes only and may or may not represent actual or preferred values or dimensions. Where applicable, some or all features may not be illustrated to assist in the description of underlying features. In the drawings:

[0019] FIG. 1 is a flow diagram of an example system operational flow for matching aerial image features to corresponding property maintenance levels;

[0020] FIG. 2A illustrates example characteristic classifications and corresponding risk profile data;

[0021] FIG. 2B illustrates examples of condition characteristics and corresponding example histograms;

[0022] FIG. 2C illustrates an example condition profile corresponding to an example property characteristic type;

[0023] FIG. 2D is an example error rate graph comparing training data with test data in conducting matching aerial image features to corresponding rooftop shapes;

[0024] FIG. 3 is a block diagram of an example environment for matching aerial image topographical features to corresponding property maintenance levels;

[0025] FIG. 4 is a flow chart of an example method for classifying condition characteristics of a property based on aerial image analysis;

[0026] FIG. 5A illustrates an example structure shape map of a geographic area;

[0027] FIG. 5B illustrates an example two-dimensional aerial image of the geographic area of FIG. 5A;

[0028] FIG. 5C illustrates an example overlay map image of a section of the structure shape map of FIG. 5A overlaying a corresponding section of the aerial image of FIG. 5B;

[0029] FIG. 6 is a block diagram of an example computing system;

[0030] FIG. 7 is a block diagram of an example distributing computing environment including a cloud computing environment; and

[0031] FIGs. 8A, 8B, and 8C illustrate a series of example user interface screen shots for reviewing property characteristic and maintenance level information.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0032] The description set forth below in connection with the appended drawings is intended to be a description of various, illustrative embodiments of the disclosed subject matter. Specific features and functionalities are described in connection with each illustrative embodiment; however, it will be apparent to those skilled in the art that the disclosed embodiments may be practiced without each of those specific features and functionalities.

[0033] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments. Further, it is intended that embodiments of the disclosed subject matter cover modifications and variations thereof.

[0034] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context expressly dictates otherwise. That is, unless expressly specified otherwise, as used herein the words "a," "an," "the," and the like carry the meaning of "one or more." Additionally, it is to be understood that terms such as "left," "right," "top," "bottom," "front," "rear," "side," "height," "length," "width," "upper," "lower," "interior," "exterior," "inner," "outer," and the like that may be used herein merely describe points of reference and do not necessarily limit embodiments of the present disclosure to any particular orientation or configuration. Furthermore, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components, steps, operations, functions, and/or points of reference as disclosed herein, and likewise do not necessarily limit embodiments of the present disclosure to any particular configuration or orientation.

[0035] Furthermore, the terms "approximately," "about," "proximate," "minor variation," and similar terms generally refer to ranges that include the identified value within a margin of 20%, 10% or preferably 5% in certain embodiments, and any values therebetween.

[0036] All of the functionalities described in connection with one embodiment are intended to be applicable to the additional embodiments described below except where expressly

stated or where the feature or function is incompatible with the additional embodiments. For example, where a given feature or function is expressly described in connection with one embodiment but not expressly mentioned in connection with an alternative embodiment, it should be understood that the inventors intend that that feature or function may be deployed, utilized or implemented in connection with the alternative embodiment unless the feature or function is incompatible with the alternative embodiment.

[0037] Turning to FIG. 1, a flow diagram of an example system operational flow 100 for matching aerial image features to corresponding property maintenance levels obtains images (104) at property locations 102b is illustrated. In some implementations, commencement of at least a portion of the operational flow 100 by the system may be triggered by a property classification request submitted by a user, such as an insurance carrier or real estate investment broker at a dashboard interface screen on a computing device connected to the system via a network. For example, as illustrated in FIG. 8A, a particular property or, alternatively, a neighborhood of properties, may be selected within a map view user interface 800. The operational flow 100 may be used to analyze the condition of features of each property at each property location 102b based on aerial imagery 102c. In some implementations, the operational flow 100 may aid in estimating costs of repair or replacement of each property characteristic detected in the aerial images, for example. In another example, the operational flow 100 may be used to confirm that a property location 102b has been repaired.

[0038] The property locations 102b may represent, in some examples, locations of properties insured by a particular insurer, locations of properties recently affected by a disaster such as a tornado, hurricane, earthquake, fire, storm surge, or explosion, locations of properties held in an investment portfolio, or locations of properties considered for addition to an investment

portfolio. The property locations 102b may be identified, in some examples, by a street address, global positioning system coordinates, or other geographic coordinates.

[0039] In some implementations, the operational flow 100 obtains images (104) at each property location 102b. The images can include aerial imagery 102c stored by the system or accessed by the system from a remote networked location. The aerial imagery 102c, for example, may include a three-dimensional or two-dimensional image of a geographic location including at least one of the property locations 102b. In one example, based upon street address or geographic coordinates, the system may query a remote database to obtain recent aerial imagery 102c including an image of at least one of the property locations 102b. The remote database, in some examples, can include private industry databases such as Google® Earth images by Google, Inc. of Mountain View, CA or NTT Geospace Corporation of Japan. In other examples, the remote database can include one or more databases of publicly owned organizations such as the Geospatial Information Authority (GSI) of Japan, the United States Geological Survey, or the Federal Agency for Cartography and Geodesy of Germany. Aerial imagery can be collected from one or more remote network locations, in some embodiments, using an Open Source Geographic Information System (GIS) such as QGIS by the Open Source Geospatial Foundation (OSGeo). The format for the images of the property locations 102b, in some embodiments, depends upon the format accepted by the various sources available for aerial imagery 102c. An example aerial image 510 of multiple property locations 102b is illustrated in FIG. 5B.

[0040] In some embodiments, the system may be configured to query multiple remote database systems to obtain at least two aerial images of a given property location 102b. The aerial images available at the various databases, for example, may differ in resolution and recency of capture. Through collecting two or more images of a particular property, for example, the system may analyze each image to determine a best quality image for use in

condition analysis. The condition analysis can include balancing of multiple factors such as, in some examples, clarity, completeness, and recency.

[0041] Further, in some embodiments, the system may be configured to query multiple remote database systems to obtain both a two-dimensional aerial image and a three-dimensional aerial image. Different property characteristics may be discerned based upon whether the aerial image is captured in two-dimensional or three-dimensional format. Two-dimensional aerial images, in some examples, can be used to determine location coordinates of the property, street name, occupancy type, floor area, existence of skylights, existence of chimneys, roof condition, roof shape, roof covering, roof anchors, roof equipment, and/or pounding. Three-dimensional aerial images, in comparison, can be used to determine location coordinates, street name, construction type, occupancy type, year built, building height, soft stories, number of stories, roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding. Where there is an overlap in characteristics identifiable using either a two-dimensional image or a three-dimensional image, in some embodiments, machine learning analysis of both images can be combined to provide increase confidence in identification of the individual characteristics.

[0042] In some implementations, the system obtains (104) shape map images 102a of each of the property locations 102b. The shape map images 102a, for example, include a block shape layout of existing properties in a municipality, such as urban planning maps used in urban planning and development. The shape map images 102a, in another example, can include block shape layout maps used in presenting information to a user of a computer-based navigation system. The shape map images 102a, in one example, can be obtained from Geospatial Information Authority of Japan or Zenrin Co. Ltd. of Japan. An example of an urban planning map 500 is illustrated in FIG. 5A (image obtained from the Geospatial Information Authority of Japan, Digital Map 2500 (Spatial Data Framework)).

[0043] The shape map images 102a, in some embodiments, are used to confirm location of a particular property. The shape map image 102a of a geographical area, for example, can be overlaid with a corresponding aerial image 102c to match properties with images. An example overlaid image 520 of planning map image 500 of FIG. 5A with aerial image 510 of FIG. 5B is illustrated in FIG. 5C. In some embodiments, the shape map image 102a may not match in shape or location with the aerial image 102c. As illustrated in FIG. 5C, for example, a shape map outline (illustrated in a thickened line) for a location 522 may not be rectangular, while a rooftop shape beneath the outline may be rectangular in shape. In some embodiments, analyzing multiple aerial images 102c to determine the best quality image may include identifying one or more aerial images 102c that substantially align with the corresponding shape map image 102a. The overlay of the aerial image 102c with the shape map image 102a, further, can be used in aiding in cropping the aerial image 102c to focus analysis on a particular property location 102b. For example, turning to FIG. 5C, property location 524 is substantially aligning with the corresponding planning map image, and the general outline can be used in aiding in cropping of the property location 524. In some examples, the property location 524 may be identified within the overlaid image 520 when the property location 524 aligns with a property in the overlaid image 520 within a predetermined tolerance in order to account for renovations that may have been made to the property 524, such as property additions that may alter an overall shape of the property.

[0044] Returning to FIG. 1, in some embodiments, the shape map images 102a may be used to correct or compensate for alignment errors or inconsistencies of the corresponding two-dimensional aerial images 102c. For example, an aerial image representing a normal orthophoto angle may not be directly centered upon the planning map block. Using the planning map block as a guide, for example, the aerial image can be geometrically corrected to obtain a true orthophoto version of the aerial image.

[0045] As illustrated in FIG. 1, in some implementations, the system identifies (106) features of each aerial image 102c to classify property characteristics. Using machine learning for analysis, for example, the system can extract features of the aerial image of a particular property location 102b. Groupings of extracted features, such as angles, outlines, substantially homogenous fields, etc. can be used to identify property features such as rooftop, swimming pool, chimney, and sky lights. The groupings of extracted features, for example, may include pixel groupings obtained through filtering, cropping, or otherwise adjusting the original image. Upon extracting image-related features identifiable as a property feature (e.g., rooftop), the extracted features may be analyzed to determine one or more property characteristics of that feature (e.g., type of rooftop). In one example, a swimming pool may be identified as the property feature of a pool (e.g., various shapes of outlines of a particular size or greater bordering a substantially homogenous field of blue), then characterized as a particular shape (e.g., rectangular, round, or kidney bean, etc.), type (e.g., above ground or in-ground), and/or size (e.g., approximate area). The machine learning classifier used in the machine learning analysis, in some embodiments, includes a convolutional neural network (CNN) to preprocess the aerial image 102c of the particular property location 102b and to classify the property features as property characteristics 110. Using CNN technology, for example, the biological process of visually reviewing and identifying an object or feature of an object is mimicked through a feed-forward artificial neural network where multilayer artificial perception minimizes preprocessing. CNN is a well-established and popular machine-learning methodology. An example of a CNN processing model is Alexnet. (See Krizhevksy et al. "ImageNet Classification with Deep Convolutional Neural Networks", Advances in neural information processing systems, 2012, the entire contents of which has been incorporated herein by reference). In other embodiments, the machine learning classifier may include a Network in Network (NIN)

where a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification. NIN has demonstrated superior performance outcome to conventional CNN processing. Additionally, NIN processing is less storage-intensive than CNN processing.

[0046] In some implementations, property characteristic profiles 108 are used in classifying property features. The property characteristic profiles 108, for example, may be developed through training the machine learning algorithms using aerial images (and, in some embodiments, terrestrial images 102d) of known property characteristics. Each property feature, for example, may be broken down into multiple classifications. In an illustrative example involving a classification of terrestrial images, cladding can include stone, brick, stucco, shingles, vertical boards, horizontal boards, or metal. The machine learning algorithms, for example, may generate a percentage confidence in a match between a new aerial image 102c including a gambrel rooftop and the characteristic profile 108 of gambrel rooftops.

[0047] In an illustrative example, turning to FIG. 2A, extracted angular and outline features of aerial images 204 may be used to classify a roof shape 202 of the particular property location 102b. In a first example, a gable roof 202b includes a central peak upon a generally rectangular outline, as depicted in corresponding aerial image 204b. A gambrel roof 202a includes these features of the gable roof 202b but, as illustrated in aerial image 204a, the gambrel roof additionally includes a "skirt" region surrounding the central gable-shaped portion. The "skirt" region can be identified, in part, based upon its corner edges extending from the four corners of the gable-shaped portion. A hipped roof 202c, as shown in aerial image 204c, includes a central peak and two opposing triangular ends extending from either end of the central peak. The central peak forms a top edge of two trapezoidal sections. A

square roof 202d, in contrast, has no central peak. Instead, as illustrated in aerial image 204d, the square roof includes four triangular portions meeting at a central point. Finally, a flat roof 202e, as shown in aerial image 204e, is represented by a substantially flat surface outlined by a rectangle.

[0048] Turning to FIG. 2D, an example error rate graph 240 compares training data 242 with accuracy of matching test data 244 in matching aerial image rooftop characteristics to corresponding rooftop type (e.g., shape). A test was conducted using NIN deep learning algorithms to classify rooftop shape in two-dimensional aerial images including a mix of gambrel, gable, hipped, square, and flat roof shapes of assorted colors. Further tests involved differing image sizes and mini-batch sizes. In particular, images were scaled using a formula of $y = w * (x\text{-}100) + z$, where x represents a property size (e.g., building with a small border surrounding the area of the rooftop), y represents pixel size, w ranged from 0.33 to 0.40 and z ranged from 90 to 110. The error rates ranged, among initial test cases involving mini batches from 5 to 20, from about 4.3% to about 10%. As shown by the error rate graph 240, in a test situation involving 2,250 sample images in a training dataset 242 and 250 test images in a test dataset 244, the minimum error rate in determining rooftop condition was 6%, corresponding to an accuracy rate of 94%.

[0049] To improve accuracy rate, in some implementations, the image can be cropped and/or resized prior to analyzing. For example, the image may be cropped to include the property of interest, or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Resizing to a standard image size, in another example, can contribute to accuracy improvement.

[0050] Further to roof shape, in some embodiments, feature analysis can be used to discern additional roof features such as, in some examples, roof covering, roof anchors, roof

equipment, skylights, widow's walks, turrets, towers, dormers, and/or chimneys. Furthermore, upon identifying the outline of the roof, a footprint of the property location 102b (e.g., size of the roof) can be calculated based upon a scale of the aerial image 102c.

[0051] Returning to FIG. 1, rather than exclusively analyzing the particular property locations 102b individually, in some implementations, the particular property locations 102b are each classified based in part upon nearby structures. For example, based upon property location 102b dimensions, which may include lot dimensions, machine learning can be used to identify additional structures at the property location 102b such as, in some examples, a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, or greenhouse. Further, the particular property locations 102b may be classified in part based upon distance from neighboring structures and/or natural features (e.g., pounding).

[0052] In some implementations, terrestrial images 102d may be used to classify features difficult to recognize using aerial imagery 102c. The terrestrial images 102d, in some examples, can include street view images obtained from a street view service or real estate listing. In some examples, street view images including a street-facing view of the property location 102b may be obtained from Google® Street View by Google, Inc., Bing® Maps Streetside by Microsoft Corp. of Redmond, WA, or Mapillary by Mapillary AB of Sweden. Using a terrestrial image, for example, the system can identify features such as construction type, cladding, building height, number of soft stories, number of floors, location coordinates, street name, slope, elevation, year built, and/or occupancy type. Where the characteristics identifiable via the terrestrial imagery 102d overlap with characteristics identifiable via two-dimensional or three-dimensional aerial imagery 102c, analysis of terrestrial imagery 102d can be combined with analysis of aerial imagery, in some embodiments, to increase confidence in identification of the particular characteristic(s). For example, house siding

features may be more easily detected in terrestrial imagery 102d and/or three-dimensional aerial imagery 120c than in two-dimensional aerial imagery 102c.

[0053] In some implementations, a condition of each property feature may be classified (112) as a corresponding condition characteristic 116. New properties are in good condition, but property feature conditions can deteriorate over time due to normal wear-and-tear on the property. Further, property features can suffer damage due to external forces such as storms and natural disasters. Eventually, conditions of housing features can deteriorate to the point where repair and/or replacement may be necessary. As with property characteristics described above at block 110, machine learning algorithms can be used to classify a present condition of individual detected property features. Using machine learning for analysis, for example, the system can extract pixel intensity distributions of previously identified property features of the aerial image of the particular property location 102b. In some examples, newly constructed property features generally have sharp contrast and well-defined features in machine learning image analysis. Conversely, weathered or damaged property features can have softened edges, blurred contrasts, and asymmetrical patches of wear. The machine learning classifier used in the machine learning condition analysis, in some embodiments, includes a machine learning analysis to process the aerial image 102c of the particular property location 102b and to classify the condition of previously identified property characteristics 110 as condition characteristics 116. The machine learning analysis, in some examples, can include two-dimensional color histogram analysis or three-dimensional color histogram analysis. In other embodiments, the machine learning analysis may be performed using pattern recognition algorithms (e.g., determining missing fence posts or missing/misaligned rooftop shingles). In other embodiments, the machine learning classifier includes deep learning analysis such as CNN or NIN. For example, CNN analysis may leverage feature maps created during the training process to assess the condition through

extracting meaningful features within a given image through convolution and pooling layers. Other machine learning models and algorithms are possible.

[0054] In an illustrative example, turning to FIG. 2B, examples of condition characteristics of aerial images of hipped rooftops and corresponding example histograms generated through machine learning analysis of pixel intensity are presented. For example, a set of good condition aerial images 210a through 214a, are presented alongside corresponding good condition histograms 210b through 214b. The good condition histograms 210b through 214b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 210c through 214c demonstrates the peak probability of grayscale color distribution of a good condition roof. The values, for example, can range from 0 (total black) to 255 (total white).

[0055] Conversely, a set of poor condition aerial images 216a through 220a, are presented alongside corresponding poor condition histograms 216b through 220b. The poor condition histograms 216b through 220b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 216c through 220c demonstrates the peak probability of grayscale color distribution of a good condition roof. The maximum values 216c through 220c corresponding to the poor condition rooftops 216a through 220a are markedly lower than corresponding maximum values 210c through 214c of good condition rooftops 210a through 214a. In addition, a width of the distributions of the poor condition histograms 216b through 220b may be markedly wider than a width of the distributions of the good condition histograms 210b through 214b. As can be seen of the aerial images of the poor condition rooftops 216a through 220a, the color distribution is patchy and bleached out, while the edges of the rooftops have lost their crisp lines. Conversely, looking to the aerial images of the good condition rooftops 210a through 214a, the rooftops are more substantially uniform in color with crisp lines on the edges.

[0056] Turning to FIG. 2C, a condition profile 230 for a rooftop condition is illustrated. In some implementations, pixel value distribution histograms such as the histograms 210b through 220b, in some implementations, can be combined to generate an example condition profile 230 corresponding to rooftop condition. The condition profile 230, for example, may be included as one of the condition profiles 114 of FIG. 1. Example reference bars 232a, 232b on the condition profile 230 illustrate values corresponding to a non-deteriorated hipped roof 214a and the deteriorated hipped roof 216a, respectively. In some examples, the closer the value of a reference bar 232 comes to 1 on the Y-axis, the better the condition of the roof, while values close to 0 represent poor condition rooftops. In one example, the reference bars 232 of the example condition profile 230 correspond to a test conditions sample data set including 2,500 images). The reference bars 232 can be combined, in some embodiments, in a logistic regression to generate a roof condition profile graph 236. The accuracy rate of the image histogram is 80% based on some validation.

[0057] Although illustrated as a single condition profile 230 corresponding to different types of rooftops (e.g., at least the hipped rooftop 216a and the gable rooftop 234), in other embodiments, individual condition profiles 114 can be generated for each property characteristic (e.g., profiles specific to gabled, gambrel, flat, hipped, square, etc.). In further refinements, in certain embodiments, individual condition profiles 114 can be generated for combinations of property characteristics (e.g., a gabled, shingled roof, a gabled, clay tiled roof, a gabled, metal roof, etc.) to increase accuracy rate based upon pixel densities corresponding to the combined characteristics. Many combinations of characteristics of property features may be used singly or in combination to generate a condition profile 114 designed to accurately identify the condition of the corresponding property feature.

[0058] Returning to FIG. 1, in some implementations, the property characteristics 110 and/or condition characteristics 116 may be analyzed to calculate (120) a risk estimate 122

corresponding to a risk of damage based upon one or more types of disasters. The types of disasters can include, in some examples, earthquake, hurricane, tornado, storm surge, fire, straight line winds, or explosion. The types and estimated severity of disasters, in some embodiments, may depend upon the particular property location 102b. For example, properties near active fault lines may be more susceptible to earthquakes, while coastal properties may be more susceptible to storm surge damage. The risk estimate 122, in some examples, can include an actuarial percentage indicating a likelihood of damage based upon the particular property characteristics. Different property characteristics, for example, may be more susceptible than others to certain types of damage. For example, flatter rooftops may be more susceptible to damage from excessive snow build-up, while peaked rooftops may be more vulnerable to strong winds.

[0059] In some embodiments, in calculating damage risk, one or more disaster risk profiles 118 can be applied based upon property characteristics. Vulnerability to damage due to disaster can vary, in some examples, by location, altitude, slope, rooftop shape, rooftop condition, cladding type, cladding condition, and/or pounding. In a particular example, as shown in FIG. 2A, a graphical risk profile 206 ranks types of rooftops by their vulnerability to strong winds. Vulnerability to wind damage increases from lowest vulnerability (flat rooftop 202e) to square roof 202d, to hipped roof 202c, to gable roof 202b, with the greatest wind damage vulnerability in gambrel roofs 202a. Vulnerability may be mathematically modeled based upon statistical information built from past damage results due to varying types and/or severity of disaster. In combining location-based vulnerabilities with individual property characteristic-based vulnerabilities, risk of damage due to disaster can be more accurately estimated.

[0060] Referring back to FIG. 1, the risk estimates 122, in some embodiments, can be used in insurance assessments. For example, the risk estimate 122 may be used in determining

whether a property is adequately insured against potential damage. Further, when tracking an impending natural disaster, an insurance company may use the risk estimates 122 to estimate claims based upon the forecast path and severity of the storm. Additionally, the risk estimates 122 may be applied by investors when selecting investment properties for an investment portfolio.

[0061] In some implementations, repair or replacement costs can be calculated (126) to determine a cost estimate 128 to place one or more property characteristics in good or "like new" condition. The cost estimates 128, in some embodiments, can be based in part on one or more replacement cost profiles 120. Replacement costs, in some examples, may vary based upon type of materials (e.g., rooftop materials, cladding materials, etc.), size of the job (e.g., estimated area of the roof, estimated length of fence, etc.), and/or additional property characteristics (e.g., contributing to the complexity of the work). The replacement profiles 120, in further examples, may be based in part on location (e.g., varying costs of material and labor regionally). In some implementations, the cost estimates 128 for repair or replacement of the property characteristics may be output to a dashboard interface screen at a remote computing device of a requester, such as an insurance carrier or real estate investment broker.

[0062] In some embodiments, cost estimates 128 can be used in automatically analyzing insurance claims. The cost estimate 128, further, may be combined with the risk estimate 122 in analyzing adequacy of insurance coverage for a particular property location 102b. Further, the cost estimates 128 may be used by investors in determining cost of maintaining/upgrading a particular investment property.

[0063] Although the operational flow is illustrated as a series of computational stages, in other implementations, more or fewer computational stages may be included. For example, aerial imagery 102c may be analyzed after an insurance claim has been paid to verify that the insured property has been repaired and/or to upgrade the estimated value of the property (e.g.,

in the circumstance where the owner upgraded the property rather than applying a straight repair/replacement of the damaged property characteristics.

[0064] Additionally, in other implementations, certain computational stages may be performed in a different order. For example, cost estimates 128 may be calculated prior to risk estimates 122. Other modifications of the operational flow 100 are possible.

[0065] FIG. 3 is a block diagram of an example environment 300 for matching aerial image topographical features to corresponding property maintenance levels. The example environment 300, for example, can be used to implement the operational flow 100 described in relation to FIG. 1. The example environment 300 includes a property characteristic classification and condition analysis system 302 in communication with client computing system(s) 306, a number of cost data and/or risk data source computing system(s) 308, and a number of shape map, aerial imagery, and/or terrestrial imagery source computing system(s) 304. The communication connection may be wired or wireless, over a variety of network types. In a general overview, the system 302 obtains property identifier(s) 340 from client computing system(s) 306, accesses images of a property identified by the property identifier 340 from the imagery source computing system(s) 304, and analyzes the images to determine property characteristic(s) 342 and condition characteristic(s) 344. Using cost and/or risk data obtained from cost and risk data source computing system(s) 308, the system 302 may determine replacement cost estimate data 350 and/or disaster risk estimate data 352 based upon the property characteristics and their condition.

[0066] In some implementations, a user of a particular client computing system 306 submits a request to the system 302 through a graphical user interface supplied by a graphical user interface engine 334. The request, for example, may include at least one property identifier 340 as well as one or more property characteristics 342 and/or identification of at least one of a replacement or repair cost estimate, a disaster risk estimate, and a confirmation of repair

assessment. The property identifier 340, in some examples, may include location information (e.g., address, geolocation coordinates, lot boundaries, etc.). The location information, for example, may conform with property location information 102b described in relation to FIG. 1. In other embodiments, the property identifier 340 may be a unique property identifier (e.g., number or string) used to look up property location information in a data store 310. In another embodiment, rather than submitting a property identifier, the user may submit a unique user identifier used to look up one or more properties associated with the user (e.g., properties insured by an insurance client, properties held by an investment client, etc.).

[0067] In one example, turning to FIG. 8A, a user may identify locations of one or more properties by selecting the properties within a graphical map interface 800. A number of properties are identified within the map view user interface 800 as indicated with an associated pin, such as pin 804. The pins, in some examples, may indicate properties insured by a particular insurance carrier, a type of property (e.g., commercial, industrial, residential, etc.), and/or properties of a value range (e.g., within a range, above a threshold, etc.). The pins, for example, may be displayed based upon filtering options supplied by the user or otherwise associated with a user profile (e.g., insurance carrier identification). In a particular example, a user may select three properties associated with three dialogue bubbles 802. As illustrated, each dialogue bubble identifies a replacement value associated with the property and invites the user to review details regarding the selected property via a details control.

[0068] In some implementations, the user enters property characteristics associated with each selected property. In other implementations, the characteristics may be accessed upon identification of the property (e.g., selection of a pin identifying a property, as illustrated in FIG. 8A). For example, the property characteristics 342 may be obtained from the data store 310, as illustrated in FIG. 3. Turning to FIG. 8B, an example property characteristics user interface 820 presents building area characteristics 822 (e.g., building area 822a, stories 822b,

and total building area 822c) and structure characteristics 824 (e.g., structure material 824a, construction class 824b). As described within, different or additional characteristics may vary per implementation. In some embodiments, the user may be provided the ability via the user interface 820 to edit the building area characteristics 822 and/or the structure characteristics 824, for example via an edit control 828a or 828b. For example, in the circumstance of recent development or renovation (e.g., construction of an addition), the user may modify previously stored characteristics values. The property characteristics user interface 820, for example, may be presented to a user upon selection of a details control of one of the dialogue bubbles 802 illustrated in the user interface of FIG. 8A.

[0069] The user interface 820 further presents, in some implementations, premium characteristics 826 such as a replacement value. The premium information, for example, may relate to an insurance policy purchased for the property or parameters for insuring the property (e.g., based upon upgraded or new characteristics). The user, in some embodiments, may be provided to update the premium information via an edit control 828c.

[0070] In some implementations, upon identification of property location information, the system 302 accesses imagery of the property from the imagery source computing system(s) 304 using an image acquisition engine 336. The images can include, in some examples, a shape map (e.g., such as the shape maps 102a described in relation to FIG. 1), two-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), three-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), and/or terrestrial imagery (e.g., such as the terrestrial imagery 102d described in relation to FIG. 1). The images obtained by the image acquisition engine 336, in some embodiments, depend upon the property characteristic(s) identified by the user. For example, certain types of images are preferred for analyzing certain types of property

characteristics. Housing siding, for example, is more easily perceived from a terrestrial image or three-dimensional aerial image than from a two-dimensional aerial image.

[0071] In some implementations, an image quality analysis and preparation engine 326 analyzes the acquired image(s) to confirm the acquired image(s) contains an adequately clear and detailed image of the property identified by the property identifier 340. In some embodiments, the image quality analysis and preparation engine 326 crops and/or resizes the acquired image(s). For example, the image quality analysis and preparation engine 326 may extract a portion of an acquired image based upon the property (e.g., building size). In some implementations, the image quality analysis and preparation engine 326 resizes each acquired image to a standard size. The standard size, in a particular example, may be 256 by 256 pixels per image. Resizing to a standard size, for example, may increase accuracy in later classification analysis. The image quality analysis and preparation engine 326, in some embodiments, may be configured to apply corrections to the acquired image(s). For example, the image quality analysis and preparation engine 326 may be configured to adjust an aerial image from a normal orthophoto angle, to a true orthophoto version as described above.

[0072] In some implementations, the image quality analysis and preparation engine 326 uses shape outlines as part of the analysis. For example, a composite image generation engine 318 may overlay an aerial image with a shape map image, as described in relation to FIG. 5C. Using the resultant composite image, the image quality analysis and preparation engine 326 may confirm the aerial image conforms with an urban planning map or other property placement guide (e.g., navigational map data, etc.). Further, the image quality analysis and preparation engine 326 may use the overlaid shape map as a guide in determining whether an aerial image requires correction to a true orthophoto angle and/or how closely to crop the image to capture the property (and, optionally, its immediate surroundings such as its lot or a portion of the proximate neighborhood).

[0073] In some implementations, if the image quality analysis and preparation engine 326 determines that the acquired image is insufficient, the image quality analysis and preparation engine 326 may request a replacement image from the image acquisition engine 336. For example, the image acquisition engine 336 may obtain images based upon a variety of factors including, in some examples, recency of capture, resolution, cost, and/or applicability to a particular property characteristic analysis. Upon determination by the image quality analysis and preparation engine 326 that the first obtained image is insufficient, for example, the image acquisition engine 336 may determine a next best source for obtaining an image of the property.

[0074] In some implementations, once an image has been approved (and, optionally, prepared and/or corrected) by the image quality analysis and preparation engine 326, a feature identification engine 320 extracts features from the property image(s) related to the identified property characteristics 342. In the circumstance of a fence, for example, the feature identification engine 320 may identify a perimeter enclosure or partial perimeter enclosure abutting and extending from the property as indicative of a fence.

[0075] In some implementations, upon identification of features by the feature identification engine 320, a property characteristic classification engine 322 classifies the property characteristic. For example, the features may be classified using one or more machine learning techniques as described in relation to computational stage 106 (classify features of each image) of FIG. 1. The property characteristic classification engine 322, for example, may generate property characteristics 342 representing a grouping, type, or other characterization of a particular property feature. Continuing with the particular example of a fence, the extracted features may be analyzed and classified in relation to height and/or material. Upon classifying the property characteristics, the property characteristic

classifications may be stored in the data store 310 as property characteristics 342 (e.g., similar to property characteristics 110 of FIG. 1).

[0076] In some implementations, the property characteristic classification engine 322 uses characteristic profile(s) 360 in classifying property characteristics. The property characteristic classification engine 322, for example, may obtain, for each property characteristic being analyzed, a particular characteristic profile 360 from a profile data store 314. The characteristic profiles, for example, may be similar to the characteristic profiles 108 described in relation to FIG. 1.

[0077] In some implementations, the property characteristic profiles 360 are generated by a characteristic classification learning engine 328. The characteristic classification learning engine 328, for example, may generate characteristic profiles 360 through a sample data set and learning process as described, generally, in relation to FIG. 2A. In a particular example, the characteristic classification learning engine 328 may analyze JPG (lossy compression digital image standard developed by the Joint Photographic Experts Group) to recognize varying rooftop shapes.

[0078] While certain property characteristic classifications are done by analysis, in some implementations, one or more feature classifications may be obtained from previously stored property characteristics 342. For example, based upon tax records, real estate records, etc. some basic materials and structure information regarding a property may be readily available through local and/or remote database system(s). In other examples, the previously stored property characteristics 342 may also be obtained from previous condition assessments performed for a property location by the system 302.

[0079] In some implementations, once the property characteristic classification engine 322 has classified the property characteristic(s), a characteristic condition classification engine 324 classifies the condition of each property characteristic. For example, the property

characteristics may be classified as described in relation to computational stage 112 (classify condition of each feature) of FIG. 1. The characteristic condition classification engine 324, for example, may generate condition characteristics 344 representing a rating, qualification, or ranking of the condition of the particular characteristic. In some examples, the characteristic condition classification engine 324 may qualify a characteristic as a) "good" or "bad", b) "like new", "acceptable", "needs repair", or "needs replacement", c) rated on a numeric scale such as a scale from 1 to 5 where 5 may correspond to "like new" and 1 may correspond to "needs replacement." In other implementations, particular problems may be identified by the characteristic condition classification engine 324 such as, in some examples, a fence feature is partially fallen, or a roof feature shows signs of structural damage.

[0080] In some implementations, the characteristic condition classification engine 324 uses condition profile(s) 362 in classifying property characteristic conditions. The characteristic condition classification engine 324, for example, may obtain, for each property characteristic being analyzed, a particular condition profile 362 from the profile data store 314. The condition profiles 362, for example, may be similar to the condition profiles 114 described in relation to FIG. 1.

[0081] In some implementations, the condition profiles 362 are generated by a condition classification learning engine 330. The condition classification learning engine 330, for example, may generate condition profiles 362 through a sample data set and learning process as described, generally, in relation to FIG. 2B. In a particular example, color histogram analysis may be used to identify peak pixel values of the images in gray scale. Using the group of calculated peak pixel values, the learning engine can classify property condition into certain categories.

[0082] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a risk

calculation engine 316 may estimate risk of damage based upon one or more types of disaster. For example, the disaster risk estimate data 352 may be calculated as described in relation to computational stage 120 (calculate damage risk) of FIG. 1. The disaster risk estimate data 350, in one example, can include a percentage likelihood of damage due to each particular type of risk based upon the particular property characteristics and/or property conditions, as described in relation to the risk estimates 122 of FIG. 1. Further, in some embodiments, the disaster risk estimate data 350 may include a set of risk estimates based upon, in some examples, a number of severities of disaster, a particular path of disaster, and/or hazard intensity of disaster. The disaster severities, in some examples, may correspond to the Richter scale of seismic activity magnitude or the Saffir-Simpson Hurricane Wind Scale category. The path of the disaster, in some examples, can include geographical direction such as northeasterly, etc. or angle of impact with respect to the property characteristic(s). The hazard intensity of disaster, in some examples, can relate to wind speed or rainfall amount. Repair costs, for example, may be more accurately estimated when the roof condition is known. Due to poor condition of a rooftop in one particular example, the roof may be more vulnerable to damage requiring replacement. In another particular example, due to a poor condition rooftop, the likelihood for interior property damage (e.g., water damage due to breach of the roof) may increase at a set level of severity of disaster and above.

[0083] In some embodiments, the risk calculation engine 316 accesses one or more risk profiles 364 from the data store 314 based upon property characteristics and/or condition characteristics. The risk profiles, for example, may be similar to the disaster risk profiles 118 described in relation to FIG. 1. The risk profiles 364, for example, may be obtained from one or more risk data sources 308 by a cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate risk profiles 364 (e.g., using risk data obtained

from one or more cost and risk data sources 308 and a risk data analysis engine (not illustrated)).

[0084] The risk estimate data 352, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use risk estimate data in making insurance assessments. In another example, a real estate investment broker or firm client 306 may apply risk estimate data 352 when selecting investment properties for an investment portfolio.

[0085] Turning to FIG. 8C, an example disaster risk user interface 840 presents risk assessment information based upon risk profiles 364 related to the selected property (e.g., one of the properties identified via the dialogue bubbles 802c of FIG. 8A). The user interface 840, for example, may be accessed by scrolling downward from the user interface 820. The user interface 840 illustrates a number of disaster risk factors 842 and associated risk estimate data 844 for the selected property. As illustrated, the disaster risk factors 842 include a fire factor 842a, a wind factor 842b, a flood factor 842c, an earthquake factor 842d, a tsunami factor 842e, and a landslide factor 842f. In some embodiments, only a subset of the risk estimate data is determined via risk assessment techniques described herein. For example, flood data 844c may be generated based upon governmental flood map evaluation rather than via aerial imaging assessment, while fire risk 844a may be determined at least in part based upon proximity to neighboring properties as derived via imaging analysis and/or construction properties derived via image analysis. Further, wind risk data 842b may be derived via rooftop analysis as described in greater detail herein.

[0086] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a cost calculation engine 332 calculates repair or replacement costs for improving problems identified by the characteristic condition classification engine 324 and generates replacement

cost estimate data 350. For example, the replacement cost estimate data 350 may be calculated as described in relation to computational stage 126 (calculate repair or replacement costs) of FIG. 1. The replacement cost estimate data 350, for example, may be similar to the cost estimates 128 described in relation to FIG. 1.

[0087] In some implementations, the cost calculation engine 332 based calculations in part on one or more cost profiles 366 (e.g., similar to the cost profiles 120 of FIG. 1). In some embodiments, the cost calculation engine 332 accesses one or more cost profiles 366 from the data store 314 based upon property characteristics and/or condition characteristics. The cost profiles 366, in some embodiments, are obtained from one or more cost data sources 308 by the cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate cost profiles 366 (e.g., by a cost data analysis engine (not illustrated) using cost data obtained from one or more cost and risk data sources 308).

[0088] The cost estimate data 350, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use cost estimate data in determining adequacy of insurance coverage for a particular property. In another example, a real estate investment broker or real estate investment firm client 306 may apply cost estimate data 350 in determining cost of maintaining/upgrading a particular investment property.

[0089] In some implementations, the cost estimate data 350 and/or risk estimate data 352 is provided to a requesting client 306, responsive to receiving identification of one or more properties, in real-time or near real-time. For example, a client 306 accessing a dashboard interface, may format a request for a risk estimate or cost estimate related to an identified property within a dashboard interface and submit the request via a network to the system 302. Responsive to the request, the system 302 may conduct the analysis described generally above and respond, in real time or near-real time to the client 306 with a risk analysis or cost

analysis. For example, risk analysis information is presented in user interface 840 of FIG. 8C.

[0090] In some implementations, the system may identify, through updated meteorological data, one or more properties within a client real estate portfolio affected by a disaster. The system, further to identification of the affected properties, may proactively prepare a repair estimate to provide to the client corresponding to the real estate portfolio shortly after the disaster took effect. In one example, the Japan Meteorological Agency may update observation data via a web site interface within an hour or so of observation. In this example, the system may provide repair cost estimates to clients between one and two hours after a disaster has taken place.

[0091] Rather than sharing cost estimate data 350 and/or risk estimate data 352 directly with the clients 306, in other embodiments, the system 302 may include a report generation engine (not illustrated) that prepares reports regarding condition, damage, and risk assessments of one or more properties. Further, in some embodiments, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to confirm whether a property owner made repairs to a property (e.g., based upon payment of an insurance claim), replaced one or more features of a property, or removed one or more features of a property (e.g., removed a hazardous collapsing structure, cut back brush encroaching a fire risk distance to a home, etc.). In another illustration, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to determine whether a repair or replacement is an upgrade (e.g., replacement using superior materials) or a downgrade (e.g., replacing an in-ground pool with an above-ground pool) to the property characteristic. Other modifications of the system 302 are possible.

[0092] FIG. 4 is a flow chart of an example method 400 for classifying condition characteristics of a property based on aerial image analysis. The flow chart, for example,

may represent computational stages 104 through 112 as described in relation to FIG. 1. The method 400 may be performed, for example, by the system 302 of FIG. 3.

[0093] In some implementations, the method 400 begins with accessing a two-dimensional shape map including the shape of a property (402). The shape map, for example, may be accessed by the image acquisition engine 336 from a shape map imagery source 304, as described in relation to FIG. 3. The two-dimensional shape map, for example, may take a form of any of the shape maps 102a described in relation to FIG. 1. In a particular example, the shape map may be in a form similar to the shape map 500 described in relation to FIG. 5A.

[0094] In some implementations, two-dimensional and/or three-dimensional aerial imagery including an image of the property is accessed (404). The two-dimensional and/or three-dimensional aerial imagery, for example, may be accessed by the image acquisition engine 336 from an aerial imagery source 304, as described in relation to FIG. 3. The two-dimensional and/or three-dimensional aerial imagery, for example, may take a form of any of the aerial imagery 102c described in relation to FIG. 1. In a particular example, the two-dimensional aerial imagery may be in a form similar to the aerial image 510 described in relation to FIG. 5B.

[0095] In some implementations, the aerial imagery is overlaid with the shape map (406). The composite image generation engine 318 of FIG. 3, for example, may overlay the aerial imagery with the shape map to generate a composite image. The composite image, for example, may be in a form similar to the composite image 520 described in relation to FIG. 5C.

[0096] If a shape match is not identified (408), in some implementations, the method 400 accesses alternate two-dimensional or three-dimensional aerial imagery (410). In some embodiments, the image quality analysis and preparation engine 326 of FIG. 3 determines

whether the composite image presents an adequate shape match of the property(s) of interest. Upon determining the image does not match, the image acquisition engine 336 of FIG. 3, for example, may obtain an alternative two-dimensional or three-dimensional aerial image from the aerial imagery source(s) 304. As described in relation to FIG. 3, for example, For the image acquisition engine 336 may determine a next best source for obtaining an image of the property based upon one or more factors. Conversely, the method 400, in other implementations (not illustrated), could proceed without matching the shape map to the aerial imagery.

[0097] If a shape match is identified (408), in some implementations, the formatting of the aerial imagery is prepared (411). In some embodiments, the image is cropped to include the property of interest or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Cropping may be based, for example, on the correlation of the shape map to the property. In illustration, the image may be cropped to include the shape map outline of the property plus a border region. In some embodiments, cropping may include cropping to a set shape (e.g., X by X pixels square, X by Y pixels rectangle, etc.). In some embodiments, in addition to cropping the image, the image may be resized. For example, depending upon the resolution of the aerial imagery, the image resolution may be reduced, for example, to fit within an X by X pixels square or an X by Y pixels rectangle. Resizing to a standard image size, for example, can contribute to analysis consistency and improvement in classification accuracy. In further embodiments, the color depth and/or color mapping of the aerial imagery may be adjusted. For consistent color histogram analysis of the imagery, for example, the color depth and color mapping may be made consistent across analyzed images. In a particular example, color images may be converted to grayscale for grayscale image analysis.

Adjustments to the imagery, for example, may be effected by the image quality analysis and preparation engine 326, described in relation to FIG. 3.

[0098] In some implementations, orthogonality of the aerial imagery is assessed (412). For example, the image quality analysis and preparation engine 326 may assess orthogonality of the aerial imagery. The image quality analysis and preparation engine 326, in one example, may determine that orthogonality correction is desired. In another example, if the image represents a normal orthophoto rather than a true orthophoto, the image quality analysis and preparation engine 326 may notify further modules which may compensate for the angle of capture of the aerial image. In other implementations (not illustrated), orthogonality may be assessed without use of an overlaid shape map.

[0099] Returning to FIG. 4, in some implementations, if the aerial imagery is not orthogonal (414), an orthogonal version of the aerial imagery is generated (416). The image quality analysis and preparation engine 326 of FIG. 3, for example, may correct a normal orthophoto form to generate a true orthophoto form. The true orthophoto form, for example, may better match the shape map overly.

[0100] In some implementations, one or more property characteristics of the property are classified (418). The property, in some embodiments, is analyzed based on the portion of the aerial image substantially bounded by the shape map of the property. In other embodiments, the property analysis encompasses a surrounding of the property (e.g., features proximate the property upon the property lot, nearby properties, etc.). The property characteristic(s), for example, may be classified by the property characteristic classification engine 322, as described in relation to FIG. 3. In a particular example, a rooftop property feature may be classified as one of a variety of rooftop shapes, as illustrated in FIG. 2A.

[0101] In some implementations, if a property characteristic classification is identified (420), a condition of each of the property characteristics can be classified (422). The property

characteristic condition(s), for example, may be classified by the characteristic condition classification engine 324, as described in relation to FIG. 3. In a particular example, a hipped classification of the rooftop feature may be classified as one of a good condition and a poor condition, as illustrated in FIG. 2B. In some implementations, the classifications of the condition of each of the property characteristics may by output to a computing device of a requester (422) via a dashboard interface screen. In some examples, in addition to providing the condition classification for the property characteristics, the dashboard interface screen may include replacement costs for replacing the property characteristics, risk cost estimates due to damage from natural disasters, or confirmation of whether or not repairs have been made to the property characteristics.

[0102] If, instead, a classification match was not identified (420), in some implementations, alternate two-dimensional or three-dimensional aerial imagery is accessed (410) and the method 400 restarts with overlaying the replacement aerial imagery with the shape map (406). Alternatively, in some embodiments, even if a classification match is not identified, condition may be assessed based upon a default profile associated with the property feature (not illustrated). For example, if the rooftop shape does not match one of the shapes trained into the system, the condition of the rooftop may still be assessed based upon a general condition profile trained with a variety of rooftop shapes. In some examples, the condition of the rooftop may be assessed by comparing the current rooftop conditions to stored historic condition characteristics for the property from a previous condition assessment.

[0103] Although the method 400 is illustrated as a series of steps, in other implementations, more or fewer steps may be included. For example, in some implementations, terrestrial images are obtained and used to classify the same and/or different property characteristics, as described in relation to the operational flow 100 of FIG. 1.

[0104] Additionally, in other implementations, certain steps may be performed in a different order. For example, in some implementations, property characteristics and condition characteristics may be classified (418, 422) in parallel. Other modifications of the operational flow 100 are possible.

[0105] Aspects of the present disclosure may be directed to computing systems for categorizing a repair condition of a property characteristic in order to provide dynamic, real-time property condition assessments in response to requests received from users such as insurance carriers or real estate investment brokers using aerial imagery. The implementations described herein improve upon conventional methodologies by applying deep learning analysis models to detected property characteristics of the obtained imagery in order to assess whether a condition of the property characteristics is degraded to a point of needing repair or replacement and determine an amount of risk exposure of the property due to the detected condition of the property characteristics. The implementations described herein improve processing efficiency of the system to reduce an amount of time it takes to perform the condition assessments and automate a condition assessment process.

[0106] Next, a hardware description of the computing device, mobile computing device, or server according to exemplary embodiments is described with reference to Figure 6. In Figure 6, the computing device, mobile computing device, or server includes a CPU 600 which performs the processes described above. The process data and instructions may be stored in memory 602. These processes and instructions may also be stored on a storage medium disk 604 such as a hard drive (HDD) or portable storage medium or may be stored remotely. Further, the claimed advancements are not limited by the form of the computer-readable media on which the instructions of the inventive process are stored. For example, the instructions may be stored on CDs, DVDs, in FLASH memory, RAM, ROM, PROM, EPROM, EEPROM, hard disk or any other information processing device with which the

computing device, mobile computing device, or server communicates, such as a server or computer.

[0107] Further, a portion of the claimed advancements may be provided as a utility application, background daemon, or component of an operating system, or combination thereof, executing in conjunction with CPU 600 and an operating system such as Microsoft Windows 6, UNIX, Solaris, LINUX, Apple MAC-OS and other systems known to those skilled in the art.

[0108] CPU 600 may be a Xenon or Core processor from Intel of America or an Opteron processor from AMD of America, or may be other processor types that would be recognized by one of ordinary skill in the art. Alternatively, the CPU 600 may be implemented on an FPGA, ASIC, PLD or using discrete logic circuits, as one of ordinary skill in the art would recognize. Further, CPU 600 may be implemented as multiple processors cooperatively working in parallel to perform the instructions of the inventive processes described above.

[0109] The computing device, mobile computing device, or server in FIG. 6 also includes a network controller 606, such as an Intel Ethernet PRO network interface card from Intel Corporation of America, for interfacing with network 6X. As can be appreciated, the network 628 can be a public network, such as the Internet, or a private network such as an LAN or WAN network, or any combination thereof and can also include PSTN or ISDN sub-networks. The network 628 can also be wired, such as an Ethernet network, or can be wireless such as a cellular network including EDGE, 3G and 4G wireless cellular systems. The wireless network can also be Wi-Fi, Bluetooth, or any other wireless form of communication that is known.

[0110] The computing device, mobile computing device, or server further includes a display controller 608, such as a NVIDIA GeForce GTX or Quadro graphics adaptor from NVIDIA Corporation of America for interfacing with display 610, such as a Hewlett Packard

HPL2445w LCD monitor. A general purpose I/O interface 612 interfaces with a keyboard and/or mouse 614 as well as a touch screen panel 616 on or separate from display 610. General purpose I/O interface also connects to a variety of peripherals 618 including printers and scanners, such as an OfficeJet or DeskJet from Hewlett Packard.

[0111] A sound controller 620 is also provided in the computing device, mobile computing device, or server, such as Sound Blaster X-Fi Titanium from Creative, to interface with speakers/microphone 622 thereby providing sounds and/or music.

[0112] The general purpose storage controller 624 connects the storage medium disk 604 with communication bus 626, which may be an ISA, EISA, VESA, PCI, or similar, for interconnecting all of the components of the computing device, mobile computing device, or server. A description of the general features and functionality of the display 610, keyboard and/or mouse 614, as well as the display controller 608, storage controller 624, network controller 606, sound controller 620, and general purpose I/O interface 612 is omitted herein for brevity as these features are known.

[0113] One or more processors can be utilized to implement various functions and/or algorithms described herein, unless explicitly stated otherwise. Additionally, any functions and/or algorithms described herein, unless explicitly stated otherwise, can be performed upon one or more virtual processors, for example on one or more physical computing systems such as a computer farm or a cloud drive.

[0114] Reference has been made to flowchart illustrations and block diagrams of methods, systems and computer program products according to implementations of this disclosure. Aspects thereof are implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other

programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0115] These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means which implement the function/act specified in the flowchart and/or block diagram block or blocks.

[0116] The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0117] Moreover, the present disclosure is not limited to the specific circuit elements described herein, nor is the present disclosure limited to the specific sizing and classification of these elements. For example, the skilled artisan will appreciate that the circuitry described herein may be adapted based on changes on battery sizing and chemistry, or based on the requirements of the intended back-up load to be powered.

[0118] The functions and features described herein may also be executed by various distributed components of a system. For example, one or more processors may execute these system functions, where the processors are distributed across multiple components communicating in a network. The distributed components may include one or more client and server machines, which may share processing, as shown on Fig. 8, in addition to various human interface and communication devices (e.g., display monitors, smart phones, tablets, personal digital assistants (PDAs)). The network may be a private network, such as a LAN or

WAN, or may be a public network, such as the Internet. Input to the system may be received via direct user input and received remotely either in real-time or as a batch process. Additionally, some implementations may be performed on modules or hardware not identical to those described. Accordingly, other implementations are within the scope that may be claimed.

[0119] In some implementations, as illustrated in FIG. 7, the innovations described herein may interface with a cloud computing environment 730, such as Google Cloud Platform™ to perform at least portions of methods or algorithms detailed above. The processes associated with the methods described herein can be executed on a computation processor, such as the Google Compute Engine by data center 734. The data center 734, for example, can also include an application processor, such as the Google App Engine, that can be used as the interface with the systems described herein to receive data and output corresponding information. The cloud computing environment 730 may also include one or more databases 738 or other data storage, such as cloud storage and a query database. In some implementations, the cloud storage database 738, such as the Google Cloud Storage, may store processed and unprocessed data supplied by systems described herein.

[0120] The systems described herein may communicate with the cloud computing environment 730 through a secure gateway 732. In some implementations, the secure gateway 732 includes a database querying interface, such as the Google BigQuery platform.

[0121] The cloud computing environment 102 may include a provisioning tool 740 for resource management. The provisioning tool 740 may be connected to the computing devices of a data center 734 to facilitate the provision of computing resources of the data center 734. The provisioning tool 740 may receive a request for a computing resource via the secure gateway 732 or a cloud controller 736. The provisioning tool 740 may facilitate a connection to a particular computing device of the data center 734.

[0122] A network 702 represents one or more networks, such as the Internet, connecting the cloud environment 730 to a number of client devices such as, in some examples, a cellular telephone 710, a tablet computer 712, a mobile computing device 714, and a desktop computing device 716. The network 702 can also communicate via wireless networks using a variety of mobile network services 720 such as Wi-Fi, Bluetooth, cellular networks including EDGE, 3G and 4G wireless cellular systems, or any other wireless form of communication that is known. In some embodiments, the network 702 is agnostic to local interfaces and networks associated with the client devices to allow for integration of the local interfaces and networks configured to perform the processes described herein.

[0123] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present disclosures. Indeed, the novel methods, apparatuses and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods, apparatuses and systems described herein can be made without departing from the spirit of the present disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the present disclosures.

Electronic Patent Application Fee Transmittal

Application Number:	16868113
Filing Date:	06-May-2020
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Filer:	Natalie J. Grace/Anthony Gorney
Attorney Docket Number:	474139US03

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
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P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

146018 7590 10/01/2021
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	05/06/2020	Takeshi Okazaki	474139US03	5664

TITLE OF INVENTION: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/03/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, TIEN C	3694	382-224000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Gardella Grace P.A.
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Aon Benfield Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Chicago, IL

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 601484

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Natalie J. Grace/ Date October 22, 2021

Typed or printed name Natalie J. Grace Registration No. 65803

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	|
AON BENFIELD INC.	| EXAMINER: TIEN C. NGUYEN
APPLICATION NO.: 16/868,113	| GROUP ART UNIT: 3694
FILED: MAY 6, 2020	| DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	|

AMENDMENT AFTER ALLOWANCE UNDER 37 CFR § 1.312

MAIL STOP ISSUE FEE
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Notice of Allowance dated October 1, 2021, please amend the above-identified application as follows.

Applicant does not believe that any fees are due at this time. If, however, any fees are required, including fees for extensions of time, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Amendments to the Specification begin on page **2** of this paper.

Amendments to the Claims begin on page **3** of this paper.

Remarks begin on page **9** of this paper.

AMENDMENTS TO THE SPECIFICATION

Please amend the Specification as follows:

In accordance with 37 CFR §§ 1.121(b)(3), and 1.125, please amend paragraphs **[0002]**, **[0045]**, **[0048]**, **[0053]**, **[0059]**, **[0068]**, **[0083]**, **[0086]**, **[0087]** and **[00101]** of the Specification as indicated in the attached marked-up version of the substitute specification. An accompanying clean version of the specification, incorporating changes of the marked-up version of the substitute specification, is also attached herewith. The substitute specification includes no new matter.

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (Cancelled)

2. (Allowed) A system for automatically assessing features of a property location comprising a structure, the system comprising:

a non-volatile computer readable medium storing

a set of property characteristic profiles, each property characteristic profile of the set of property characteristic profiles being developed through training one or more machine learning algorithms using first property images to identify one or more characteristics of at least one property feature of one or more property features, and

a set of property condition profiles, each property condition profile of the set of property condition profiles being developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and

processing circuitry configured to

receive, from a user at a remote computing device via a network, a request comprising identification of a property location,

access aerial imagery of the property location,

classify a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features,

identifying the respective feature from at least one image obtained from the aerial imagery,

applying one or more property characteristic profiles of the set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein

a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and

applying one or more property condition profiles of the set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, and

responsive to receiving the request, cause presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

3. (Allowed) The system of claim 2, wherein identifying the respective feature from the at least one image comprises extracting, from the at least one image, one or more pixel groupings representing the respective feature.

4. (Allowed) The system of claim 3, wherein each pixel grouping of the one or more pixel groupings comprises angles, outlines, and/or substantially homogenous pixel fields.

5. (Allowed) The system of claim 2, wherein the aerial imagery comprises at least one aerial image of a geographic region including the property.

6. (Allowed) The system of claim 2, wherein the one or more characteristics of a first feature of the one or more property features comprises a shape characteristic and a material characteristic.

7. (Allowed) The system of claim 2, wherein the information regarding a first feature of the at least one property feature comprises identification of at least one of a shape or a material of the first feature.

8. (Allowed) The system of claim 2, wherein the information regarding a first feature of the at least one property feature comprises a condition classification indicating at least one of: a good condition, an acceptable condition, a needs repair condition, or a needs replacement condition.

9. (Allowed) The system of claim 2, wherein the at least one property feature comprises a rooftop and a chimney.

10. (Allowed) The system of claim 2, wherein at least one profile of the one or more property condition profiles includes a convolutional neural network (CNN).

11. (Allowed) The system of claim 2, wherein the processing circuitry is further configured to compare a current condition classification of the property characteristic to a historic condition classification of the property characteristic.

12. (Allowed) The system of claim 2, wherein at least one profile of the one or more property condition profiles includes a deep learning algorithm for identifying the respective feature within a given image.

13. (Allowed) The system of claim 2, wherein applying the one or more property characteristic profiles of the set of property characteristic profiles to at least the portion of each image of the at least one image to determine the plurality of characteristics of the respective feature comprises approximating a size of the respective feature.

14. (Allowed-Currently Amended) A method for automatically assessing features of a property location comprising a structure, the ~~system~~ method comprising:

receiving, from a user at a remote computing device via a network, a request comprising identification of a property location;

accessing, by processing circuitry, aerial imagery of the property location;

classifying, by the processing circuitry, a condition of one or more features of the property location, wherein classifying comprises, for each feature of the one or more features,

identifying the respective feature from at least one image obtained from the aerial imagery,

applying one or more property characteristic profiles of a set of property characteristic profiles to at least a portion of each image of the at least one image to determine a plurality of characteristics of the respective feature, wherein

each property characteristic profile of the set of property characteristic profiles is developed through training one or more machine learning algorithms

using first property images to identify one or more characteristics of at least one property feature of one or more property features, and

a first characteristic of the plurality of characteristics comprises a type of material of the feature or a shape of the feature, and

applying one or more property condition profiles of a set of property condition profiles to at least a portion of each image of the at least one image to classify a condition of the respective property feature, wherein

each property condition profile of the set of property condition profiles is developed through training one or more machine learning algorithms using second property images to identify one or more conditions of at least one property characteristic of one or more property characteristics corresponding to a given feature or features of the one or more property features; and

responsive to receiving the request, causing presentation of, for review by the user at the remote computing device, a graphical user interface comprising information regarding the plurality of characteristics and the condition of each feature of the at least one property feature.

15. (Allowed) The method of claim 14, wherein a given feature of the one or more features of the property location comprises a natural feature.

16. (Allowed) The method of claim 14, wherein causing presentation of the graphical user interface comprises causing presentation of an interactive user interface.

17. (Allowed-Currently Amended) The method of claim 14, wherein accessing the aerial imagery comprises accessing the aerial imagery via a second network from non-volatile storage media.

18. (Allowed-Currently Amended) The method of claim 14, wherein a first property condition profile of [[a]] the set of property condition profiles includes a color histogram machine learning analysis model.

19. (Allowed) The method of claim 14, wherein the set of property characteristic profiles are part of a neural network.

20. (Allowed-Currently Amended) The method of claim 14, wherein:

the property location comprises multiple structures; and

classifying the condition of the one or more features of the property location comprises classifying the condition of one or more features of each structure of the multiple structures.

21. (Allowed) The method of claim 14, further comprising, prior to classifying the condition, adjusting color of the at least one image.

REMARKS

Status of the Claims

Claims 2-21 are currently allowed. Claims 14, 17, 18 and 20 are currently amended. The present amendments introduce no new matter.

Amendment to the Specification

The specification as filed is hereby amended to correct minor typographical errors. No new matter has been added.

Amendments to the Claims

The claims are hereby amended to correct minor typographical and antecedent basis errors. No new matter has been added.

No Disclaimers or Disavowals

Although this paper may amend the specification or claims, identify claimed features not taught or suggested in the prior art, or otherwise distinguish the claimed subject matter from the prior art, Applicant(s) are not conceding that the subject matter of any previously pending claim is not patentable over the prior art. Applicant(s) reserve the right to later pursue claims covering any of the subject matter embraced by the previously pending claims or supported by the specification and drawings as filed. Accordingly, the Office should not infer from this paper any disclaimer or disavowal of any subject matter.

CONCLUSION

It is believed that the application, as amended, is in condition for issuance. Favorable reconsideration of this application is respectfully requested. Examiner Nguyen is encouraged to contact Representative Natalie Grace at 703-740-4538 should any additional information be necessary.

Respectfully submitted,

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Date: October 22, 2021

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In the United States Patent and Trademark Office

Application for United States Patent

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

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474139US03

RELATED APPLICATIONS

[0001] This application is a continuation of and claims priority to U.S. Patent Application Serial No. 16/733,888 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Conditions Through Aerial Imagery Analysis" and filed January 3, 2020, which is a continuation-in-part of and claims priority to U.S. Patent Application Serial No. 15/714,376 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis" and filed September 25, 2017, which claims priority to U.S. Provisional Patent Application Serial No. 62/398, 665, entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis," filed September 23, 2016. All above identified applications are hereby incorporated by reference in their entireties.

BACKGROUND

[0002] A risk exposure database contains a compilation of as many building properties or characteristics relevant to insurance as possible. These properties can include characteristics like location coordinates, address, slope, and elevation. Other characteristics include construction type, occupancy type, year built and/or year of renovation, building height, soft stories, number of stories, and floor area. Further characteristics can include roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding (distance to closest building). Some of these characteristics can only be assessed by on-site inspections or by official documentation, but others can be measured using visual imagery.

[0003] Characteristics addressed in this disclosure include roof shape and roof condition. In one example, roof shapes can be broken into five categories: gambrel roof, gable roof, hipped

roof, square roof, and flat roof. Each roof shape has a unique response and damage vulnerability to different natural perils like earthquake or wind.

[0004] Deep learning involves computational models composed of multiple processing layers to learn representations of data with multiple levels of abstractions. These models can be thought of as a way to automate predictive analytics. Representation learning is a set of methods that allows a machine to be fed with raw data and to automatically discover the representations needed for detection or classification. Use cases for deep learning include voice recognition, motion detection, translation, and medical diagnosis. By using deep learning algorithms and sample datasets, computers can learn to distinguish and classify a wide range of characteristics to high levels of accuracy, often surpassing the recognition levels of human beings.

[0005] One model used for deep learning is the Network in Network model described in the paper "Network In Network" by M. Lin et al. and published in the International Conference on Learning Representations, 2014 (arXiv:1409.1556), the contents of which are hereby incorporated by reference in its entirety. Using the Network in Network model, a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification.

[0006] When applied to visual recognition, deep learning algorithms can break down an observation (e.g., an image) in a number of different ways to characterize features of the observation. In some examples, deep learning algorithms can be applied to review images as a set of intensity values per pixel, or in a more abstract way as a set of edges, regions of particular shape, etc. Some representations may demonstrate superior performance to others based upon the particular learning task. One of the promises of deep learning is replacing

human identification of features with efficient algorithms for unsupervised or semi-supervised feature learning and hierarchical feature extraction.

[0007] The inventors recognized that deep learning methodology could be applied to risk exposure database population to analyze aerial imagery and automatically extract characteristics of individual properties, providing fast and efficient automated classification of building styles and repair conditions. In combining location-based vulnerabilities with individual property vulnerabilities identified in part through classification of repair conditions of one or more property features, risk of damage due to disaster can be more accurately estimated.

SUMMARY OF ILLUSTRATIVE EMBODIMENTS

[0008] The forgoing general description of the illustrative implementations and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure, and are not restrictive.

[0009] Systems, methods, and computing system platforms described herein support matching aerial image features of one or more properties to corresponding property conditions (e.g., maintenance levels of property features, including structural features, manmade features included within a vicinity of a structure (e.g., on a property lot, within a property parcel, or a geographic region of the property), and/or natural features included within the vicinity of the structure) through machine learning analysis. In a preferred application, the property condition analysis may be used in estimating damage risk in light of one or more disaster conditions, such as severe storms. The analysis may further aid in estimating costs of repair or replacement of each property, in one example, should a disaster cause the estimated damage. In another example, the analysis may be used to confirm that a property has been repaired.

[0010] In one aspect, the present disclosure relates to a method for automatically categorizing a repair condition or maintenance condition of a property characteristic, including obtaining an aerial image of a geographic region including the property; identifying features of the aerial image corresponding to the property characteristic; analyzing the features to determine a property characteristic classification; analyzing a region of the aerial image including the property characteristic to determine a condition classification; and determining, using the property characteristic classification and the condition classification, a risk estimate of damage to the property due to one or more disasters. The property characteristic of a structure such as a house, factory, or barn, in some examples, can include a rooftop, porch, chimney, or skylights. Property characteristics of manmade structures within a property location, in some examples, can include a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, equipment or vehicles, or greenhouse. Property characteristics of natural features within a property location, in some examples, include trees, ponds, marshes, rivers, lakes, grasses, cliffs, or ocean shore. Further, property characteristic classifications can include shapes, materials, size (breadth and/or height, relative or actual), and/or distance of the property characteristic from other features. In some embodiments, the property characteristic classification may include existing versus not existing (e.g., in the event of determining replacement or removal of a manmade feature at a property location such as a fence). The property characteristic classification, in a particular illustration, may be a rooftop shape. Analyzing the features to determine a property characteristic may include applying a deep learning analysis model to the features. The deep learning analysis model may be NIN.

[0011] In some embodiments, analyzing the region of the aerial image including the property characteristic to determine the condition classification includes applying a machine learning analysis model to image pixels within the region. The machine learning analysis model may

include a color histogram analysis model. The condition classification may encompass classifications good and bad. Determining the risk estimate may include applying a disaster risk profile corresponding to a first disaster of the at least one disaster and the property characteristic.

[0012] In one aspect, the present disclosure relates to a system for automatically categorizing a repair condition of a property characteristic, the system including processing circuitry and a non-transitory computer-readable medium having instructions stored thereon. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to obtain an aerial image of a geographic region including the property; identify features of the aerial image corresponding to the property characteristic; analyze the features to determine a property characteristic classification; analyze a region of the aerial image including the property characteristic to determine a condition classification; and determine, using the property characteristic classification and the condition classification, a replacement cost for replacing the property characteristic. The aerial image may be a two-dimensional aerial image.

[0013] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to identifying the features, obtain a shape map image including the property; overlay the aerial image with the shape map image; and determine whether a boundary of the property as identified by the shape map matches a boundary of the property as illustrated in the aerial image. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, upon determining that the shape map does not match the boundary of the corresponding property, obtain an alternate aerial image of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, prior to identifying the features, assess orthogonality of the aerial imagery. The property may be a single family home.

[0014] In one aspect, the present disclosure relates to a non-transitory computer readable medium having instructions stored thereon, where the instructions, when executed by processing circuitry, cause the processing circuitry to receive identification of a property and at least one property characteristic; obtain an aerial image of a geographic region including the property; and identify respective features of the aerial image corresponding to each property characteristic of the at least one property characteristic. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, for each property characteristic, analyze the corresponding features to determine a respective property characteristic classification, and analyze a region of the aerial image including the respective property characteristic to determine a respective condition classification. The instructions, when executed by the processing circuitry, may cause the processing circuitry to determine, using the property characteristic classification of each property characteristic and the condition classification of each property characteristic, at least one risk estimate representing risk of damage due to disaster.

[0015] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to obtaining the aerial image of the geographic region, determine, based upon the at least one property characteristic, a preferred image type corresponding to each property characteristic of the at least one property characteristic. The at least one property characteristic may include two or more property characteristics. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, responsive to determining the preferred image type corresponding to a first property characteristic of the at least one property characteristic is a terrestrial image, obtain a terrestrial image of the geographic region including the property.

[0016] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to access one or more known property characteristics.

Determining the at least one risk estimate may include determining the at least one risk estimate further based on the one or more known property characteristics. The one or more known property characteristics may include at least one of a property age, a property elevation, a property slope, a year built, a year renovated, and a building height.

[0017] In some embodiments, receiving identification of the property and the at least one property characteristic includes receiving, via a network from a remote computing device, the identification of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to provide, via the network to the remote computing device in real-time responsive to receiving the at least one property characteristic, the at least one risk estimate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one or more embodiments and, together with the description, explain these embodiments. The accompanying drawings have not necessarily been drawn to scale. Any values dimensions illustrated in the accompanying graphs and figures are for illustration purposes only and may or may not represent actual or preferred values or dimensions. Where applicable, some or all features may not be illustrated to assist in the description of underlying features. In the drawings:

[0019] FIG. 1 is a flow diagram of an example system operational flow for matching aerial image features to corresponding property maintenance levels;

[0020] FIG. 2A illustrates example characteristic classifications and corresponding risk profile data;

[0021] FIG. 2B illustrates examples of condition characteristics and corresponding example histograms;

[0022] FIG. 2C illustrates an example condition profile corresponding to an example property characteristic type;

[0023] FIG. 2D is an example error rate graph comparing training data with test data in conducting matching aerial image features to corresponding rooftop shapes;

[0024] FIG. 3 is a block diagram of an example environment for matching aerial image topographical features to corresponding property maintenance levels;

[0025] FIG. 4 is a flow chart of an example method for classifying condition characteristics of a property based on aerial image analysis;

[0026] FIG. 5A illustrates an example structure shape map of a geographic area;

[0027] FIG. 5B illustrates an example two-dimensional aerial image of the geographic area of FIG. 5A;

[0028] FIG. 5C illustrates an example overlay map image of a section of the structure shape map of FIG. 5A overlaying a corresponding section of the aerial image of FIG. 5B;

[0029] FIG. 6 is a block diagram of an example computing system;

[0030] FIG. 7 is a block diagram of an example distributing computing environment including a cloud computing environment; and

[0031] FIGs. 8A, 8B, and 8C illustrate a series of example user interface screen shots for reviewing property characteristic and maintenance level information.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0032] The description set forth below in connection with the appended drawings is intended to be a description of various, illustrative embodiments of the disclosed subject matter. Specific features and functionalities are described in connection with each illustrative embodiment; however, it will be apparent to those skilled in the art that the disclosed embodiments may be practiced without each of those specific features and functionalities.

[0033] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments. Further, it is intended that embodiments of the disclosed subject matter cover modifications and variations thereof.

[0034] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context expressly dictates otherwise. That is, unless expressly specified otherwise, as used herein the words "a," "an," "the," and the like carry the meaning of "one or more." Additionally, it is to be understood that terms such as "left," "right," "top," "bottom," "front," "rear," "side," "height," "length," "width," "upper," "lower," "interior," "exterior," "inner," "outer," and the like that may be used herein merely describe points of reference and do not necessarily limit embodiments of the present disclosure to any particular orientation or configuration. Furthermore, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components, steps, operations, functions, and/or points of reference as disclosed herein, and likewise do not necessarily limit embodiments of the present disclosure to any particular configuration or orientation.

[0035] Furthermore, the terms "approximately," "about," "proximate," "minor variation," and similar terms generally refer to ranges that include the identified value within a margin of 20%, 10% or preferably 5% in certain embodiments, and any values therebetween.

[0036] All of the functionalities described in connection with one embodiment are intended to be applicable to the additional embodiments described below except where expressly

stated or where the feature or function is incompatible with the additional embodiments. For example, where a given feature or function is expressly described in connection with one embodiment but not expressly mentioned in connection with an alternative embodiment, it should be understood that the inventors intend that that feature or function may be deployed, utilized or implemented in connection with the alternative embodiment unless the feature or function is incompatible with the alternative embodiment.

[0037] Turning to FIG. 1, a flow diagram of an example system operational flow 100 for matching aerial image features to corresponding property maintenance levels obtains images (104) at property locations 102b is illustrated. In some implementations, commencement of at least a portion of the operational flow 100 by the system may be triggered by a property classification request submitted by a user, such as an insurance carrier or real estate investment broker at a dashboard interface screen on a computing device connected to the system via a network. For example, as illustrated in FIG. 8A, a particular property or, alternatively, a neighborhood of properties, may be selected within a map view user interface 800. The operational flow 100 may be used to analyze the condition of features of each property at each property location 102b based on aerial imagery 102c. In some implementations, the operational flow 100 may aid in estimating costs of repair or replacement of each property characteristic detected in the aerial images, for example. In another example, the operational flow 100 may be used to confirm that a property location 102b has been repaired.

[0038] The property locations 102b may represent, in some examples, locations of properties insured by a particular insurer, locations of properties recently affected by a disaster such as a tornado, hurricane, earthquake, fire, storm surge, or explosion, locations of properties held in an investment portfolio, or locations of properties considered for addition to an investment

portfolio. The property locations 102b may be identified, in some examples, by a street address, global positioning system coordinates, or other geographic coordinates.

[0039] In some implementations, the operational flow 100 obtains images (104) at each property location 102b. The images can include aerial imagery 102c stored by the system or accessed by the system from a remote networked location. The aerial imagery 102c, for example, may include a three-dimensional or two-dimensional image of a geographic location including at least one of the property locations 102b. In one example, based upon street address or geographic coordinates, the system may query a remote database to obtain recent aerial imagery 102c including an image of at least one of the property locations 102b. The remote database, in some examples, can include private industry databases such as Google® Earth images by Google, Inc. of Mountain View, CA or NTT Geospace Corporation of Japan. In other examples, the remote database can include one or more databases of publicly owned organizations such as the Geospatial Information Authority (GSI) of Japan, the United States Geological Survey, or the Federal Agency for Cartography and Geodesy of Germany. Aerial imagery can be collected from one or more remote network locations, in some embodiments, using an Open Source Geographic Information System (GIS) such as QGIS by the Open Source Geospatial Foundation (OSGeo). The format for the images of the property locations 102b, in some embodiments, depends upon the format accepted by the various sources available for aerial imagery 102c. An example aerial image 510 of multiple property locations 102b is illustrated in FIG. 5B.

[0040] In some embodiments, the system may be configured to query multiple remote database systems to obtain at least two aerial images of a given property location 102b. The aerial images available at the various databases, for example, may differ in resolution and recency of capture. Through collecting two or more images of a particular property, for example, the system may analyze each image to determine a best quality image for use in

condition analysis. The condition analysis can include balancing of multiple factors such as, in some examples, clarity, completeness, and recency.

[0041] Further, in some embodiments, the system may be configured to query multiple remote database systems to obtain both a two-dimensional aerial image and a three-dimensional aerial image. Different property characteristics may be discerned based upon whether the aerial image is captured in two-dimensional or three-dimensional format. Two-dimensional aerial images, in some examples, can be used to determine location coordinates of the property, street name, occupancy type, floor area, existence of skylights, existence of chimneys, roof condition, roof shape, roof covering, roof anchors, roof equipment, and/or pounding. Three-dimensional aerial images, in comparison, can be used to determine location coordinates, street name, construction type, occupancy type, year built, building height, soft stories, number of stories, roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding. Where there is an overlap in characteristics identifiable using either a two-dimensional image or a three-dimensional image, in some embodiments, machine learning analysis of both images can be combined to provide increase confidence in identification of the individual characteristics.

[0042] In some implementations, the system obtains (104) shape map images 102a of each of the property locations 102b. The shape map images 102a, for example, include a block shape layout of existing properties in a municipality, such as urban planning maps used in urban planning and development. The shape map images 102a, in another example, can include block shape layout maps used in presenting information to a user of a computer-based navigation system. The shape map images 102a, in one example, can be obtained from Geospatial Information Authority of Japan or Zenrin Co. Ltd. of Japan. An example of an urban planning map 500 is illustrated in FIG. 5A (image obtained from the Geospatial Information Authority of Japan, Digital Map 2500 (Spatial Data Framework)).

[0043] The shape map images 102a, in some embodiments, are used to confirm location of a particular property. The shape map image 102a of a geographical area, for example, can be overlaid with a corresponding aerial image 102c to match properties with images. An example overlaid image 520 of planning map image 500 of FIG. 5A with aerial image 510 of FIG. 5B is illustrated in FIG. 5C. In some embodiments, the shape map image 102a may not match in shape or location with the aerial image 102c. As illustrated in FIG. 5C, for example, a shape map outline (illustrated in a thickened line) for a location 522 may not be rectangular, while a rooftop shape beneath the outline may be rectangular in shape. In some embodiments, analyzing multiple aerial images 102c to determine the best quality image may include identifying one or more aerial images 102c that substantially align with the corresponding shape map image 102a. The overlay of the aerial image 102c with the shape map image 102a, further, can be used in aiding in cropping the aerial image 102c to focus analysis on a particular property location 102b. For example, turning to FIG. 5C, property location 524 is substantially aligning with the corresponding planning map image, and the general outline can be used in aiding in cropping of the property location 524. In some examples, the property location 524 may be identified within the overlaid image 520 when the property location 524 aligns with a property in the overlaid image 520 within a predetermined tolerance in order to account for renovations that may have been made to the property 524, such as property additions that may alter an overall shape of the property.

[0044] Returning to FIG. 1, in some embodiments, the shape map images 102a may be used to correct or compensate for alignment errors or inconsistencies of the corresponding two-dimensional aerial images 102c. For example, an aerial image representing a normal orthophoto angle may not be directly centered upon the planning map block. Using the planning map block as a guide, for example, the aerial image can be geometrically corrected to obtain a true orthophoto version of the aerial image.

[0045] As illustrated in FIG. 1, in some implementations, the system identifies (106) features of each aerial image 102c to classify property characteristics. Using machine learning for analysis, for example, the system can extract features of the aerial image of a particular property location 102b. Groupings of extracted features, such as angles, outlines, substantially homogenous fields, etc. can be used to identify property features such as rooftop, swimming pool, chimney, and sky lights. The groupings of extracted features, for example, may include pixel groupings obtained through filtering, cropping, or otherwise adjusting the original image. Upon extracting image-related features identifiable as a property feature (e.g., rooftop), the extracted features may be analyzed to determine one or more property characteristics of that feature (e.g., type of rooftop). In one example, a swimming pool may be identified as the property feature of a pool (e.g., various shapes of outlines of a particular size or greater bordering a substantially homogenous field of blue), then characterized as a particular shape (e.g., rectangular, round, or kidney bean, etc.), type (e.g., above ground or in-ground), and/or size (e.g., approximate area). The machine learning classifier used in the machine learning analysis, in some embodiments, includes a convolutional neural network (CNN) to preprocess the aerial image 102c of the particular property location 102b and to classify the property features as property characteristics 110. Using CNN technology, for example, the biological process of visually reviewing and identifying an object or feature of an object is mimicked through a feed-forward artificial neural network where multilayer artificial perception minimizes preprocessing. CNN is a well-established and popular machine-learning methodology. An example of a CNN processing model is Alexnet. (See Krizhevksy et al. "ImageNet Classification with Deep Convolutional Neural Networks", Advances in neural information processing systems, 2012, the entire contents of which has been incorporated herein by reference). In other embodiments, the machine learning classifier may include a Network in Network (NIN)

where a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification. NIN has demonstrated superior performance outcome to conventional CNN processing. Additionally, NIN processing is less storage-intensive than CNN processing.

[0046] In some implementations, property characteristic profiles 108 are used in classifying property features. The property characteristic profiles 108, for example, may be developed through training the machine learning algorithms using aerial images (and, in some embodiments, terrestrial images 102d) of known property characteristics. Each property feature, for example, may be broken down into multiple classifications. In an illustrative example involving a classification of terrestrial images, cladding can include stone, brick, stucco, shingles, vertical boards, horizontal boards, or metal. The machine learning algorithms, for example, may generate a percentage confidence in a match between a new aerial image 102c including a gambrel rooftop and the characteristic profile 108 of gambrel rooftops.

[0047] In an illustrative example, turning to FIG. 2A, extracted angular and outline features of aerial images 204 may be used to classify a roof shape 202 of the particular property location 102b. In a first example, a gable roof 202b includes a central peak upon a generally rectangular outline, as depicted in corresponding aerial image 204b. A gambrel roof 202a includes these features of the gable roof 202b but, as illustrated in aerial image 204a, the gambrel roof additionally includes a "skirt" region surrounding the central gable-shaped portion. The "skirt" region can be identified, in part, based upon its corner edges extending from the four corners of the gable-shaped portion. A hipped roof 202c, as shown in aerial image 204c, includes a central peak and two opposing triangular ends extending from either end of the central peak. The central peak forms a top edge of two trapezoidal sections. A

square roof 202d, in contrast, has no central peak. Instead, as illustrated in aerial image 204d, the square roof includes four triangular portions meeting at a central point. Finally, a flat roof 202e, as shown in aerial image 204e, is represented by a substantially flat surface outlined by a rectangle.

[0048] Turning to FIG. 2D, an example error rate graph 240 compares training data 242 with accuracy of matching test data 244 in matching aerial image rooftop characteristics to corresponding rooftop type (e.g., shape). A test was conducted using NIN deep learning algorithms to classify rooftop shape in two-dimensional aerial images including a mix of gambrel, gable, hipped, square, and flat roof shapes of assorted colors. Further tests involved differing image sizes and mini-batch sizes. In particular, images were scaled using a formula of $y = w * (x\text{-}100) + z$, where x represents a property size (e.g., building with a small border surrounding the area of the rooftop), y represents pixel size, w ranged from 0.33 to 0.40 and z ranged from 90 to 110. The error rates ranged, among initial test cases involving mini batches from 5 to 20, from about 4.3% to about 10%. As shown by the error rate graph 240, in a test situation involving 2,250 sample images in a training dataset 242 and 250 test images in a test dataset 244, the minimum error rate in determining rooftop condition was 6%, corresponding to an accuracy rate of 94%.

[0049] To improve accuracy rate, in some implementations, the image can be cropped and/or resized prior to analyzing. For example, the image may be cropped to include the property of interest, or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Resizing to a standard image size, in another example, can contribute to accuracy improvement.

[0050] Further to roof shape, in some embodiments, feature analysis can be used to discern additional roof features such as, in some examples, roof covering, roof anchors, roof

equipment, skylights, widow's walks, turrets, towers, dormers, and/or chimneys. Furthermore, upon identifying the outline of the roof, a footprint of the property location 102b (e.g., size of the roof) can be calculated based upon a scale of the aerial image 102c.

[0051] Returning to FIG. 1, rather than exclusively analyzing the particular property locations 102b individually, in some implementations, the particular property locations 102b are each classified based in part upon nearby structures. For example, based upon property location 102b dimensions, which may include lot dimensions, machine learning can be used to identify additional structures at the property location 102b such as, in some examples, a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, or greenhouse. Further, the particular property locations 102b may be classified in part based upon distance from neighboring structures and/or natural features (e.g., pounding).

[0052] In some implementations, terrestrial images 102d may be used to classify features difficult to recognize using aerial imagery 102c. The terrestrial images 102d, in some examples, can include street view images obtained from a street view service or real estate listing. In some examples, street view images including a street-facing view of the property location 102b may be obtained from Google® Street View by Google, Inc., Bing® Maps Streetside by Microsoft Corp. of Redmond, WA, or Mapillary by Mapillary AB of Sweden. Using a terrestrial image, for example, the system can identify features such as construction type, cladding, building height, number of soft stories, number of floors, location coordinates, street name, slope, elevation, year built, and/or occupancy type. Where the characteristics identifiable via the terrestrial imagery 102d overlap with characteristics identifiable via two-dimensional or three-dimensional aerial imagery 102c, analysis of terrestrial imagery 102d can be combined with analysis of aerial imagery, in some embodiments, to increase confidence in identification of the particular characteristic(s). For example, house siding

features may be more easily detected in terrestrial imagery 102d and/or three-dimensional aerial imagery 120c than in two-dimensional aerial imagery 102c.

[0053] In some implementations, a condition of each property feature may be classified (112) as a corresponding condition characteristic 116. New properties are in good condition, but property feature conditions can deteriorate over time due to normal wear-and-tear on the property. Further, property features can suffer damage due to external forces such as storms and natural disasters. Eventually, conditions of housing features can deteriorate to the point where repair and/or replacement may be necessary. As with property characteristics described above at block ~~106~~110, machine learning algorithms can be used to classify a present condition of individual detected property features. Using machine learning for analysis, for example, the system can extract pixel intensity distributions of previously identified property features of the aerial image of the particular property location 102b. In some examples, newly constructed property features generally have sharp contrast and well-defined features in machine learning image analysis. Conversely, weathered or damaged property features can have softened edges, blurred contrasts, and asymmetrical patches of wear. The machine learning classifier used in the machine learning condition analysis, in some embodiments, includes a machine learning analysis to process the aerial image 102c of the particular property location 102b and to classify the condition of previously identified property characteristics 110 as condition characteristics 116. The machine learning analysis, in some examples, can include two-dimensional color histogram analysis or three-dimensional color histogram analysis. In other embodiments, the machine learning analysis may be performed using pattern recognition algorithms (e.g., determining missing fence posts or missing/misaligned rooftop shingles). In other embodiments, the machine learning classifier includes deep learning analysis such as CNN or NIN. For example, CNN analysis may leverage feature maps created during the training process to assess the condition through

extracting meaningful features within a given image through convolution and pooling layers. Other machine learning models and algorithms are possible.

[0054] In an illustrative example, turning to FIG. 2B, examples of condition characteristics of aerial images of hipped rooftops and corresponding example histograms generated through machine learning analysis of pixel intensity are presented. For example, a set of good condition aerial images 210a through 214a, are presented alongside corresponding good condition histograms 210b through 214b. The good condition histograms 210b through 214b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 210c through 214c demonstrates the peak probability of grayscale color distribution of a good condition roof. The values, for example, can range from 0 (total black) to 255 (total white).

[0055] Conversely, a set of poor condition aerial images 216a through 220a, are presented alongside corresponding poor condition histograms 216b through 220b. The poor condition histograms 216b through 220b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 216c through 220c demonstrates the peak probability of grayscale color distribution of a good condition roof. The maximum values 216c through 220c corresponding to the poor condition rooftops 216a through 220a are markedly lower than corresponding maximum values 210c through 214c of good condition rooftops 210a through 214a. In addition, a width of the distributions of the poor condition histograms 216b through 220b may be markedly wider than a width of the distributions of the good condition histograms 210b through 214b. As can be seen of the aerial images of the poor condition rooftops 216a through 220a, the color distribution is patchy and bleached out, while the edges of the rooftops have lost their crisp lines. Conversely, looking to the aerial images of the good condition rooftops 210a through 214a, the rooftops are more substantially uniform in color with crisp lines on the edges.

[0056] Turning to FIG. 2C, a condition profile 230 for a rooftop condition is illustrated. In some implementations, pixel value distribution histograms such as the histograms 210b through 220b, in some implementations, can be combined to generate an example condition profile 230 corresponding to rooftop condition. The condition profile 230, for example, may be included as one of the condition profiles 114 of FIG. 1. Example reference bars 232a, 232b on the condition profile 230 illustrate values corresponding to a non-deteriorated hipped roof 214a and the deteriorated hipped roof 216a, respectively. In some examples, the closer the value of a reference bar 232 comes to 1 on the Y-axis, the better the condition of the roof, while values close to 0 represent poor condition rooftops. In one example, the reference bars 232 of the example condition profile 230 correspond to a test conditions sample data set including 2,500 images). The reference bars 232 can be combined, in some embodiments, in a logistic regression to generate a roof condition profile graph 236. The accuracy rate of the image histogram is 80% based on some validation.

[0057] Although illustrated as a single condition profile 230 corresponding to different types of rooftops (e.g., at least the hipped rooftop 216a and the gable rooftop 234), in other embodiments, individual condition profiles 114 can be generated for each property characteristic (e.g., profiles specific to gabled, gambrel, flat, hipped, square, etc.). In further refinements, in certain embodiments, individual condition profiles 114 can be generated for combinations of property characteristics (e.g., a gabled, shingled roof, a gabled, clay tiled roof, a gabled, metal roof, etc.) to increase accuracy rate based upon pixel densities corresponding to the combined characteristics. Many combinations of characteristics of property features may be used singly or in combination to generate a condition profile 114 designed to accurately identify the condition of the corresponding property feature.

[0058] Returning to FIG. 1, in some implementations, the property characteristics 110 and/or condition characteristics 116 may be analyzed to calculate (120) a risk estimate 122

corresponding to a risk of damage based upon one or more types of disasters. The types of disasters can include, in some examples, earthquake, hurricane, tornado, storm surge, fire, straight line winds, or explosion. The types and estimated severity of disasters, in some embodiments, may depend upon the particular property location 102b. For example, properties near active fault lines may be more susceptible to earthquakes, while coastal properties may be more susceptible to storm surge damage. The risk estimate 122, in some examples, can include an actuarial percentage indicating a likelihood of damage based upon the particular property characteristics. Different property characteristics, for example, may be more susceptible than others to certain types of damage. For example, flatter rooftops may be more susceptible to damage from excessive snow build-up, while peaked rooftops may be more vulnerable to strong winds.

[0059] In some embodiments, in calculating damage risk, one or more disaster risk profiles 118 can be applied based upon property characteristics. Vulnerability to damage due to disaster can vary, in some examples, by location, altitude, slope, rooftop shape, rooftop condition, cladding type, cladding condition, and/or pounding. In a particular example, as shown in FIG. 2A, a graphical risk profile 206 ranks types of rooftops by their vulnerability to strong winds. [[ ]]Vulnerability to wind damage increases from lowest vulnerability (flat rooftop 202e) to square roof 202d, to hipped roof 202c, to gable roof 202b, with the greatest wind damage vulnerability in gambrel roofs 202a._Vulnerability may be mathematically modeled based upon statistical information built from past damage results due to varying types and/or severity of disaster. In combining location-based vulnerabilities with individual property characteristic-based vulnerabilities, risk of damage due to disaster can be more accurately estimated.

[0060] Referring back to FIG. 1, the risk estimates 122, in some embodiments, can be used in insurance assessments. For example, the risk estimate 122 may be used in determining

whether a property is adequately insured against potential damage. Further, when tracking an impending natural disaster, an insurance company may use the risk estimates 122 to estimate claims based upon the forecast path and severity of the storm. Additionally, the risk estimates 122 may be applied by investors when selecting investment properties for an investment portfolio.

[0061] In some implementations, repair or replacement costs can be calculated (126) to determine a cost estimate 128 to place one or more property characteristics in good or "like new" condition. The cost estimates 128, in some embodiments, can be based in part on one or more replacement cost profiles 120. Replacement costs, in some examples, may vary based upon type of materials (e.g., rooftop materials, cladding materials, etc.), size of the job (e.g., estimated area of the roof, estimated length of fence, etc.), and/or additional property characteristics (e.g., contributing to the complexity of the work). The replacement profiles 120, in further examples, may be based in part on location (e.g., varying costs of material and labor regionally). In some implementations, the cost estimates 128 for repair or replacement of the property characteristics may be output to a dashboard interface screen at a remote computing device of a requester, such as an insurance carrier or real estate investment broker.

[0062] In some embodiments, cost estimates 128 can be used in automatically analyzing insurance claims. The cost estimate 128, further, may be combined with the risk estimate 122 in analyzing adequacy of insurance coverage for a particular property location 102b. Further, the cost estimates 128 may be used by investors in determining cost of maintaining/upgrading a particular investment property.

[0063] Although the operational flow is illustrated as a series of computational stages, in other implementations, more or fewer computational stages may be included. For example, aerial imagery 102c may be analyzed after an insurance claim has been paid to verify that the insured property has been repaired and/or to upgrade the estimated value of the property (e.g.,

in the circumstance where the owner upgraded the property rather than applying a straight repair/replacement of the damaged property characteristics.

[0064] Additionally, in other implementations, certain computational stages may be performed in a different order. For example, cost estimates 128 may be calculated prior to risk estimates 122. Other modifications of the operational flow 100 are possible.

[0065] FIG. 3 is a block diagram of an example environment 300 for matching aerial image topographical features to corresponding property maintenance levels. The example environment 300, for example, can be used to implement the operational flow 100 described in relation to FIG. 1. The example environment 300 includes a property characteristic classification and condition analysis system 302 in communication with client computing system(s) 306, a number of cost data and/or risk data source computing system(s) 308, and a number of shape map, aerial imagery, and/or terrestrial imagery source computing system(s) 304. The communication connection may be wired or wireless, over a variety of network types. In a general overview, the system 302 obtains property identifier(s) 340 from client computing system(s) 306, accesses images of a property identified by the property identifier 340 from the imagery source computing system(s) 304, and analyzes the images to determine property characteristic(s) 342 and condition characteristic(s) 344. Using cost and/or risk data obtained from cost and risk data source computing system(s) 308, the system 302 may determine replacement cost estimate data 350 and/or disaster risk estimate data 352 based upon the property characteristics and their condition.

[0066] In some implementations, a user of a particular client computing system 306 submits a request to the system 302 through a graphical user interface supplied by a graphical user interface engine 334. The request, for example, may include at least one property identifier 340 as well as one or more property characteristics 342 and/or identification of at least one of a replacement or repair cost estimate, a disaster risk estimate, and a confirmation of repair

assessment. The property identifier 340, in some examples, may include location information (e.g., address, geolocation coordinates, lot boundaries, etc.). The location information, for example, may conform with property location information 102b described in relation to FIG. 1. In other embodiments, the property identifier 340 may be a unique property identifier (e.g., number or string) used to look up property location information in a data store 310. In another embodiment, rather than submitting a property identifier, the user may submit a unique user identifier used to look up one or more properties associated with the user (e.g., properties insured by an insurance client, properties held by an investment client, etc.).

[0067] In one example, turning to FIG. 8A, a user may identify locations of one or more properties by selecting the properties within a graphical map interface 800. A number of properties are identified within the map view user interface 800 as indicated with an associated pin, such as pin 804. The pins, in some examples, may indicate properties insured by a particular insurance carrier, a type of property (e.g., commercial, industrial, residential, etc.), and/or properties of a value range (e.g., within a range, above a threshold, etc.). The pins, for example, may be displayed based upon filtering options supplied by the user or otherwise associated with a user profile (e.g., insurance carrier identification). In a particular example, a user may select three properties associated with three dialogue bubbles 802. As illustrated, each dialogue bubble identifies a replacement value associated with the property and invites the user to review details regarding the selected property via a details control.

[0068] In some implementations, the user enters property characteristics associated with each selected property. In other implementations, the characteristics may be accessed upon identification of the property (e.g., selection of a pin identifying a property, as illustrated in FIG. 8A). For example, the property characteristics 342 may be obtained from the data store 310, as illustrated in FIG. 3. Turning to FIG. 8B, an example property characteristics user interface 820 presents building area characteristics 822 (e.g., building area 822a, stories 822b,

and total building area ~~824~~822c) and structure characteristics 824 (e.g., structure material 824a, construction class 824b). As described within, different or additional characteristics may vary per implementation. In some embodiments, the user may be provided the ability via the user interface 820 to edit the building area characteristics 822 and/or the structure characteristics 824, for example via an edit control 828a or 828b. For example, in the circumstance of recent development or renovation (e.g., construction of an addition), the user may modify previously stored characteristics values. The property characteristics user interface 820, for example, may be presented to a user upon selection of a details control of one of the dialogue bubbles 802 illustrated in the user interface of FIG. 8A.

[0069] The user interface 820 further presents, in some implementations, premium characteristics 826 such as a replacement value. The premium information, for example, may relate to an insurance policy purchased for the property or parameters for insuring the property (e.g., based upon upgraded or new characteristics). The user, in some embodiments, may be provided to update the premium information via an edit control 828c.

[0070] In some implementations, upon identification of property location information, the system 302 accesses imagery of the property from the imagery source computing system(s) 304 using an image acquisition engine 336. The images can include, in some examples, a shape map (e.g., such as the shape maps 102a described in relation to FIG. 1), two-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), three-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), and/or terrestrial imagery (e.g., such as the terrestrial imagery 102d described in relation to FIG. 1). The images obtained by the image acquisition engine 336, in some embodiments, depend upon the property characteristic(s) identified by the user. For example, certain types of images are preferred for analyzing certain types of property

characteristics. Housing siding, for example, is more easily perceived from a terrestrial image or three-dimensional aerial image than from a two-dimensional aerial image.

[0071] In some implementations, an image quality analysis and preparation engine 326 analyzes the acquired image(s) to confirm the acquired image(s) contains an adequately clear and detailed image of the property identified by the property identifier 340. In some embodiments, the image quality analysis and preparation engine 326 crops and/or resizes the acquired image(s). For example, the image quality analysis and preparation engine 326 may extract a portion of an acquired image based upon the property (e.g., building size). In some implementations, the image quality analysis and preparation engine 326 resizes each acquired image to a standard size. The standard size, in a particular example, may be 256 by 256 pixels per image. Resizing to a standard size, for example, may increase accuracy in later classification analysis. The image quality analysis and preparation engine 326, in some embodiments, may be configured to apply corrections to the acquired image(s). For example, the image quality analysis and preparation engine 326 may be configured to adjust an aerial image from a normal orthophoto angle, to a true orthophoto version as described above.

[0072] In some implementations, the image quality analysis and preparation engine 326 uses shape outlines as part of the analysis. For example, a composite image generation engine 318 may overlay an aerial image with a shape map image, as described in relation to FIG. 5C. Using the resultant composite image, the image quality analysis and preparation engine 326 may confirm the aerial image conforms with an urban planning map or other property placement guide (e.g., navigational map data, etc.). Further, the image quality analysis and preparation engine 326 may use the overlaid shape map as a guide in determining whether an aerial image requires correction to a true orthophoto angle and/or how closely to crop the image to capture the property (and, optionally, its immediate surroundings such as its lot or a portion of the proximate neighborhood).

[0073] In some implementations, if the image quality analysis and preparation engine 326 determines that the acquired image is insufficient, the image quality analysis and preparation engine 326 may request a replacement image from the image acquisition engine 336. For example, the image acquisition engine 336 may obtain images based upon a variety of factors including, in some examples, recency of capture, resolution, cost, and/or applicability to a particular property characteristic analysis. Upon determination by the image quality analysis and preparation engine 326 that the first obtained image is insufficient, for example, the image acquisition engine 336 may determine a next best source for obtaining an image of the property.

[0074] In some implementations, once an image has been approved (and, optionally, prepared and/or corrected) by the image quality analysis and preparation engine 326, a feature identification engine 320 extracts features from the property image(s) related to the identified property characteristics 342. In the circumstance of a fence, for example, the feature identification engine 320 may identify a perimeter enclosure or partial perimeter enclosure abutting and extending from the property as indicative of a fence.

[0075] In some implementations, upon identification of features by the feature identification engine 320, a property characteristic classification engine 322 classifies the property characteristic. For example, the features may be classified using one or more machine learning techniques as described in relation to computational stage 106 (classify features of each image) of FIG. 1. The property characteristic classification engine 322, for example, may generate property characteristics 342 representing a grouping, type, or other characterization of a particular property feature. Continuing with the particular example of a fence, the extracted features may be analyzed and classified in relation to height and/or material. Upon classifying the property characteristics, the property characteristic

classifications may be stored in the data store 310 as property characteristics 342 (e.g., similar to property characteristics 110 of FIG. 1).

[0076] In some implementations, the property characteristic classification engine 322 uses characteristic profile(s) 360 in classifying property characteristics. The property characteristic classification engine 322, for example, may obtain, for each property characteristic being analyzed, a particular characteristic profile 360 from a profile data store 314. The characteristic profiles, for example, may be similar to the characteristic profiles 108 described in relation to FIG. 1.

[0077] In some implementations, the property characteristic profiles 360 are generated by a characteristic classification learning engine 328. The characteristic classification learning engine 328, for example, may generate characteristic profiles 360 through a sample data set and learning process as described, generally, in relation to FIG. 2A. In a particular example, the characteristic classification learning engine 328 may analyze JPG (lossy compression digital image standard developed by the Joint Photographic Experts Group) to recognize varying rooftop shapes.

[0078] While certain property characteristic classifications are done by analysis, in some implementations, one or more feature classifications may be obtained from previously stored property characteristics 342. For example, based upon tax records, real estate records, etc. some basic materials and structure information regarding a property may be readily available through local and/or remote database system(s). In other examples, the previously stored property characteristics 342 may also be obtained from previous condition assessments performed for a property location by the system 302.

[0079] In some implementations, once the property characteristic classification engine 322 has classified the property characteristic(s), a characteristic condition classification engine 324 classifies the condition of each property characteristic. For example, the property

characteristics may be classified as described in relation to computational stage 112 (classify condition of each feature) of FIG. 1. The characteristic condition classification engine 324, for example, may generate condition characteristics 344 representing a rating, qualification, or ranking of the condition of the particular characteristic. In some examples, the characteristic condition classification engine 324 may qualify a characteristic as a) "good" or "bad", b) "like new", "acceptable", "needs repair", or "needs replacement", c) rated on a numeric scale such as a scale from 1 to 5 where 5 may correspond to "like new" and 1 may correspond to "needs replacement." In other implementations, particular problems may be identified by the characteristic condition classification engine 324 such as, in some examples, a fence feature is partially fallen, or a roof feature shows signs of structural damage.

[0080] In some implementations, the characteristic condition classification engine 324 uses condition profile(s) 362 in classifying property characteristic conditions. The characteristic condition classification engine 324, for example, may obtain, for each property characteristic being analyzed, a particular condition profile 362 from the profile data store 314. The condition profiles 362, for example, may be similar to the condition profiles 114 described in relation to FIG. 1.

[0081] In some implementations, the condition profiles 362 are generated by a condition classification learning engine 330. The condition classification learning engine 330, for example, may generate condition profiles 362 through a sample data set and learning process as described, generally, in relation to FIG. 2B. In a particular example, color histogram analysis may be used to identify peak pixel values of the images in gray scale. Using the group of calculated peak pixel values, the learning engine can classify property condition into certain categories.

[0082] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a risk

calculation engine 316 may estimate risk of damage based upon one or more types of disaster. For example, the disaster risk estimate data 352 may be calculated as described in relation to computational stage 120 (calculate damage risk) of FIG. 1. The disaster risk estimate data 350, in one example, can include a percentage likelihood of damage due to each particular type of risk based upon the particular property characteristics and/or property conditions, as described in relation to the risk estimates 122 of FIG. 1. Further, in some embodiments, the disaster risk estimate data 350 may include a set of risk estimates based upon, in some examples, a number of severities of disaster, a particular path of disaster, and/or hazard intensity of disaster. The disaster severities, in some examples, may correspond to the Richter scale of seismic activity magnitude or the Saffir-Simpson Hurricane Wind Scale category. The path of the disaster, in some examples, can include geographical direction such as northeasterly, etc. or angle of impact with respect to the property characteristic(s). The hazard intensity of disaster, in some examples, can relate to wind speed or rainfall amount. Repair costs, for example, may be more accurately estimated when the roof condition is known. Due to poor condition of a rooftop in one particular example, the roof may be more vulnerable to damage requiring replacement. In another particular example, due to a poor condition rooftop, the likelihood for interior property damage (e.g., water damage due to breach of the roof) may increase at a set level of severity of disaster and above.

[0083] In some embodiments, the risk calculation engine 316 accesses one or more risk profiles 364 from the data store 314 based upon property characteristics and/or condition characteristics. The risk profiles, for example, may be similar to the disaster risk profiles 118 described in relation to FIG. 1. The risk profiles 364, for example, may be obtained from one or more risk data sources ~~306~~308 by a cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate risk profiles 364 (e.g., using risk data obtained

from one or more cost and risk data sources ~~306~~308 and a risk data analysis engine (not illustrated)).

[0084] The risk estimate data 352, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use risk estimate data in making insurance assessments. In another example, a real estate investment broker or firm client 306 may apply risk estimate data 352 when selecting investment properties for an investment portfolio.

[0085] Turning to FIG. 8C, an example disaster risk user interface 840 presents risk assessment information based upon risk profiles 364 related to the selected property (e.g., one of the properties identified via the dialogue bubbles 802c of FIG. 8A). The user interface 840, for example, may be accessed by scrolling downward from the user interface 820. The user interface 840 illustrates a number of disaster risk factors 842 and associated risk estimate data 844 for the selected property. As illustrated, the disaster risk factors 842 include a fire factor 842a, a wind factor 842b, a flood factor 842c, an earthquake factor 842d, a tsunami factor 842e, and a landslide factor 842f. In some embodiments, only a subset of the risk estimate data is determined via risk assessment techniques described herein. For example, flood data 844c may be generated based upon governmental flood map evaluation rather than via aerial imaging assessment, while fire risk 844a may be determined at least in part based upon proximity to neighboring properties as derived via imaging analysis and/or construction properties derived via image analysis. Further, wind risk data 842b may be derived via rooftop analysis as described in greater detail herein.

[0086] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a cost calculation engine ~~336~~332 calculates repair or replacement costs for improving problems identified by the characteristic condition classification engine 324 and generates replacement

cost estimate data 350. For example, the replacement cost estimate data ~~352~~350 may be calculated as described in relation to computational stage 126 (calculate repair or replacement costs) of FIG. 1. The replacement cost estimate data 350, for example, may be similar to the cost estimates 128 described in relation to FIG. 1.

[0087] In some implementations, the cost calculation engine ~~336~~332 based calculations in part on one or more cost profiles 366 (e.g., similar to the cost profiles 120 of FIG. 1). In some embodiments, the cost calculation engine ~~336~~332 accesses one or more cost profiles 366 from the data store 314 based upon property characteristics and/or condition characteristics. The cost profiles 366, in some embodiments, are obtained from one or more cost data sources ~~306~~308 by the cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate cost profiles 366 (e.g., by a cost data analysis engine (not illustrated) using cost data obtained from one or more cost and risk data sources ~~306~~308).

[0088] The cost estimate data 350, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use cost estimate data in determining adequacy of insurance coverage for a particular property. In another example, a real estate investment broker or real estate investment firm client 306 may apply cost estimate data 350 in determining cost of maintaining/upgrading a particular investment property.

[0089] In some implementations, the cost estimate data 350 and/or risk estimate data 352 is provided to a requesting client 306, responsive to receiving identification of one or more properties, in real-time or near real-time. For example, a client 306 accessing a dashboard interface, may format a request for a risk estimate or cost estimate related to an identified property within a dashboard interface and submit the request via a network to the system 302. Responsive to the request, the system 302 may conduct the analysis described generally above and respond, in real time or near-real time to the client 306 with a risk analysis or cost

analysis. For example, risk analysis information is presented in user interface 840 of FIG. 8C.

[0090] In some implementations, the system may identify, through updated meteorological data, one or more properties within a client real estate portfolio affected by a disaster. The system, further to identification of the affected properties, may proactively prepare a repair estimate to provide to the client corresponding to the real estate portfolio shortly after the disaster took effect. In one example, the Japan Meteorological Agency may update observation data via a web site interface within an hour or so of observation. In this example, the system may provide repair cost estimates to clients between one and two hours after a disaster has taken place.

[0091] Rather than sharing cost estimate data 350 and/or risk estimate data 352 directly with the clients 306, in other embodiments, the system 302 may include a report generation engine (not illustrated) that prepares reports regarding condition, damage, and risk assessments of one or more properties. Further, in some embodiments, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to confirm whether a property owner made repairs to a property (e.g., based upon payment of an insurance claim), replaced one or more features of a property, or removed one or more features of a property (e.g., removed a hazardous collapsing structure, cut back brush encroaching a fire risk distance to a home, etc.). In another illustration, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to determine whether a repair or replacement is an upgrade (e.g., replacement using superior materials) or a downgrade (e.g., replacing an in-ground pool with an above-ground pool) to the property characteristic. Other modifications of the system 302 are possible.

[0092] FIG. 4 is a flow chart of an example method 400 for classifying condition characteristics of a property based on aerial image analysis. The flow chart, for example,

may represent computational stages 104 through 112 as described in relation to FIG. 1. The method 400 may be performed, for example, by the system 302 of FIG. 3.

[0093] In some implementations, the method 400 begins with accessing a two-dimensional shape map including the shape of a property (402). The shape map, for example, may be accessed by the image acquisition engine 336 from a shape map imagery source 304, as described in relation to FIG. 3. The two-dimensional shape map, for example, may take a form of any of the shape maps 102a described in relation to FIG. 1. In a particular example, the shape map may be in a form similar to the shape map 500 described in relation to FIG. 5A.

[0094] In some implementations, two-dimensional and/or three-dimensional aerial imagery including an image of the property is accessed (404). The two-dimensional and/or three-dimensional aerial imagery, for example, may be accessed by the image acquisition engine 336 from an aerial imagery source 304, as described in relation to FIG. 3. The two-dimensional and/or three-dimensional aerial imagery, for example, may take a form of any of the aerial imagery 102c described in relation to FIG. 1. In a particular example, the two-dimensional aerial imagery may be in a form similar to the aerial image 510 described in relation to FIG. 5B.

[0095] In some implementations, the aerial imagery is overlaid with the shape map (406). The composite image generation engine 318 of FIG. 3, for example, may overlay the aerial imagery with the shape map to generate a composite image. The composite image, for example, may be in a form similar to the composite image 520 described in relation to FIG. 5C.

[0096] If a shape match is not identified (408), in some implementations, the method 400 accesses alternate two-dimensional or three-dimensional aerial imagery (410). In some embodiments, the image quality analysis and preparation engine 326 of FIG. 3 determines

whether the composite image presents an adequate shape match of the property(s) of interest. Upon determining the image does not match, the image acquisition engine 336 of FIG. 3, for example, may obtain an alternative two-dimensional or three-dimensional aerial image from the aerial imagery source(s) 304. As described in relation to FIG. 3, for example, For the image acquisition engine 336 may determine a next best source for obtaining an image of the property based upon one or more factors. Conversely, the method 400, in other implementations (not illustrated), could proceed without matching the shape map to the aerial imagery.

[0097] If a shape match is identified (408), in some implementations, the formatting of the aerial imagery is prepared (411). In some embodiments, the image is cropped to include the property of interest or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Cropping may be based, for example, on the correlation of the shape map to the property. In illustration, the image may be cropped to include the shape map outline of the property plus a border region. In some embodiments, cropping may include cropping to a set shape (e.g., X by X pixels square, X by Y pixels rectangle, etc.). In some embodiments, in addition to cropping the image, the image may be resized. For example, depending upon the resolution of the aerial imagery, the image resolution may be reduced, for example, to fit within an X by X pixels square or an X by Y pixels rectangle. Resizing to a standard image size, for example, can contribute to analysis consistency and improvement in classification accuracy. In further embodiments, the color depth and/or color mapping of the aerial imagery may be adjusted. For consistent color histogram analysis of the imagery, for example, the color depth and color mapping may be made consistent across analyzed images. In a particular example, color images may be converted to grayscale for grayscale image analysis.

Adjustments to the imagery, for example, may be effected by the image quality analysis and preparation engine 326, described in relation to FIG. 3.

[0098] In some implementations, orthogonality of the aerial imagery is assessed (412). For example, the image quality analysis and preparation engine 326 may assess orthogonality of the aerial imagery. The image quality analysis and preparation engine 326, in one example, may determine that orthogonality correction is desired. In another example, if the image represents a normal orthophoto rather than a true orthophoto, the image quality analysis and preparation engine 326 may notify further modules which may compensate for the angle of capture of the aerial image. In other implementations (not illustrated), orthogonality may be assessed without use of an overlaid shape map.

[0099] Returning to FIG. 4, in some implementations, if the aerial imagery is not orthogonal (414), an orthogonal version of the aerial imagery is generated (416). The image quality analysis and preparation engine 326 of FIG. 3, for example, may correct a normal orthophoto form to generate a true orthophoto form. The true orthophoto form, for example, may better match the shape map overly.

[0100] In some implementations, one or more property characteristics of the property are classified (418). The property, in some embodiments, is analyzed based on the portion of the aerial image substantially bounded by the shape map of the property. In other embodiments, the property analysis encompasses a surrounding of the property (e.g., features proximate the property upon the property lot, nearby properties, etc.). The property characteristic(s), for example, may be classified by the property characteristic classification engine 322, as described in relation to FIG. 3. In a particular example, a rooftop property feature may be classified as one of a variety of rooftop shapes, as illustrated in FIG. 2A.

[0101] In some implementations, if a property characteristic classification is identified (420), a condition of each of the property characteristics can be classified (422). The property

characteristic condition(s), for example, may be classified by the characteristic condition classification engine 324, as described in relation to FIG. 3. In a particular example, a hipped classification of the rooftop feature may be classified as one of a good condition and a poor condition, as illustrated in FIG. 2B. In some implementations, the classifications of the condition of each of the property characteristics may by output to a computing device of a requester (~~424~~422) via a dashboard interface screen. In some examples, in addition to providing the condition classification for the property characteristics, the dashboard interface screen may include replacement costs for replacing the property characteristics, risk cost estimates due to damage from natural disasters, or confirmation of whether or not repairs have been made to the property characteristics.

[0102] If, instead, a classification match was not identified (420), in some implementations, alternate two-dimensional or three-dimensional aerial imagery is accessed (410) and the method 400 restarts with overlaying the replacement aerial imagery with the shape map (406). Alternatively, in some embodiments, even if a classification match is not identified, condition may be assessed based upon a default profile associated with the property feature (not illustrated). For example, if the rooftop shape does not match one of the shapes trained into the system, the condition of the rooftop may still be assessed based upon a general condition profile trained with a variety of rooftop shapes. In some examples, the condition of the rooftop may be assessed by comparing the current rooftop conditions to stored historic condition characteristics for the property from a previous condition assessment.

[0103] Although the method 400 is illustrated as a series of steps, in other implementations, more or fewer steps may be included. For example, in some implementations, terrestrial images are obtained and used to classify the same and/or different property characteristics, as described in relation to the operational flow 100 of FIG. 1.

[0104] Additionally, in other implementations, certain steps may be performed in a different order. For example, in some implementations, property characteristics and condition characteristics may be classified (418, 422) in parallel. Other modifications of the operational flow 100 are possible.

[0105] Aspects of the present disclosure may be directed to computing systems for categorizing a repair condition of a property characteristic in order to provide dynamic, real-time property condition assessments in response to requests received from users such as insurance carriers or real estate investment brokers using aerial imagery. The implementations described herein improve upon conventional methodologies by applying deep learning analysis models to detected property characteristics of the obtained imagery in order to assess whether a condition of the property characteristics is degraded to a point of needing repair or replacement and determine an amount of risk exposure of the property due to the detected condition of the property characteristics. The implementations described herein improve processing efficiency of the system to reduce an amount of time it takes to perform the condition assessments and automate a condition assessment process.

[0106] Next, a hardware description of the computing device, mobile computing device, or server according to exemplary embodiments is described with reference to Figure 6. In Figure 6, the computing device, mobile computing device, or server includes a CPU 600 which performs the processes described above. The process data and instructions may be stored in memory 602. These processes and instructions may also be stored on a storage medium disk 604 such as a hard drive (HDD) or portable storage medium or may be stored remotely. Further, the claimed advancements are not limited by the form of the computer-readable media on which the instructions of the inventive process are stored. For example, the instructions may be stored on CDs, DVDs, in FLASH memory, RAM, ROM, PROM, EPROM, EEPROM, hard disk or any other information processing device with which the

computing device, mobile computing device, or server communicates, such as a server or computer.

[0107] Further, a portion of the claimed advancements may be provided as a utility application, background daemon, or component of an operating system, or combination thereof, executing in conjunction with CPU 600 and an operating system such as Microsoft Windows 6, UNIX, Solaris, LINUX, Apple MAC-OS and other systems known to those skilled in the art.

[0108] CPU 600 may be a Xenon or Core processor from Intel of America or an Opteron processor from AMD of America, or may be other processor types that would be recognized by one of ordinary skill in the art. Alternatively, the CPU 600 may be implemented on an FPGA, ASIC, PLD or using discrete logic circuits, as one of ordinary skill in the art would recognize. Further, CPU 600 may be implemented as multiple processors cooperatively working in parallel to perform the instructions of the inventive processes described above.

[0109] The computing device, mobile computing device, or server in FIG. 6 also includes a network controller 606, such as an Intel Ethernet PRO network interface card from Intel Corporation of America, for interfacing with network 6X. As can be appreciated, the network 628 can be a public network, such as the Internet, or a private network such as an LAN or WAN network, or any combination thereof and can also include PSTN or ISDN sub-networks. The network 628 can also be wired, such as an Ethernet network, or can be wireless such as a cellular network including EDGE, 3G and 4G wireless cellular systems. The wireless network can also be Wi-Fi, Bluetooth, or any other wireless form of communication that is known.

[0110] The computing device, mobile computing device, or server further includes a display controller 608, such as a NVIDIA GeForce GTX or Quadro graphics adaptor from NVIDIA Corporation of America for interfacing with display 610, such as a Hewlett Packard

HPL2445w LCD monitor. A general purpose I/O interface 612 interfaces with a keyboard and/or mouse 614 as well as a touch screen panel 616 on or separate from display 610. General purpose I/O interface also connects to a variety of peripherals 618 including printers and scanners, such as an OfficeJet or DeskJet from Hewlett Packard.

[0111] A sound controller 620 is also provided in the computing device, mobile computing device, or server, such as Sound Blaster X-Fi Titanium from Creative, to interface with speakers/microphone 622 thereby providing sounds and/or music.

[0112] The general purpose storage controller 624 connects the storage medium disk 604 with communication bus 626, which may be an ISA, EISA, VESA, PCI, or similar, for interconnecting all of the components of the computing device, mobile computing device, or server. A description of the general features and functionality of the display 610, keyboard and/or mouse 614, as well as the display controller 608, storage controller 624, network controller 606, sound controller 620, and general purpose I/O interface 612 is omitted herein for brevity as these features are known.

[0113] One or more processors can be utilized to implement various functions and/or algorithms described herein, unless explicitly stated otherwise. Additionally, any functions and/or algorithms described herein, unless explicitly stated otherwise, can be performed upon one or more virtual processors, for example on one or more physical computing systems such as a computer farm or a cloud drive.

[0114] Reference has been made to flowchart illustrations and block diagrams of methods, systems and computer program products according to implementations of this disclosure. Aspects thereof are implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other

programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0115] These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means which implement the function/act specified in the flowchart and/or block diagram block or blocks.

[0116] The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0117] Moreover, the present disclosure is not limited to the specific circuit elements described herein, nor is the present disclosure limited to the specific sizing and classification of these elements. For example, the skilled artisan will appreciate that the circuitry described herein may be adapted based on changes on battery sizing and chemistry, or based on the requirements of the intended back-up load to be powered.

[0118] The functions and features described herein may also be executed by various distributed components of a system. For example, one or more processors may execute these system functions, where the processors are distributed across multiple components communicating in a network. The distributed components may include one or more client and server machines, which may share processing, as shown on Fig. 8, in addition to various human interface and communication devices (e.g., display monitors, smart phones, tablets, personal digital assistants (PDAs)). The network may be a private network, such as a LAN or

WAN, or may be a public network, such as the Internet. Input to the system may be received via direct user input and received remotely either in real-time or as a batch process. Additionally, some implementations may be performed on modules or hardware not identical to those described. Accordingly, other implementations are within the scope that may be claimed.

[0119] In some implementations, as illustrated in FIG. 7, the innovations described herein may interface with a cloud computing environment 730, such as Google Cloud Platform™ to perform at least portions of methods or algorithms detailed above. The processes associated with the methods described herein can be executed on a computation processor, such as the Google Compute Engine by data center 734. The data center 734, for example, can also include an application processor, such as the Google App Engine, that can be used as the interface with the systems described herein to receive data and output corresponding information. The cloud computing environment 730 may also include one or more databases 738 or other data storage, such as cloud storage and a query database. In some implementations, the cloud storage database 738, such as the Google Cloud Storage, may store processed and unprocessed data supplied by systems described herein.

[0120] The systems described herein may communicate with the cloud computing environment 730 through a secure gateway 732. In some implementations, the secure gateway 732 includes a database querying interface, such as the Google BigQuery platform.

[0121] The cloud computing environment 102 may include a provisioning tool 740 for resource management. The provisioning tool 740 may be connected to the computing devices of a data center 734 to facilitate the provision of computing resources of the data center 734. The provisioning tool 740 may receive a request for a computing resource via the secure gateway 732 or a cloud controller 736. The provisioning tool 740 may facilitate a connection to a particular computing device of the data center 734.

[0122] A network 702 represents one or more networks, such as the Internet, connecting the cloud environment 730 to a number of client devices such as, in some examples, a cellular telephone 710, a tablet computer 712, a mobile computing device 714, and a desktop computing device 716. The network 702 can also communicate via wireless networks using a variety of mobile network services 720 such as Wi-Fi, Bluetooth, cellular networks including EDGE, 3G and 4G wireless cellular systems, or any other wireless form of communication that is known. In some embodiments, the network 702 is agnostic to local interfaces and networks associated with the client devices to allow for integration of the local interfaces and networks configured to perform the processes described herein.

[0123] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present disclosures. Indeed, the novel methods, apparatuses and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods, apparatuses and systems described herein can be made without departing from the spirit of the present disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the present disclosures.

In the United States Patent and Trademark Office

Application for United States Patent

Title

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

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474139US03

RELATED APPLICATIONS

[0001] This application is a continuation of and claims priority to U.S. Patent Application Serial No. 16/733,888 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Conditions Through Aerial Imagery Analysis" and filed January 3, 2020, which is a continuation-in-part of and claims priority to U.S. Patent Application Serial No. 15/714,376 entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis" and filed September 25, 2017, which claims priority to U.S. Provisional Patent Application Serial No. 62/398, 665, entitled "Platform, Systems, and Methods for Identifying Property Characteristics and Property Feature Maintenance Through Aerial Imagery Analysis," filed September 23, 2016. All above identified applications are hereby incorporated by reference in their entireties.

BACKGROUND

[0002] A risk exposure database contains a compilation of as many building properties or characteristics relevant to insurance as possible. These properties can include characteristics like location coordinates, address, slope, and elevation. Other characteristics include construction type, occupancy type, year built and/or year of renovation, building height, soft stories, number of stories, and floor area. Further characteristics can include roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding (distance to closest building). Some of these characteristics can only be assessed by on-site inspections or by official documentation, but others can be measured using visual imagery.

[0003] Characteristics addressed in this disclosure include roof shape and roof condition. In one example, roof shapes can be broken into five categories: gambrel roof, gable roof, hipped

roof, square roof, and flat roof. Each roof shape has a unique response and damage vulnerability to different natural perils like earthquake or wind.

[0004] Deep learning involves computational models composed of multiple processing layers to learn representations of data with multiple levels of abstractions. These models can be thought of as a way to automate predictive analytics. Representation learning is a set of methods that allows a machine to be fed with raw data and to automatically discover the representations needed for detection or classification. Use cases for deep learning include voice recognition, motion detection, translation, and medical diagnosis. By using deep learning algorithms and sample datasets, computers can learn to distinguish and classify a wide range of characteristics to high levels of accuracy, often surpassing the recognition levels of human beings.

[0005] One model used for deep learning is the Network in Network model described in the paper "Network In Network" by M. Lin et al. and published in the International Conference on Learning Representations, 2014 (arXiv:1409.1556), the contents of which are hereby incorporated by reference in its entirety. Using the Network in Network model, a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification.

[0006] When applied to visual recognition, deep learning algorithms can break down an observation (e.g., an image) in a number of different ways to characterize features of the observation. In some examples, deep learning algorithms can be applied to review images as a set of intensity values per pixel, or in a more abstract way as a set of edges, regions of particular shape, etc. Some representations may demonstrate superior performance to others based upon the particular learning task. One of the promises of deep learning is replacing

human identification of features with efficient algorithms for unsupervised or semi-supervised feature learning and hierarchical feature extraction.

[0007] The inventors recognized that deep learning methodology could be applied to risk exposure database population to analyze aerial imagery and automatically extract characteristics of individual properties, providing fast and efficient automated classification of building styles and repair conditions. In combining location-based vulnerabilities with individual property vulnerabilities identified in part through classification of repair conditions of one or more property features, risk of damage due to disaster can be more accurately estimated.

SUMMARY OF ILLUSTRATIVE EMBODIMENTS

[0008] The forgoing general description of the illustrative implementations and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure, and are not restrictive.

[0009] Systems, methods, and computing system platforms described herein support matching aerial image features of one or more properties to corresponding property conditions (e.g., maintenance levels of property features, including structural features, manmade features included within a vicinity of a structure (e.g., on a property lot, within a property parcel, or a geographic region of the property), and/or natural features included within the vicinity of the structure) through machine learning analysis. In a preferred application, the property condition analysis may be used in estimating damage risk in light of one or more disaster conditions, such as severe storms. The analysis may further aid in estimating costs of repair or replacement of each property, in one example, should a disaster cause the estimated damage. In another example, the analysis may be used to confirm that a property has been repaired.

[0010] In one aspect, the present disclosure relates to a method for automatically categorizing a repair condition or maintenance condition of a property characteristic, including obtaining an aerial image of a geographic region including the property; identifying features of the aerial image corresponding to the property characteristic; analyzing the features to determine a property characteristic classification; analyzing a region of the aerial image including the property characteristic to determine a condition classification; and determining, using the property characteristic classification and the condition classification, a risk estimate of damage to the property due to one or more disasters. The property characteristic of a structure such as a house, factory, or barn, in some examples, can include a rooftop, porch, chimney, or skylights. Property characteristics of manmade structures within a property location, in some examples, can include a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, equipment or vehicles, or greenhouse. Property characteristics of natural features within a property location, in some examples, include trees, ponds, marshes, rivers, lakes, grasses, cliffs, or ocean shore. Further, property characteristic classifications can include shapes, materials, size (breadth and/or height, relative or actual), and/or distance of the property characteristic from other features. In some embodiments, the property characteristic classification may include existing versus not existing (e.g., in the event of determining replacement or removal of a manmade feature at a property location such as a fence). The property characteristic classification, in a particular illustration, may be a rooftop shape. Analyzing the features to determine a property characteristic may include applying a deep learning analysis model to the features. The deep learning analysis model may be NIN.

[0011] In some embodiments, analyzing the region of the aerial image including the property characteristic to determine the condition classification includes applying a machine learning analysis model to image pixels within the region. The machine learning analysis model may

include a color histogram analysis model. The condition classification may encompass classifications good and bad. Determining the risk estimate may include applying a disaster risk profile corresponding to a first disaster of the at least one disaster and the property characteristic.

[0012] In one aspect, the present disclosure relates to a system for automatically categorizing a repair condition of a property characteristic, the system including processing circuitry and a non-transitory computer-readable medium having instructions stored thereon. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to obtain an aerial image of a geographic region including the property; identify features of the aerial image corresponding to the property characteristic; analyze the features to determine a property characteristic classification; analyze a region of the aerial image including the property characteristic to determine a condition classification; and determine, using the property characteristic classification and the condition classification, a replacement cost for replacing the property characteristic. The aerial image may be a two-dimensional aerial image.

[0013] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to identifying the features, obtain a shape map image including the property; overlay the aerial image with the shape map image; and determine whether a boundary of the property as identified by the shape map matches a boundary of the property as illustrated in the aerial image. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, upon determining that the shape map does not match the boundary of the corresponding property, obtain an alternate aerial image of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, prior to identifying the features, assess orthogonality of the aerial imagery. The property may be a single family home.

[0014] In one aspect, the present disclosure relates to a non-transitory computer readable medium having instructions stored thereon, where the instructions, when executed by processing circuitry, cause the processing circuitry to receive identification of a property and at least one property characteristic; obtain an aerial image of a geographic region including the property; and identify respective features of the aerial image corresponding to each property characteristic of the at least one property characteristic. In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, for each property characteristic, analyze the corresponding features to determine a respective property characteristic classification, and analyze a region of the aerial image including the respective property characteristic to determine a respective condition classification. The instructions, when executed by the processing circuitry, may cause the processing circuitry to determine, using the property characteristic classification of each property characteristic and the condition classification of each property characteristic, at least one risk estimate representing risk of damage due to disaster.

[0015] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to, prior to obtaining the aerial image of the geographic region, determine, based upon the at least one property characteristic, a preferred image type corresponding to each property characteristic of the at least one property characteristic. The at least one property characteristic may include two or more property characteristics. The instructions, when executed by the processing circuitry, may cause the processing circuitry to, responsive to determining the preferred image type corresponding to a first property characteristic of the at least one property characteristic is a terrestrial image, obtain a terrestrial image of the geographic region including the property.

[0016] In some embodiments, the instructions, when executed by the processing circuitry, cause the processing circuitry to access one or more known property characteristics.

Determining the at least one risk estimate may include determining the at least one risk estimate further based on the one or more known property characteristics. The one or more known property characteristics may include at least one of a property age, a property elevation, a property slope, a year built, a year renovated, and a building height.

[0017] In some embodiments, receiving identification of the property and the at least one property characteristic includes receiving, via a network from a remote computing device, the identification of the property. The instructions, when executed by the processing circuitry, may cause the processing circuitry to provide, via the network to the remote computing device in real-time responsive to receiving the at least one property characteristic, the at least one risk estimate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one or more embodiments and, together with the description, explain these embodiments. The accompanying drawings have not necessarily been drawn to scale. Any values dimensions illustrated in the accompanying graphs and figures are for illustration purposes only and may or may not represent actual or preferred values or dimensions. Where applicable, some or all features may not be illustrated to assist in the description of underlying features. In the drawings:

[0019] FIG. 1 is a flow diagram of an example system operational flow for matching aerial image features to corresponding property maintenance levels;

[0020] FIG. 2A illustrates example characteristic classifications and corresponding risk profile data;

[0021] FIG. 2B illustrates examples of condition characteristics and corresponding example histograms;

[0022] FIG. 2C illustrates an example condition profile corresponding to an example property characteristic type;

[0023] FIG. 2D is an example error rate graph comparing training data with test data in conducting matching aerial image features to corresponding rooftop shapes;

[0024] FIG. 3 is a block diagram of an example environment for matching aerial image topographical features to corresponding property maintenance levels;

[0025] FIG. 4 is a flow chart of an example method for classifying condition characteristics of a property based on aerial image analysis;

[0026] FIG. 5A illustrates an example structure shape map of a geographic area;

[0027] FIG. 5B illustrates an example two-dimensional aerial image of the geographic area of FIG. 5A;

[0028] FIG. 5C illustrates an example overlay map image of a section of the structure shape map of FIG. 5A overlaying a corresponding section of the aerial image of FIG. 5B;

[0029] FIG. 6 is a block diagram of an example computing system;

[0030] FIG. 7 is a block diagram of an example distributing computing environment including a cloud computing environment; and

[0031] FIGs. 8A, 8B, and 8C illustrate a series of example user interface screen shots for reviewing property characteristic and maintenance level information.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0032] The description set forth below in connection with the appended drawings is intended to be a description of various, illustrative embodiments of the disclosed subject matter. Specific features and functionalities are described in connection with each illustrative embodiment; however, it will be apparent to those skilled in the art that the disclosed embodiments may be practiced without each of those specific features and functionalities.

[0033] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments. Further, it is intended that embodiments of the disclosed subject matter cover modifications and variations thereof.

[0034] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context expressly dictates otherwise. That is, unless expressly specified otherwise, as used herein the words "a," "an," "the," and the like carry the meaning of "one or more." Additionally, it is to be understood that terms such as "left," "right," "top," "bottom," "front," "rear," "side," "height," "length," "width," "upper," "lower," "interior," "exterior," "inner," "outer," and the like that may be used herein merely describe points of reference and do not necessarily limit embodiments of the present disclosure to any particular orientation or configuration. Furthermore, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components, steps, operations, functions, and/or points of reference as disclosed herein, and likewise do not necessarily limit embodiments of the present disclosure to any particular configuration or orientation.

[0035] Furthermore, the terms "approximately," "about," "proximate," "minor variation," and similar terms generally refer to ranges that include the identified value within a margin of 20%, 10% or preferably 5% in certain embodiments, and any values therebetween.

[0036] All of the functionalities described in connection with one embodiment are intended to be applicable to the additional embodiments described below except where expressly

stated or where the feature or function is incompatible with the additional embodiments. For example, where a given feature or function is expressly described in connection with one embodiment but not expressly mentioned in connection with an alternative embodiment, it should be understood that the inventors intend that that feature or function may be deployed, utilized or implemented in connection with the alternative embodiment unless the feature or function is incompatible with the alternative embodiment.

[0037] Turning to FIG. 1, a flow diagram of an example system operational flow 100 for matching aerial image features to corresponding property maintenance levels obtains images (104) at property locations 102b is illustrated. In some implementations, commencement of at least a portion of the operational flow 100 by the system may be triggered by a property classification request submitted by a user, such as an insurance carrier or real estate investment broker at a dashboard interface screen on a computing device connected to the system via a network. For example, as illustrated in FIG. 8A, a particular property or, alternatively, a neighborhood of properties, may be selected within a map view user interface 800. The operational flow 100 may be used to analyze the condition of features of each property at each property location 102b based on aerial imagery 102c. In some implementations, the operational flow 100 may aid in estimating costs of repair or replacement of each property characteristic detected in the aerial images, for example. In another example, the operational flow 100 may be used to confirm that a property location 102b has been repaired.

[0038] The property locations 102b may represent, in some examples, locations of properties insured by a particular insurer, locations of properties recently affected by a disaster such as a tornado, hurricane, earthquake, fire, storm surge, or explosion, locations of properties held in an investment portfolio, or locations of properties considered for addition to an investment

portfolio. The property locations 102b may be identified, in some examples, by a street address, global positioning system coordinates, or other geographic coordinates.

[0039] In some implementations, the operational flow 100 obtains images (104) at each property location 102b. The images can include aerial imagery 102c stored by the system or accessed by the system from a remote networked location. The aerial imagery 102c, for example, may include a three-dimensional or two-dimensional image of a geographic location including at least one of the property locations 102b. In one example, based upon street address or geographic coordinates, the system may query a remote database to obtain recent aerial imagery 102c including an image of at least one of the property locations 102b. The remote database, in some examples, can include private industry databases such as Google® Earth images by Google, Inc. of Mountain View, CA or NTT Geospace Corporation of Japan. In other examples, the remote database can include one or more databases of publicly owned organizations such as the Geospatial Information Authority (GSI) of Japan, the United States Geological Survey, or the Federal Agency for Cartography and Geodesy of Germany. Aerial imagery can be collected from one or more remote network locations, in some embodiments, using an Open Source Geographic Information System (GIS) such as QGIS by the Open Source Geospatial Foundation (OSGeo). The format for the images of the property locations 102b, in some embodiments, depends upon the format accepted by the various sources available for aerial imagery 102c. An example aerial image 510 of multiple property locations 102b is illustrated in FIG. 5B.

[0040] In some embodiments, the system may be configured to query multiple remote database systems to obtain at least two aerial images of a given property location 102b. The aerial images available at the various databases, for example, may differ in resolution and recency of capture. Through collecting two or more images of a particular property, for example, the system may analyze each image to determine a best quality image for use in

condition analysis. The condition analysis can include balancing of multiple factors such as, in some examples, clarity, completeness, and recency.

[0041] Further, in some embodiments, the system may be configured to query multiple remote database systems to obtain both a two-dimensional aerial image and a three-dimensional aerial image. Different property characteristics may be discerned based upon whether the aerial image is captured in two-dimensional or three-dimensional format. Two-dimensional aerial images, in some examples, can be used to determine location coordinates of the property, street name, occupancy type, floor area, existence of skylights, existence of chimneys, roof condition, roof shape, roof covering, roof anchors, roof equipment, and/or pounding. Three-dimensional aerial images, in comparison, can be used to determine location coordinates, street name, construction type, occupancy type, year built, building height, soft stories, number of stories, roof condition, roof shape, roof covering, roof anchors, roof equipment, cladding, and pounding. Where there is an overlap in characteristics identifiable using either a two-dimensional image or a three-dimensional image, in some embodiments, machine learning analysis of both images can be combined to provide increase confidence in identification of the individual characteristics.

[0042] In some implementations, the system obtains (104) shape map images 102a of each of the property locations 102b. The shape map images 102a, for example, include a block shape layout of existing properties in a municipality, such as urban planning maps used in urban planning and development. The shape map images 102a, in another example, can include block shape layout maps used in presenting information to a user of a computer-based navigation system. The shape map images 102a, in one example, can be obtained from Geospatial Information Authority of Japan or Zenrin Co. Ltd. of Japan. An example of an urban planning map 500 is illustrated in FIG. 5A (image obtained from the Geospatial Information Authority of Japan, Digital Map 2500 (Spatial Data Framework)).

[0043] The shape map images 102a, in some embodiments, are used to confirm location of a particular property. The shape map image 102a of a geographical area, for example, can be overlaid with a corresponding aerial image 102c to match properties with images. An example overlaid image 520 of planning map image 500 of FIG. 5A with aerial image 510 of FIG. 5B is illustrated in FIG. 5C. In some embodiments, the shape map image 102a may not match in shape or location with the aerial image 102c. As illustrated in FIG. 5C, for example, a shape map outline (illustrated in a thickened line) for a location 522 may not be rectangular, while a rooftop shape beneath the outline may be rectangular in shape. In some embodiments, analyzing multiple aerial images 102c to determine the best quality image may include identifying one or more aerial images 102c that substantially align with the corresponding shape map image 102a. The overlay of the aerial image 102c with the shape map image 102a, further, can be used in aiding in cropping the aerial image 102c to focus analysis on a particular property location 102b. For example, turning to FIG. 5C, property location 524 is substantially aligning with the corresponding planning map image, and the general outline can be used in aiding in cropping of the property location 524. In some examples, the property location 524 may be identified within the overlaid image 520 when the property location 524 aligns with a property in the overlaid image 520 within a predetermined tolerance in order to account for renovations that may have been made to the property 524, such as property additions that may alter an overall shape of the property.

[0044] Returning to FIG. 1, in some embodiments, the shape map images 102a may be used to correct or compensate for alignment errors or inconsistencies of the corresponding two-dimensional aerial images 102c. For example, an aerial image representing a normal orthophoto angle may not be directly centered upon the planning map block. Using the planning map block as a guide, for example, the aerial image can be geometrically corrected to obtain a true orthophoto version of the aerial image.

[0045] As illustrated in FIG. 1, in some implementations, the system identifies (106) features of each aerial image 102c to classify property characteristics. Using machine learning for analysis, for example, the system can extract features of the aerial image of a particular property location 102b. Groupings of extracted features, such as angles, outlines, substantially homogenous fields, etc. can be used to identify property features such as rooftop, swimming pool, chimney, and sky lights. The groupings of extracted features, for example, may include pixel groupings obtained through filtering, cropping, or otherwise adjusting the original image. Upon extracting image-related features identifiable as a property feature (e.g., rooftop), the extracted features may be analyzed to determine one or more property characteristics of that feature (e.g., type of rooftop). In one example, a swimming pool may be identified as the property feature of a pool (e.g., various shapes of outlines of a particular size or greater bordering a substantially homogenous field of blue), then characterized as a particular shape (e.g., rectangular, round, or kidney bean, etc.), type (e.g., above ground or in-ground), and/or size (e.g., approximate area). The machine learning classifier used in the machine learning analysis, in some embodiments, includes a convolutional neural network (CNN) to preprocess the aerial image 102c of the particular property location 102b and to classify the property features as property characteristics 110. Using CNN technology, for example, the biological process of visually reviewing and identifying an object or feature of an object is mimicked through a feed-forward artificial neural network where multilayer artificial perception minimizes preprocessing. CNN is a well-established and popular machine-learning methodology. An example of a CNN processing model is Alexnet. (See Krizhevksy et al. "ImageNet Classification with Deep Convolutional Neural Networks", Advances in neural information processing systems, 2012, the entire contents of which has been incorporated herein by reference). In other embodiments, the machine learning classifier may include a Network in Network (NIN)

where a number of layers of artificial perception outcomes are generated using micro neural networks with complex structures. The artificial perception outcomes are then stacked and averaged to generate a single global average pooling layer for classification. NIN has demonstrated superior performance outcome to conventional CNN processing. Additionally, NIN processing is less storage-intensive than CNN processing.

[0046] In some implementations, property characteristic profiles 108 are used in classifying property features. The property characteristic profiles 108, for example, may be developed through training the machine learning algorithms using aerial images (and, in some embodiments, terrestrial images 102d) of known property characteristics. Each property feature, for example, may be broken down into multiple classifications. In an illustrative example involving a classification of terrestrial images, cladding can include stone, brick, stucco, shingles, vertical boards, horizontal boards, or metal. The machine learning algorithms, for example, may generate a percentage confidence in a match between a new aerial image 102c including a gambrel rooftop and the characteristic profile 108 of gambrel rooftops.

[0047] In an illustrative example, turning to FIG. 2A, extracted angular and outline features of aerial images 204 may be used to classify a roof shape 202 of the particular property location 102b. In a first example, a gable roof 202b includes a central peak upon a generally rectangular outline, as depicted in corresponding aerial image 204b. A gambrel roof 202a includes these features of the gable roof 202b but, as illustrated in aerial image 204a, the gambrel roof additionally includes a "skirt" region surrounding the central gable-shaped portion. The "skirt" region can be identified, in part, based upon its corner edges extending from the four corners of the gable-shaped portion. A hipped roof 202c, as shown in aerial image 204c, includes a central peak and two opposing triangular ends extending from either end of the central peak. The central peak forms a top edge of two trapezoidal sections. A

square roof 202d, in contrast, has no central peak. Instead, as illustrated in aerial image 204d, the square roof includes four triangular portions meeting at a central point. Finally, a flat roof 202e, as shown in aerial image 204e, is represented by a substantially flat surface outlined by a rectangle.

[0048] Turning to FIG. 2D, an example error rate graph 240 compares training data 242 with accuracy of matching test data 244 in matching aerial image rooftop characteristics to corresponding rooftop type (e.g., shape). A test was conducted using NIN deep learning algorithms to classify rooftop shape in two-dimensional aerial images including a mix of gambrel, gable, hipped, square, and flat roof shapes of assorted colors. Further tests involved differing image sizes and mini-batch sizes. In particular, images were scaled using a formula of $y = w * (x\text{-}100) + z$, where x represents a property size (e.g., building with a small border surrounding the area of the rooftop), y represents pixel size, w ranged from 0.33 to 0.40 and z ranged from 90 to 110. The error rates ranged, among initial test cases involving mini batches from 5 to 20, from about 4.3% to about 10%. As shown by the error rate graph 240, in a test situation involving 2,250 sample images in a training dataset 242 and 250 test images in a test dataset 244, the minimum error rate in determining rooftop condition was 6%, corresponding to an accuracy rate of 94%.

[0049] To improve accuracy rate, in some implementations, the image can be cropped and/or resized prior to analyzing. For example, the image may be cropped to include the property of interest, or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Resizing to a standard image size, in another example, can contribute to accuracy improvement.

[0050] Further to roof shape, in some embodiments, feature analysis can be used to discern additional roof features such as, in some examples, roof covering, roof anchors, roof

equipment, skylights, widow's walks, turrets, towers, dormers, and/or chimneys. Furthermore, upon identifying the outline of the roof, a footprint of the property location 102b (e.g., size of the roof) can be calculated based upon a scale of the aerial image 102c.

[0051] Returning to FIG. 1, rather than exclusively analyzing the particular property locations 102b individually, in some implementations, the particular property locations 102b are each classified based in part upon nearby structures. For example, based upon property location 102b dimensions, which may include lot dimensions, machine learning can be used to identify additional structures at the property location 102b such as, in some examples, a deck, swimming pool, shed, gazebo, detached garage, tennis court, fence, retaining wall, dock, playground equipment, or greenhouse. Further, the particular property locations 102b may be classified in part based upon distance from neighboring structures and/or natural features (e.g., pounding).

[0052] In some implementations, terrestrial images 102d may be used to classify features difficult to recognize using aerial imagery 102c. The terrestrial images 102d, in some examples, can include street view images obtained from a street view service or real estate listing. In some examples, street view images including a street-facing view of the property location 102b may be obtained from Google® Street View by Google, Inc., Bing® Maps Streetside by Microsoft Corp. of Redmond, WA, or Mapillary by Mapillary AB of Sweden. Using a terrestrial image, for example, the system can identify features such as construction type, cladding, building height, number of soft stories, number of floors, location coordinates, street name, slope, elevation, year built, and/or occupancy type. Where the characteristics identifiable via the terrestrial imagery 102d overlap with characteristics identifiable via two-dimensional or three-dimensional aerial imagery 102c, analysis of terrestrial imagery 102d can be combined with analysis of aerial imagery, in some embodiments, to increase confidence in identification of the particular characteristic(s). For example, house siding

features may be more easily detected in terrestrial imagery 102d and/or three-dimensional aerial imagery 120c than in two-dimensional aerial imagery 102c.

[0053] In some implementations, a condition of each property feature may be classified (112) as a corresponding condition characteristic 116. New properties are in good condition, but property feature conditions can deteriorate over time due to normal wear-and-tear on the property. Further, property features can suffer damage due to external forces such as storms and natural disasters. Eventually, conditions of housing features can deteriorate to the point where repair and/or replacement may be necessary. As with property characteristics described above at block 110, machine learning algorithms can be used to classify a present condition of individual detected property features. Using machine learning for analysis, for example, the system can extract pixel intensity distributions of previously identified property features of the aerial image of the particular property location 102b. In some examples, newly constructed property features generally have sharp contrast and well-defined features in machine learning image analysis. Conversely, weathered or damaged property features can have softened edges, blurred contrasts, and asymmetrical patches of wear. The machine learning classifier used in the machine learning condition analysis, in some embodiments, includes a machine learning analysis to process the aerial image 102c of the particular property location 102b and to classify the condition of previously identified property characteristics 110 as condition characteristics 116. The machine learning analysis, in some examples, can include two-dimensional color histogram analysis or three-dimensional color histogram analysis. In other embodiments, the machine learning analysis may be performed using pattern recognition algorithms (e.g., determining missing fence posts or missing/misaligned rooftop shingles). In other embodiments, the machine learning classifier includes deep learning analysis such as CNN or NIN. For example, CNN analysis may leverage feature maps created during the training process to assess the condition through

extracting meaningful features within a given image through convolution and pooling layers. Other machine learning models and algorithms are possible.

[0054] In an illustrative example, turning to FIG. 2B, examples of condition characteristics of aerial images of hipped rooftops and corresponding example histograms generated through machine learning analysis of pixel intensity are presented. For example, a set of good condition aerial images 210a through 214a, are presented alongside corresponding good condition histograms 210b through 214b. The good condition histograms 210b through 214b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 210c through 214c demonstrates the peak probability of grayscale color distribution of a good condition roof. The values, for example, can range from 0 (total black) to 255 (total white).

[0055] Conversely, a set of poor condition aerial images 216a through 220a, are presented alongside corresponding poor condition histograms 216b through 220b. The poor condition histograms 216b through 220b, in an illustrative embodiment, illustrate probability metrics of grayscale color distribution, where a respective maximum value 216c through 220c demonstrates the peak probability of grayscale color distribution of a good condition roof. The maximum values 216c through 220c corresponding to the poor condition rooftops 216a through 220a are markedly lower than corresponding maximum values 210c through 214c of good condition rooftops 210a through 214a. In addition, a width of the distributions of the poor condition histograms 216b through 220b may be markedly wider than a width of the distributions of the good condition histograms 210b through 214b. As can be seen of the aerial images of the poor condition rooftops 216a through 220a, the color distribution is patchy and bleached out, while the edges of the rooftops have lost their crisp lines. Conversely, looking to the aerial images of the good condition rooftops 210a through 214a, the rooftops are more substantially uniform in color with crisp lines on the edges.

[0056] Turning to FIG. 2C, a condition profile 230 for a rooftop condition is illustrated. In some implementations, pixel value distribution histograms such as the histograms 210b through 220b, in some implementations, can be combined to generate an example condition profile 230 corresponding to rooftop condition. The condition profile 230, for example, may be included as one of the condition profiles 114 of FIG. 1. Example reference bars 232a, 232b on the condition profile 230 illustrate values corresponding to a non-deteriorated hipped roof 214a and the deteriorated hipped roof 216a, respectively. In some examples, the closer the value of a reference bar 232 comes to 1 on the Y-axis, the better the condition of the roof, while values close to 0 represent poor condition rooftops. In one example, the reference bars 232 of the example condition profile 230 correspond to a test conditions sample data set including 2,500 images). The reference bars 232 can be combined, in some embodiments, in a logistic regression to generate a roof condition profile graph 236. The accuracy rate of the image histogram is 80% based on some validation.

[0057] Although illustrated as a single condition profile 230 corresponding to different types of rooftops (e.g., at least the hipped rooftop 216a and the gable rooftop 234), in other embodiments, individual condition profiles 114 can be generated for each property characteristic (e.g., profiles specific to gabled, gambrel, flat, hipped, square, etc.). In further refinements, in certain embodiments, individual condition profiles 114 can be generated for combinations of property characteristics (e.g., a gabled, shingled roof, a gabled, clay tiled roof, a gabled, metal roof, etc.) to increase accuracy rate based upon pixel densities corresponding to the combined characteristics. Many combinations of characteristics of property features may be used singly or in combination to generate a condition profile 114 designed to accurately identify the condition of the corresponding property feature.

[0058] Returning to FIG. 1, in some implementations, the property characteristics 110 and/or condition characteristics 116 may be analyzed to calculate (120) a risk estimate 122

corresponding to a risk of damage based upon one or more types of disasters. The types of disasters can include, in some examples, earthquake, hurricane, tornado, storm surge, fire, straight line winds, or explosion. The types and estimated severity of disasters, in some embodiments, may depend upon the particular property location 102b. For example, properties near active fault lines may be more susceptible to earthquakes, while coastal properties may be more susceptible to storm surge damage. The risk estimate 122, in some examples, can include an actuarial percentage indicating a likelihood of damage based upon the particular property characteristics. Different property characteristics, for example, may be more susceptible than others to certain types of damage. For example, flatter rooftops may be more susceptible to damage from excessive snow build-up, while peaked rooftops may be more vulnerable to strong winds.

[0059] In some embodiments, in calculating damage risk, one or more disaster risk profiles 118 can be applied based upon property characteristics. Vulnerability to damage due to disaster can vary, in some examples, by location, altitude, slope, rooftop shape, rooftop condition, cladding type, cladding condition, and/or pounding. In a particular example, as shown in FIG. 2A, a graphical risk profile 206 ranks types of rooftops by their vulnerability to strong winds. Vulnerability to wind damage increases from lowest vulnerability (flat rooftop 202e) to square roof 202d, to hipped roof 202c, to gable roof 202b, with the greatest wind damage vulnerability in gambrel roofs 202a. Vulnerability may be mathematically modeled based upon statistical information built from past damage results due to varying types and/or severity of disaster. In combining location-based vulnerabilities with individual property characteristic-based vulnerabilities, risk of damage due to disaster can be more accurately estimated.

[0060] Referring back to FIG. 1, the risk estimates 122, in some embodiments, can be used in insurance assessments. For example, the risk estimate 122 may be used in determining

whether a property is adequately insured against potential damage. Further, when tracking an impending natural disaster, an insurance company may use the risk estimates 122 to estimate claims based upon the forecast path and severity of the storm. Additionally, the risk estimates 122 may be applied by investors when selecting investment properties for an investment portfolio.

[0061] In some implementations, repair or replacement costs can be calculated (126) to determine a cost estimate 128 to place one or more property characteristics in good or "like new" condition. The cost estimates 128, in some embodiments, can be based in part on one or more replacement cost profiles 120. Replacement costs, in some examples, may vary based upon type of materials (e.g., rooftop materials, cladding materials, etc.), size of the job (e.g., estimated area of the roof, estimated length of fence, etc.), and/or additional property characteristics (e.g., contributing to the complexity of the work). The replacement profiles 120, in further examples, may be based in part on location (e.g., varying costs of material and labor regionally). In some implementations, the cost estimates 128 for repair or replacement of the property characteristics may be output to a dashboard interface screen at a remote computing device of a requester, such as an insurance carrier or real estate investment broker.

[0062] In some embodiments, cost estimates 128 can be used in automatically analyzing insurance claims. The cost estimate 128, further, may be combined with the risk estimate 122 in analyzing adequacy of insurance coverage for a particular property location 102b. Further, the cost estimates 128 may be used by investors in determining cost of maintaining/upgrading a particular investment property.

[0063] Although the operational flow is illustrated as a series of computational stages, in other implementations, more or fewer computational stages may be included. For example, aerial imagery 102c may be analyzed after an insurance claim has been paid to verify that the insured property has been repaired and/or to upgrade the estimated value of the property (e.g.,

in the circumstance where the owner upgraded the property rather than applying a straight repair/replacement of the damaged property characteristics.

[0064] Additionally, in other implementations, certain computational stages may be performed in a different order. For example, cost estimates 128 may be calculated prior to risk estimates 122. Other modifications of the operational flow 100 are possible.

[0065] FIG. 3 is a block diagram of an example environment 300 for matching aerial image topographical features to corresponding property maintenance levels. The example environment 300, for example, can be used to implement the operational flow 100 described in relation to FIG. 1. The example environment 300 includes a property characteristic classification and condition analysis system 302 in communication with client computing system(s) 306, a number of cost data and/or risk data source computing system(s) 308, and a number of shape map, aerial imagery, and/or terrestrial imagery source computing system(s) 304. The communication connection may be wired or wireless, over a variety of network types. In a general overview, the system 302 obtains property identifier(s) 340 from client computing system(s) 306, accesses images of a property identified by the property identifier 340 from the imagery source computing system(s) 304, and analyzes the images to determine property characteristic(s) 342 and condition characteristic(s) 344. Using cost and/or risk data obtained from cost and risk data source computing system(s) 308, the system 302 may determine replacement cost estimate data 350 and/or disaster risk estimate data 352 based upon the property characteristics and their condition.

[0066] In some implementations, a user of a particular client computing system 306 submits a request to the system 302 through a graphical user interface supplied by a graphical user interface engine 334. The request, for example, may include at least one property identifier 340 as well as one or more property characteristics 342 and/or identification of at least one of a replacement or repair cost estimate, a disaster risk estimate, and a confirmation of repair

assessment. The property identifier 340, in some examples, may include location information (e.g., address, geolocation coordinates, lot boundaries, etc.). The location information, for example, may conform with property location information 102b described in relation to FIG. 1. In other embodiments, the property identifier 340 may be a unique property identifier (e.g., number or string) used to look up property location information in a data store 310. In another embodiment, rather than submitting a property identifier, the user may submit a unique user identifier used to look up one or more properties associated with the user (e.g., properties insured by an insurance client, properties held by an investment client, etc.).

[0067] In one example, turning to FIG. 8A, a user may identify locations of one or more properties by selecting the properties within a graphical map interface 800. A number of properties are identified within the map view user interface 800 as indicated with an associated pin, such as pin 804. The pins, in some examples, may indicate properties insured by a particular insurance carrier, a type of property (e.g., commercial, industrial, residential, etc.), and/or properties of a value range (e.g., within a range, above a threshold, etc.). The pins, for example, may be displayed based upon filtering options supplied by the user or otherwise associated with a user profile (e.g., insurance carrier identification). In a particular example, a user may select three properties associated with three dialogue bubbles 802. As illustrated, each dialogue bubble identifies a replacement value associated with the property and invites the user to review details regarding the selected property via a details control.

[0068] In some implementations, the user enters property characteristics associated with each selected property. In other implementations, the characteristics may be accessed upon identification of the property (e.g., selection of a pin identifying a property, as illustrated in FIG. 8A). For example, the property characteristics 342 may be obtained from the data store 310, as illustrated in FIG. 3. Turning to FIG. 8B, an example property characteristics user interface 820 presents building area characteristics 822 (e.g., building area 822a, stories 822b,

and total building area 822c) and structure characteristics 824 (e.g., structure material 824a, construction class 824b). As described within, different or additional characteristics may vary per implementation. In some embodiments, the user may be provided the ability via the user interface 820 to edit the building area characteristics 822 and/or the structure characteristics 824, for example via an edit control 828a or 828b. For example, in the circumstance of recent development or renovation (e.g., construction of an addition), the user may modify previously stored characteristics values. The property characteristics user interface 820, for example, may be presented to a user upon selection of a details control of one of the dialogue bubbles 802 illustrated in the user interface of FIG. 8A.

[0069] The user interface 820 further presents, in some implementations, premium characteristics 826 such as a replacement value. The premium information, for example, may relate to an insurance policy purchased for the property or parameters for insuring the property (e.g., based upon upgraded or new characteristics). The user, in some embodiments, may be provided to update the premium information via an edit control 828c.

[0070] In some implementations, upon identification of property location information, the system 302 accesses imagery of the property from the imagery source computing system(s) 304 using an image acquisition engine 336. The images can include, in some examples, a shape map (e.g., such as the shape maps 102a described in relation to FIG. 1), two-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), three-dimensional aerial imagery (e.g., such as the aerial imagery 102c described in relation to FIG. 1), and/or terrestrial imagery (e.g., such as the terrestrial imagery 102d described in relation to FIG. 1). The images obtained by the image acquisition engine 336, in some embodiments, depend upon the property characteristic(s) identified by the user. For example, certain types of images are preferred for analyzing certain types of property

characteristics. Housing siding, for example, is more easily perceived from a terrestrial image or three-dimensional aerial image than from a two-dimensional aerial image.

[0071] In some implementations, an image quality analysis and preparation engine 326 analyzes the acquired image(s) to confirm the acquired image(s) contains an adequately clear and detailed image of the property identified by the property identifier 340. In some embodiments, the image quality analysis and preparation engine 326 crops and/or resizes the acquired image(s). For example, the image quality analysis and preparation engine 326 may extract a portion of an acquired image based upon the property (e.g., building size). In some implementations, the image quality analysis and preparation engine 326 resizes each acquired image to a standard size. The standard size, in a particular example, may be 256 by 256 pixels per image. Resizing to a standard size, for example, may increase accuracy in later classification analysis. The image quality analysis and preparation engine 326, in some embodiments, may be configured to apply corrections to the acquired image(s). For example, the image quality analysis and preparation engine 326 may be configured to adjust an aerial image from a normal orthophoto angle, to a true orthophoto version as described above.

[0072] In some implementations, the image quality analysis and preparation engine 326 uses shape outlines as part of the analysis. For example, a composite image generation engine 318 may overlay an aerial image with a shape map image, as described in relation to FIG. 5C. Using the resultant composite image, the image quality analysis and preparation engine 326 may confirm the aerial image conforms with an urban planning map or other property placement guide (e.g., navigational map data, etc.). Further, the image quality analysis and preparation engine 326 may use the overlaid shape map as a guide in determining whether an aerial image requires correction to a true orthophoto angle and/or how closely to crop the image to capture the property (and, optionally, its immediate surroundings such as its lot or a portion of the proximate neighborhood).

[0073] In some implementations, if the image quality analysis and preparation engine 326 determines that the acquired image is insufficient, the image quality analysis and preparation engine 326 may request a replacement image from the image acquisition engine 336. For example, the image acquisition engine 336 may obtain images based upon a variety of factors including, in some examples, recency of capture, resolution, cost, and/or applicability to a particular property characteristic analysis. Upon determination by the image quality analysis and preparation engine 326 that the first obtained image is insufficient, for example, the image acquisition engine 336 may determine a next best source for obtaining an image of the property.

[0074] In some implementations, once an image has been approved (and, optionally, prepared and/or corrected) by the image quality analysis and preparation engine 326, a feature identification engine 320 extracts features from the property image(s) related to the identified property characteristics 342. In the circumstance of a fence, for example, the feature identification engine 320 may identify a perimeter enclosure or partial perimeter enclosure abutting and extending from the property as indicative of a fence.

[0075] In some implementations, upon identification of features by the feature identification engine 320, a property characteristic classification engine 322 classifies the property characteristic. For example, the features may be classified using one or more machine learning techniques as described in relation to computational stage 106 (classify features of each image) of FIG. 1. The property characteristic classification engine 322, for example, may generate property characteristics 342 representing a grouping, type, or other characterization of a particular property feature. Continuing with the particular example of a fence, the extracted features may be analyzed and classified in relation to height and/or material. Upon classifying the property characteristics, the property characteristic

classifications may be stored in the data store 310 as property characteristics 342 (e.g., similar to property characteristics 110 of FIG. 1).

[0076] In some implementations, the property characteristic classification engine 322 uses characteristic profile(s) 360 in classifying property characteristics. The property characteristic classification engine 322, for example, may obtain, for each property characteristic being analyzed, a particular characteristic profile 360 from a profile data store 314. The characteristic profiles, for example, may be similar to the characteristic profiles 108 described in relation to FIG. 1.

[0077] In some implementations, the property characteristic profiles 360 are generated by a characteristic classification learning engine 328. The characteristic classification learning engine 328, for example, may generate characteristic profiles 360 through a sample data set and learning process as described, generally, in relation to FIG. 2A. In a particular example, the characteristic classification learning engine 328 may analyze JPG (lossy compression digital image standard developed by the Joint Photographic Experts Group) to recognize varying rooftop shapes.

[0078] While certain property characteristic classifications are done by analysis, in some implementations, one or more feature classifications may be obtained from previously stored property characteristics 342. For example, based upon tax records, real estate records, etc. some basic materials and structure information regarding a property may be readily available through local and/or remote database system(s). In other examples, the previously stored property characteristics 342 may also be obtained from previous condition assessments performed for a property location by the system 302.

[0079] In some implementations, once the property characteristic classification engine 322 has classified the property characteristic(s), a characteristic condition classification engine 324 classifies the condition of each property characteristic. For example, the property

characteristics may be classified as described in relation to computational stage 112 (classify condition of each feature) of FIG. 1. The characteristic condition classification engine 324, for example, may generate condition characteristics 344 representing a rating, qualification, or ranking of the condition of the particular characteristic. In some examples, the characteristic condition classification engine 324 may qualify a characteristic as a) "good" or "bad", b) "like new", "acceptable", "needs repair", or "needs replacement", c) rated on a numeric scale such as a scale from 1 to 5 where 5 may correspond to "like new" and 1 may correspond to "needs replacement." In other implementations, particular problems may be identified by the characteristic condition classification engine 324 such as, in some examples, a fence feature is partially fallen, or a roof feature shows signs of structural damage.

[0080] In some implementations, the characteristic condition classification engine 324 uses condition profile(s) 362 in classifying property characteristic conditions. The characteristic condition classification engine 324, for example, may obtain, for each property characteristic being analyzed, a particular condition profile 362 from the profile data store 314. The condition profiles 362, for example, may be similar to the condition profiles 114 described in relation to FIG. 1.

[0081] In some implementations, the condition profiles 362 are generated by a condition classification learning engine 330. The condition classification learning engine 330, for example, may generate condition profiles 362 through a sample data set and learning process as described, generally, in relation to FIG. 2B. In a particular example, color histogram analysis may be used to identify peak pixel values of the images in gray scale. Using the group of calculated peak pixel values, the learning engine can classify property condition into certain categories.

[0082] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a risk

calculation engine 316 may estimate risk of damage based upon one or more types of disaster. For example, the disaster risk estimate data 352 may be calculated as described in relation to computational stage 120 (calculate damage risk) of FIG. 1. The disaster risk estimate data 350, in one example, can include a percentage likelihood of damage due to each particular type of risk based upon the particular property characteristics and/or property conditions, as described in relation to the risk estimates 122 of FIG. 1. Further, in some embodiments, the disaster risk estimate data 350 may include a set of risk estimates based upon, in some examples, a number of severities of disaster, a particular path of disaster, and/or hazard intensity of disaster. The disaster severities, in some examples, may correspond to the Richter scale of seismic activity magnitude or the Saffir-Simpson Hurricane Wind Scale category. The path of the disaster, in some examples, can include geographical direction such as northeasterly, etc. or angle of impact with respect to the property characteristic(s). The hazard intensity of disaster, in some examples, can relate to wind speed or rainfall amount. Repair costs, for example, may be more accurately estimated when the roof condition is known. Due to poor condition of a rooftop in one particular example, the roof may be more vulnerable to damage requiring replacement. In another particular example, due to a poor condition rooftop, the likelihood for interior property damage (e.g., water damage due to breach of the roof) may increase at a set level of severity of disaster and above.

[0083] In some embodiments, the risk calculation engine 316 accesses one or more risk profiles 364 from the data store 314 based upon property characteristics and/or condition characteristics. The risk profiles, for example, may be similar to the disaster risk profiles 118 described in relation to FIG. 1. The risk profiles 364, for example, may be obtained from one or more risk data sources 308 by a cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate risk profiles 364 (e.g., using risk data obtained

from one or more cost and risk data sources 308 and a risk data analysis engine (not illustrated)).

[0084] The risk estimate data 352, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use risk estimate data in making insurance assessments. In another example, a real estate investment broker or firm client 306 may apply risk estimate data 352 when selecting investment properties for an investment portfolio.

[0085] Turning to FIG. 8C, an example disaster risk user interface 840 presents risk assessment information based upon risk profiles 364 related to the selected property (e.g., one of the properties identified via the dialogue bubbles 802c of FIG. 8A). The user interface 840, for example, may be accessed by scrolling downward from the user interface 820. The user interface 840 illustrates a number of disaster risk factors 842 and associated risk estimate data 844 for the selected property. As illustrated, the disaster risk factors 842 include a fire factor 842a, a wind factor 842b, a flood factor 842c, an earthquake factor 842d, a tsunami factor 842e, and a landslide factor 842f. In some embodiments, only a subset of the risk estimate data is determined via risk assessment techniques described herein. For example, flood data 844c may be generated based upon governmental flood map evaluation rather than via aerial imaging assessment, while fire risk 844a may be determined at least in part based upon proximity to neighboring properties as derived via imaging analysis and/or construction properties derived via image analysis. Further, wind risk data 842b may be derived via rooftop analysis as described in greater detail herein.

[0086] In some implementations, based upon the output of the property characteristic classification engine 322 and/or the characteristic condition classification engine 324, a cost calculation engine 332 calculates repair or replacement costs for improving problems identified by the characteristic condition classification engine 324 and generates replacement

cost estimate data 350. For example, the replacement cost estimate data 350 may be calculated as described in relation to computational stage 126 (calculate repair or replacement costs) of FIG. 1. The replacement cost estimate data 350, for example, may be similar to the cost estimates 128 described in relation to FIG. 1.

[0087] In some implementations, the cost calculation engine 332 based calculations in part on one or more cost profiles 366 (e.g., similar to the cost profiles 120 of FIG. 1). In some embodiments, the cost calculation engine 332 accesses one or more cost profiles 366 from the data store 314 based upon property characteristics and/or condition characteristics. The cost profiles 366, in some embodiments, are obtained from one or more cost data sources 308 by the cost and risk data acquisition engine 338. In other embodiments, the system 302 may generate cost profiles 366 (e.g., by a cost data analysis engine (not illustrated) using cost data obtained from one or more cost and risk data sources 308).

[0088] The cost estimate data 350, in some embodiments, is shared with one or more clients 306. For example, an insurance carrier client 306 may use cost estimate data in determining adequacy of insurance coverage for a particular property. In another example, a real estate investment broker or real estate investment firm client 306 may apply cost estimate data 350 in determining cost of maintaining/upgrading a particular investment property.

[0089] In some implementations, the cost estimate data 350 and/or risk estimate data 352 is provided to a requesting client 306, responsive to receiving identification of one or more properties, in real-time or near real-time. For example, a client 306 accessing a dashboard interface, may format a request for a risk estimate or cost estimate related to an identified property within a dashboard interface and submit the request via a network to the system 302. Responsive to the request, the system 302 may conduct the analysis described generally above and respond, in real time or near-real time to the client 306 with a risk analysis or cost

analysis. For example, risk analysis information is presented in user interface 840 of FIG. 8C.

[0090] In some implementations, the system may identify, through updated meteorological data, one or more properties within a client real estate portfolio affected by a disaster. The system, further to identification of the affected properties, may proactively prepare a repair estimate to provide to the client corresponding to the real estate portfolio shortly after the disaster took effect. In one example, the Japan Meteorological Agency may update observation data via a web site interface within an hour or so of observation. In this example, the system may provide repair cost estimates to clients between one and two hours after a disaster has taken place.

[0091] Rather than sharing cost estimate data 350 and/or risk estimate data 352 directly with the clients 306, in other embodiments, the system 302 may include a report generation engine (not illustrated) that prepares reports regarding condition, damage, and risk assessments of one or more properties. Further, in some embodiments, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to confirm whether a property owner made repairs to a property (e.g., based upon payment of an insurance claim), replaced one or more features of a property, or removed one or more features of a property (e.g., removed a hazardous collapsing structure, cut back brush encroaching a fire risk distance to a home, etc.). In another illustration, the system 302 may compare a current condition characteristic 344 to a historic condition characteristic 344 to determine whether a repair or replacement is an upgrade (e.g., replacement using superior materials) or a downgrade (e.g., replacing an in-ground pool with an above-ground pool) to the property characteristic. Other modifications of the system 302 are possible.

[0092] FIG. 4 is a flow chart of an example method 400 for classifying condition characteristics of a property based on aerial image analysis. The flow chart, for example,

may represent computational stages 104 through 112 as described in relation to FIG. 1. The method 400 may be performed, for example, by the system 302 of FIG. 3.

[0093] In some implementations, the method 400 begins with accessing a two-dimensional shape map including the shape of a property (402). The shape map, for example, may be accessed by the image acquisition engine 336 from a shape map imagery source 304, as described in relation to FIG. 3. The two-dimensional shape map, for example, may take a form of any of the shape maps 102a described in relation to FIG. 1. In a particular example, the shape map may be in a form similar to the shape map 500 described in relation to FIG. 5A.

[0094] In some implementations, two-dimensional and/or three-dimensional aerial imagery including an image of the property is accessed (404). The two-dimensional and/or three-dimensional aerial imagery, for example, may be accessed by the image acquisition engine 336 from an aerial imagery source 304, as described in relation to FIG. 3. The two-dimensional and/or three-dimensional aerial imagery, for example, may take a form of any of the aerial imagery 102c described in relation to FIG. 1. In a particular example, the two-dimensional aerial imagery may be in a form similar to the aerial image 510 described in relation to FIG. 5B.

[0095] In some implementations, the aerial imagery is overlaid with the shape map (406). The composite image generation engine 318 of FIG. 3, for example, may overlay the aerial imagery with the shape map to generate a composite image. The composite image, for example, may be in a form similar to the composite image 520 described in relation to FIG. 5C.

[0096] If a shape match is not identified (408), in some implementations, the method 400 accesses alternate two-dimensional or three-dimensional aerial imagery (410). In some embodiments, the image quality analysis and preparation engine 326 of FIG. 3 determines

whether the composite image presents an adequate shape match of the property(s) of interest. Upon determining the image does not match, the image acquisition engine 336 of FIG. 3, for example, may obtain an alternative two-dimensional or three-dimensional aerial image from the aerial imagery source(s) 304. As described in relation to FIG. 3, for example, For the image acquisition engine 336 may determine a next best source for obtaining an image of the property based upon one or more factors. Conversely, the method 400, in other implementations (not illustrated), could proceed without matching the shape map to the aerial imagery.

[0097] If a shape match is identified (408), in some implementations, the formatting of the aerial imagery is prepared (411). In some embodiments, the image is cropped to include the property of interest or the property of interest plus a portion of its surroundings (e.g., the lot containing the property and/or a portion of the proximate neighborhood in which the property resides). Cropping may be based, for example, on the correlation of the shape map to the property. In illustration, the image may be cropped to include the shape map outline of the property plus a border region. In some embodiments, cropping may include cropping to a set shape (e.g., X by X pixels square, X by Y pixels rectangle, etc.). In some embodiments, in addition to cropping the image, the image may be resized. For example, depending upon the resolution of the aerial imagery, the image resolution may be reduced, for example, to fit within an X by X pixels square or an X by Y pixels rectangle. Resizing to a standard image size, for example, can contribute to analysis consistency and improvement in classification accuracy. In further embodiments, the color depth and/or color mapping of the aerial imagery may be adjusted. For consistent color histogram analysis of the imagery, for example, the color depth and color mapping may be made consistent across analyzed images. In a particular example, color images may be converted to grayscale for grayscale image analysis.

Adjustments to the imagery, for example, may be effected by the image quality analysis and preparation engine 326, described in relation to FIG. 3.

[0098] In some implementations, orthogonality of the aerial imagery is assessed (412). For example, the image quality analysis and preparation engine 326 may assess orthogonality of the aerial imagery. The image quality analysis and preparation engine 326, in one example, may determine that orthogonality correction is desired. In another example, if the image represents a normal orthophoto rather than a true orthophoto, the image quality analysis and preparation engine 326 may notify further modules which may compensate for the angle of capture of the aerial image. In other implementations (not illustrated), orthogonality may be assessed without use of an overlaid shape map.

[0099] Returning to FIG. 4, in some implementations, if the aerial imagery is not orthogonal (414), an orthogonal version of the aerial imagery is generated (416). The image quality analysis and preparation engine 326 of FIG. 3, for example, may correct a normal orthophoto form to generate a true orthophoto form. The true orthophoto form, for example, may better match the shape map overly.

[0100] In some implementations, one or more property characteristics of the property are classified (418). The property, in some embodiments, is analyzed based on the portion of the aerial image substantially bounded by the shape map of the property. In other embodiments, the property analysis encompasses a surrounding of the property (e.g., features proximate the property upon the property lot, nearby properties, etc.). The property characteristic(s), for example, may be classified by the property characteristic classification engine 322, as described in relation to FIG. 3. In a particular example, a rooftop property feature may be classified as one of a variety of rooftop shapes, as illustrated in FIG. 2A.

[0101] In some implementations, if a property characteristic classification is identified (420), a condition of each of the property characteristics can be classified (422). The property

characteristic condition(s), for example, may be classified by the characteristic condition classification engine 324, as described in relation to FIG. 3. In a particular example, a hipped classification of the rooftop feature may be classified as one of a good condition and a poor condition, as illustrated in FIG. 2B. In some implementations, the classifications of the condition of each of the property characteristics may by output to a computing device of a requester (422) via a dashboard interface screen. In some examples, in addition to providing the condition classification for the property characteristics, the dashboard interface screen may include replacement costs for replacing the property characteristics, risk cost estimates due to damage from natural disasters, or confirmation of whether or not repairs have been made to the property characteristics.

[0102] If, instead, a classification match was not identified (420), in some implementations, alternate two-dimensional or three-dimensional aerial imagery is accessed (410) and the method 400 restarts with overlaying the replacement aerial imagery with the shape map (406). Alternatively, in some embodiments, even if a classification match is not identified, condition may be assessed based upon a default profile associated with the property feature (not illustrated). For example, if the rooftop shape does not match one of the shapes trained into the system, the condition of the rooftop may still be assessed based upon a general condition profile trained with a variety of rooftop shapes. In some examples, the condition of the rooftop may be assessed by comparing the current rooftop conditions to stored historic condition characteristics for the property from a previous condition assessment.

[0103] Although the method 400 is illustrated as a series of steps, in other implementations, more or fewer steps may be included. For example, in some implementations, terrestrial images are obtained and used to classify the same and/or different property characteristics, as described in relation to the operational flow 100 of FIG. 1.

[0104] Additionally, in other implementations, certain steps may be performed in a different order. For example, in some implementations, property characteristics and condition characteristics may be classified (418, 422) in parallel. Other modifications of the operational flow 100 are possible.

[0105] Aspects of the present disclosure may be directed to computing systems for categorizing a repair condition of a property characteristic in order to provide dynamic, real-time property condition assessments in response to requests received from users such as insurance carriers or real estate investment brokers using aerial imagery. The implementations described herein improve upon conventional methodologies by applying deep learning analysis models to detected property characteristics of the obtained imagery in order to assess whether a condition of the property characteristics is degraded to a point of needing repair or replacement and determine an amount of risk exposure of the property due to the detected condition of the property characteristics. The implementations described herein improve processing efficiency of the system to reduce an amount of time it takes to perform the condition assessments and automate a condition assessment process.

[0106] Next, a hardware description of the computing device, mobile computing device, or server according to exemplary embodiments is described with reference to Figure 6. In Figure 6, the computing device, mobile computing device, or server includes a CPU 600 which performs the processes described above. The process data and instructions may be stored in memory 602. These processes and instructions may also be stored on a storage medium disk 604 such as a hard drive (HDD) or portable storage medium or may be stored remotely. Further, the claimed advancements are not limited by the form of the computer-readable media on which the instructions of the inventive process are stored. For example, the instructions may be stored on CDs, DVDs, in FLASH memory, RAM, ROM, PROM, EPROM, EEPROM, hard disk or any other information processing device with which the

computing device, mobile computing device, or server communicates, such as a server or computer.

[0107] Further, a portion of the claimed advancements may be provided as a utility application, background daemon, or component of an operating system, or combination thereof, executing in conjunction with CPU 600 and an operating system such as Microsoft Windows 6, UNIX, Solaris, LINUX, Apple MAC-OS and other systems known to those skilled in the art.

[0108] CPU 600 may be a Xenon or Core processor from Intel of America or an Opteron processor from AMD of America, or may be other processor types that would be recognized by one of ordinary skill in the art. Alternatively, the CPU 600 may be implemented on an FPGA, ASIC, PLD or using discrete logic circuits, as one of ordinary skill in the art would recognize. Further, CPU 600 may be implemented as multiple processors cooperatively working in parallel to perform the instructions of the inventive processes described above.

[0109] The computing device, mobile computing device, or server in FIG. 6 also includes a network controller 606, such as an Intel Ethernet PRO network interface card from Intel Corporation of America, for interfacing with network 6X. As can be appreciated, the network 628 can be a public network, such as the Internet, or a private network such as an LAN or WAN network, or any combination thereof and can also include PSTN or ISDN sub-networks. The network 628 can also be wired, such as an Ethernet network, or can be wireless such as a cellular network including EDGE, 3G and 4G wireless cellular systems. The wireless network can also be Wi-Fi, Bluetooth, or any other wireless form of communication that is known.

[0110] The computing device, mobile computing device, or server further includes a display controller 608, such as a NVIDIA GeForce GTX or Quadro graphics adaptor from NVIDIA Corporation of America for interfacing with display 610, such as a Hewlett Packard

HPL2445w LCD monitor. A general purpose I/O interface 612 interfaces with a keyboard and/or mouse 614 as well as a touch screen panel 616 on or separate from display 610. General purpose I/O interface also connects to a variety of peripherals 618 including printers and scanners, such as an OfficeJet or DeskJet from Hewlett Packard.

[0111] A sound controller 620 is also provided in the computing device, mobile computing device, or server, such as Sound Blaster X-Fi Titanium from Creative, to interface with speakers/microphone 622 thereby providing sounds and/or music.

[0112] The general purpose storage controller 624 connects the storage medium disk 604 with communication bus 626, which may be an ISA, EISA, VESA, PCI, or similar, for interconnecting all of the components of the computing device, mobile computing device, or server. A description of the general features and functionality of the display 610, keyboard and/or mouse 614, as well as the display controller 608, storage controller 624, network controller 606, sound controller 620, and general purpose I/O interface 612 is omitted herein for brevity as these features are known.

[0113] One or more processors can be utilized to implement various functions and/or algorithms described herein, unless explicitly stated otherwise. Additionally, any functions and/or algorithms described herein, unless explicitly stated otherwise, can be performed upon one or more virtual processors, for example on one or more physical computing systems such as a computer farm or a cloud drive.

[0114] Reference has been made to flowchart illustrations and block diagrams of methods, systems and computer program products according to implementations of this disclosure. Aspects thereof are implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other

programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0115] These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means which implement the function/act specified in the flowchart and/or block diagram block or blocks.

[0116] The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0117] Moreover, the present disclosure is not limited to the specific circuit elements described herein, nor is the present disclosure limited to the specific sizing and classification of these elements. For example, the skilled artisan will appreciate that the circuitry described herein may be adapted based on changes on battery sizing and chemistry, or based on the requirements of the intended back-up load to be powered.

[0118] The functions and features described herein may also be executed by various distributed components of a system. For example, one or more processors may execute these system functions, where the processors are distributed across multiple components communicating in a network. The distributed components may include one or more client and server machines, which may share processing, as shown on Fig. 8, in addition to various human interface and communication devices (e.g., display monitors, smart phones, tablets, personal digital assistants (PDAs)). The network may be a private network, such as a LAN or

WAN, or may be a public network, such as the Internet. Input to the system may be received via direct user input and received remotely either in real-time or as a batch process. Additionally, some implementations may be performed on modules or hardware not identical to those described. Accordingly, other implementations are within the scope that may be claimed.

[0119] In some implementations, as illustrated in FIG. 7, the innovations described herein may interface with a cloud computing environment 730, such as Google Cloud Platform™ to perform at least portions of methods or algorithms detailed above. The processes associated with the methods described herein can be executed on a computation processor, such as the Google Compute Engine by data center 734. The data center 734, for example, can also include an application processor, such as the Google App Engine, that can be used as the interface with the systems described herein to receive data and output corresponding information. The cloud computing environment 730 may also include one or more databases 738 or other data storage, such as cloud storage and a query database. In some implementations, the cloud storage database 738, such as the Google Cloud Storage, may store processed and unprocessed data supplied by systems described herein.

[0120] The systems described herein may communicate with the cloud computing environment 730 through a secure gateway 732. In some implementations, the secure gateway 732 includes a database querying interface, such as the Google BigQuery platform.

[0121] The cloud computing environment 102 may include a provisioning tool 740 for resource management. The provisioning tool 740 may be connected to the computing devices of a data center 734 to facilitate the provision of computing resources of the data center 734. The provisioning tool 740 may receive a request for a computing resource via the secure gateway 732 or a cloud controller 736. The provisioning tool 740 may facilitate a connection to a particular computing device of the data center 734.

[0122] A network 702 represents one or more networks, such as the Internet, connecting the cloud environment 730 to a number of client devices such as, in some examples, a cellular telephone 710, a tablet computer 712, a mobile computing device 714, and a desktop computing device 716. The network 702 can also communicate via wireless networks using a variety of mobile network services 720 such as Wi-Fi, Bluetooth, cellular networks including EDGE, 3G and 4G wireless cellular systems, or any other wireless form of communication that is known. In some embodiments, the network 702 is agnostic to local interfaces and networks associated with the client devices to allow for integration of the local interfaces and networks configured to perform the processes described herein.

[0123] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the present disclosures. Indeed, the novel methods, apparatuses and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods, apparatuses and systems described herein can be made without departing from the spirit of the present disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the present disclosures.

Electronic Patent Application Fee Transmittal

Application Number:	16868113
Filing Date:	06-May-2020
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Filer:	Natalie J. Grace/Anthony Gorney
Attorney Docket Number:	474139US03

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt	
EFS ID:	44097931
Application Number:	16868113
International Application Number:	
Confirmation Number:	5664
Title of Invention:	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS
First Named Inventor/Applicant Name:	Takeshi Okazaki
Customer Number:	146018
Filer:	Natalie J. Grace/Anthony Gorney
Filer Authorized By:	Natalie J. Grace
Attorney Docket Number:	474139US03
Receipt Date:	22-OCT-2021
Filing Date:	06-MAY-2020
Time Stamp:	14:05:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20210LE06282283
Deposit Account	601484
Authorized User	Anthony Gorney
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.20 (Post Issuance fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	2021-10-22_Aon_474139US03_IssueFeeTransmittal.pdf	106235 521064d890b132a1e26b11e41294c93e9203a4f5	no	1
Warnings:					
Information:					
2		2021-10-22_Aon_474139US03_312_Amendment.pdf	310396 7e40c5bef30fe8d869d32f9dd494348cfc21e150	yes	10

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment after Notice of Allowance (Rule 312)	1	1
Specification	2	2
Claims	3	8
Applicant Arguments/Remarks Made in an Amendment	9	10

Warnings:					
Information:					
3	Specification	474139US03_Sub_Specification-MarkedUp.pdf	1427437 7c877d3102581932d298e699705946082235ce6	no	44
Warnings:					
Information:					
4	Specification	474139US03_Sub_Specification-Clean.pdf	1417117 dcc1d0adfdf5d0d1dfde8fdfa81c1d4d1c37308e	no	44
Warnings:					
Information:					

5	Fee Worksheet (SB06)	fee-info.pdf	37977 ba9c24d82f3215b89e9261b10694be8df9ca5d6d	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	3299162	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

146018 7590 10/01/2021
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	05/06/2020	Takeshi Okazaki	474139US03	5664

TITLE OF INVENTION: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/03/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, TIEN C	3694	382-224000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Gardella Grace P.A.
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Aon Benfield Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Chicago, IL

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 601484

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Natalie J. Grace/ Date October 22, 2021

Typed or printed name Natalie J. Grace Registration No. 65803

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Response to Rule 312 Communication	Application No.	Applicant(s)	
	16/868,113	Okazaki, Takeshi	
	Examiner	Art Unit	AIA (FITF) Status
	TIEN C NGUYEN	3694	Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☑ The amendment filed on 22 October 2021 under 37 CFR 1.312 has been considered, and has been:

a) ☐ entered.

b) ☑ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.

Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

/TIEN C NGUYEN/
Primary Examiner, Art Unit 3694

OK to enter After Notice of Allowance.
/tn/
10/28/2021

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	
AON BENFIELD INC.	EXAMINER: TIEN C. NGUYEN
APPLICATION NO.: 16/868,113	GROUP ART UNIT: 3694
FILED: MAY 6, 2020	DOCKET NO.: 474139US03
FOR: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

AMENDMENT AFTER ALLOWANCE UNDER 37 CFR § 1.312

MAIL STOP ISSUE FEE
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Notice of Allowance dated October 1, 2021, please amend the above-identified application as follows.

Applicant does not believe that any fees are due at this time. If, however, any fees are required, including fees for extensions of time, then the Commissioner is authorized to charge such fees to Gardella Grace P.A. deposit account number 601484, referencing docket number 474139US03.

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims begin on page 3 of this paper.

Remarks begin on page 9 of this paper.

OK to enter After Notice of Allowance.
/tn/
10/28/2021

AMENDMENTS TO THE SPECIFICATION

Please amend the Specification as follows:

In accordance with 37 CFR §§ 1.121(b)(3), and 1.125, please amend paragraphs **[0002]**, **[0045]**, **[0048]**, **[0053]**, **[0059]**, **[0068]**, **[0083]**, **[0086]**, **[0087]** and **[00101]** of the Specification as indicated in the attached marked-up version of the substitute specification. An accompanying clean version of the specification, incorporating changes of the marked-up version of the substitute specification, is also attached herewith. The substitute specification includes no new matter.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/868,113	12/07/2021	11195058	474139US03	5664

146018 7590 11/17/2021

Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Aon Benfield Inc., Chicago, IL;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PTO/AIA/80 (07-17)
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 51886

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 51886

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Aon Re, Inc.
200 East Randolph Street, Chicago, Illinois 60601

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature Kevin R Traetow	Date June 18 2024
Name Kevin R. Traetow	Telephone 952-886-8164
Title Co-President	

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0035. Public burden for this form is estimated to average 18 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.** If filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to: 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law; 2) a Federal, state, local, or international agency, in response to its request; 3) a contractor of the USPTO having need for the information in order to perform a contract; 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record; 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record; 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations; 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals; 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)); 9) the Office of Personnel Management (OPM) for personnel research purposes; and 9) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Additional Uses

Additional USPTO uses of the information in this record may include disclosure to: 1) the International Bureau of the World Intellectual Property Organization, if the record is related to an international application filed under the Patent Cooperation Treaty; 2) the public i) after publication of the application pursuant to 35 U.S.C. 122(b), ii) after issuance of a patent pursuant to 35 U.S.C. 151, iii) if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections, or an issued patent, or iv) without publication of the application or patent under the specific circumstances provided for by 37 CFR 1.14(a)(1)(v)-(vii); and/or 3) the National Archives and Records Administration, for inspection of records.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Aon Re, Inc.

Application No./Patent No.: 11,195,058 Filed/Issue Date: December 7, 2021

Titled: PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH IMAGERY ANALYSIS

Aon Re, Inc., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Takeshi Okazaki To: Aon Benfield Inc.

The document was recorded in the United States Patent and Trademark Office at
Reel 050623, Frame 0112, or for which a copy thereof is attached.

2. From: Aon Benfield Inc. To: Aon Re, Inc.

The document was recorded in the United States Patent and Trademark Office at
Reel 068292, Frame 0838, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Natalie J. Grace/	September 19, 2024
Signature	Date
Natalie J. Grace	65,803
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474139US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Takeshi		Okazaki	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Tokyo	Country of Residence	JP

Mailing Address of Inventor:

Address 1	Capitol Tower 11F, 2-10-3		
Address 2	Nagatacho, Chiyoda-ku		
City	Tokyo	State/Province	
Postal Code	100-0014	Country	JP

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	~~146018~~ 51886		
Email Address	~~info@gardellagrace.com~~ docketing@finchmaloney.com	Add Email	Remove Email

Application Information:

Title of the Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS		
Attorney Docket Number	~~474139US03~~ AON00005USC2	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	15	Suggested Figure for Publication (if any)	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474139US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	~~146018~~ 51886		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16733888	2020-01-03

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474139US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16733888	Continuation in part of	15714376	2017-09-25	10529029	2020-01-07

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
15714376	Claims benefit of provisional	62398665	2016-09-23

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474139US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474130US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	~~Aon Benfield Inc.~~ Aon Re, Inc.

Mailing Address Information For Applicant:

Address 1	200 E. Randolph Street		
Address 2			
City	Chicago	**State/Province**	IL
Country	US	Postal Code	60601
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (02-18)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474139US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	~~Aon Benfield Inc.~~ Aon Re, Inc.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	200 E. Randolph Street		
Address 2			
City	Chicago	**State/Province**	IL
Country	US	Postal Code	60601
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Natalie J. Grace/			Date (YYYY-MM-DD)	2024-09-19
First Name	Natalie	Last Name	Grace	Registration Number	65,803

Additional Signature may be generated within this form by selecting the Add button.

PTO/AIA/14 (02-18)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~474130US03~~ AON00005USC2
	Application Number	16/868113
Title of Invention	PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/868,113	**09/19/2024 03:06:04 PM Z ET**	**474139US03**

Title of Invention

PLATFORM, SYSTEMS, AND METHODS FOR IDENTIFYING PROPERTY CHARACTERISTICS AND PROPERTY FEATURE CONDITIONS THROUGH AERIAL IMAGERY ANALYSIS

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	11195058
CONFIRMATION #	5664	FILED BY	JILLIAN CAREY
PATENT CENTER #	67240799	FILING DATE	05/06/2020
CUSTOMER #	146018	FIRST NAMED INVENTOR	Takeshi Okazaki
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Natalie Grace

Documents

TOTAL DOCUMENTS: 3

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
AON00005USC2 - Executed POA- AIA80.pdf	2	Power of Attorney	125 KB
AON00005USC2 - Statement of Ownership.pdf	3	Assignee showing of ownership per 37 CFR 3.73	127 KB

Warning: The attached file contains comments or annotations. Comments are not recommended and may cause processing problems with the document.

AON00005USC2 - SADS - 3.pdf	8	Application Data Sheet	2332 KB

Warning: This is not a USPTO supplied ADS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
AON00005USC2 - Executed POA- AIA80.pdf	AA4ABC75713B2C75CCAD8AC0DC39C5255E03A4B65E4669E E4958C50B785BDFEF490F0F1453DC6ABC04890055DCED783 DDC4671E95E3BC8AFB9CD09B0AB8A2D92
AON00005USC2 - Statement of Ownership.pdf	F80CB3772B082F51B2BE626C2823FAE699C2701B2ADCAF382 C496B0220D54C1F49D99413F17BE42FE6B250798E31967CA8 366CAFD0E7FB1A82C0013E4D6A4142
AON00005USC2 - SADS - 3.pdf	18761CDD81FB0586D020584FE0C19EC5B52A289240760EC14 1EF429903B1F1C83F2E99D3D9A1DDFE427FFF453919C38548 95EBBD4B7D8CE5224659DE875662DC

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/868,113	05/06/2020	Takeshi Okazaki	474139US03

CONFIRMATION NO. 5664

146018
Gardella Grace P.A.
80 M Street SE, 1st Floor
Washington, DC 20003

POWER OF ATTORNEY NOTICE

OC000000078405759

Date Mailed: 09/26/2024

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/19/2024.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dtdinh/

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/868,113	05/06/2020	Takeshi Okazaki	AON00005USC2

CONFIRMATION NO. 5664

51886
Finch & Maloney PLLC
50 Commercial St.
Suite 300
Manchester, NH 03101

POA ACCEPTANCE LETTER

OC000000078406155

Date Mailed: 09/26/2024

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/19/2024.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dtdinh/