

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. and
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioners,

v.

SNAPAID, LTD.
Patent Owner

U.S. PATENT NO. 10,659,682

Case IPR2025-TBD

**PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 10,659,682**

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LIST OF EXHIBITS¹

Exhibit No.	Description
1001	U.S. Patent No. 10,944,682
1002	<i>Curriculum Vitae</i> of Dan Schonfeld
1003	Declaration of Dan Schonfeld in support of <i>Inter Partes</i> Review
1004	U.S. Patent No. 8,508,622 (“Anon”)
1005	U.S. Pat. App. Pub. No. 2010/0149361 (“Takeuchi”)
1006	U.S. Pat. App. Pub. No. 2009/0296989 (“Ramesh”)
1007	U.S. Pat. App. Pub. 2010/0246939A1 (“Aisaka”)
1008	U.S. Pat. App. Pub. No. 2008/0013851 (“Ishiwata”)
1009	Liu et al., “Image Quality Assessment Using Multi-Method Fusion” IEEE 2012
1010	U.S. Pat. App. Pub. No. 2011/0222724 (“Yang”)
1011	U.S. Patent No. 8,009,198 (“Alhadeff”)
1012	U.S. Patent No. 8,682,097 (“Steinberg”)
1013	U.S. Pat. App. Pub. No. 2012/0201427 (“Jasinski”)
1014	U.S. Pat. App. Pub. No. 2002/0110286 (“Cheatle”)
1015	U.S. Pat. App. Pub. No. 2012/0177352, (“Pillman”)
1016	File History of U.S. Patent No. 10,944,682
1017	Che-Hua Yeh et al., “Personalized Photograph Ranking and Selection System,” 2010 (“Yeh”)
1018	Cavalcanti, et al., “A Survey on Automatic Techniques for Enhancement and Analysis of Digital Photography,” 2013 (“Cavalcanti”)

¹ Unless otherwise specified, citations are to the original page, column, and line numbers in exhibits, and all emphasis is added unless otherwise noted.

I. INTRODUCTION

Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, “Petitioner” or “Samsung”) respectfully request *inter partes* review of claims 1-20 (“Challenged Claims”) of U.S. Patent No. 10,659,682 (“the ’682 Patent”).

II. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED

Petitioner requests cancellation of the Challenged Claims as unpatentable under 35 U.S.C. §103.

A. Prior Art Patents and Printed Publications

Petitioner’s challenge is based on the following prior art references, which predate the earliest claimed priority date to which the ’682 Patent is entitled:

1. U.S. Patent No. 8,508,622 (“Anon”) (EX1004) was filed on January 18, 2011 and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the ’682 Patent is entitled to its earliest claimed priority date, pre-AIA 35 U.S.C. §102(e).

2. U.S. Pat. App. Pub. No. 2010/0149361 (“Takeuchi”) (EX1005) published June 17, 2010, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the ’682 Patent is entitled to its earliest claimed priority date, pre-AIA 35 U.S.C. §102(b).

3. U.S. Pat. App. Pub. 2009/0296989 (“Ramesh”) (EX1006) published December 3, 2009, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the ’682 Patent is entitled to its earliest claimed priority date, pre-AIA 35 U.S.C. §102(b).

4. U.S. Pat. App. Pub. 2010/0246939A1 (“Aisaka”) (EX1007) published September 30, 2010, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the ’682 Patent is entitled to its earliest claimed priority date, at least pre-AIA 35 U.S.C. §102(b).

5. U.S. Pat. App. Pub. 2008/0013851A1 (“Ishiwata”) (EX1008) published January 7, 2008, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the ’682 Patent is entitled to its earliest claimed priority date, at least pre-AIA 35 U.S.C. §102(b).

6. Liu et al., “Image Quality Assessment Using Multi-Method Fusion” IEEE 2012 (EX1009) (“Liu”) was published on March 11, 2013. As discussed in Section III.B, below, the ’682 Patent is not entitled to the priority date of either of its provisional applications, and therefore, Liu is prior art under at least 35 U.S.C §102(a)(1).

7. U.S. Pat. App. Pub. 2011/0222724A1 (“Yang”) (EX1010) published September 15, 2011, and is prior art under at least 35 U.S.C §§102(a)(1) and

102(a)(2), and, to the extent the '682 Patent is entitled to its earliest claimed priority date, at least pre-AIA 35 U.S.C. §102(b).

8. U.S. Patent No. 8,009,198 (“Alhadeff”) (EX1011) issued on August 30, 2011, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the '682 Patent is entitled to its earliest claimed priority date, pre-AIA 35 U.S.C. §102(b).

9. U.S. Patent No. 8,682,097 (“Steinberg”) (EX1012) was filed on June 16, 2008 and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the '682 Patent is entitled to its earliest claimed priority date, pre-AIA 35 U.S.C. §102(e).

10. U.S. Pat. App. Pub. No. 2012/0201427 (“Jasinski”) (EX1013) was filed February 4, 2011, published August 9, 2012, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and to the extent the '682 Patent is entitled to its earliest claimed priority date, at least pre-AIA 35 U.S.C. §102(a) and (e).

11. U.S. Pat. App. Pub. No. 2002/0110286A1 (“Cheatle”) (EX1014) was filed on January 9, 2002, published August 15, 2002, and is prior art under at least 35 U.S.C §§102(a)(1) and 102(a)(2), and, to the extent the '682 Patent is entitled to its earliest claimed priority date, pre-AIA 35 U.S.C. §102(b).

B. Relief Requested

The grounds of the challenge are set forth below and supported by the declaration of Dr. Dan Schonfeld.

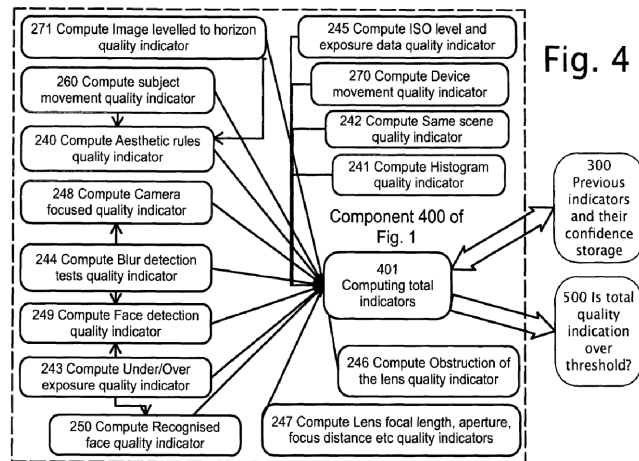
Ground	Claims	Proposed Statutory Rejection
1A	1, 2, 5-8, 11, 14-16	Anon, Takeuchi, and Jasinski
1B	17, 19, 20	Anon, Takeuchi, Jasinski, and Aisaka
1C	3	Anon, Takeuchi, Jasinski and Alhadeif
1D	4, 9	Anon, Takuechi, Jasinski and Ramesh
1E	10	Anon, Takeuchi, Jasinski and Steinberg
1F	12	Anon, Takuechi, Jasinski and Liu
1G	13	Anon, Takuechi, Jasinski and Cheadle
1H	14, 15	Anon, Takuechi, Jasinski and Yang
1I	18	Anon, Takeuchi, Jasinski, Aisaka, and Ishiwata
1J	19, 20	Anon, Takeuchi, Jasinski, Aisaka, and Yang

III. THE '682 PATENT

A. Specification

The '682 Patent, titled “Real Time Assessment of Picture Quality,” was filed as U.S. Patent Application No. 15/992,217 on May 30, 2018. The '682 Patent describes a computerized method for computing the photo quality of a captured image in a device image acquisition system. EX1001, Abstract. Multiple sensors

(e.g., accelerometers, lens modules) are used to determine a plurality of quality indicators (QIs) for the images. *Id.*, 2:14-48. The quality of captured images is evaluated by combining various quality indicators (QIs), as shown below in Figure 4.



The system provides real-time suggestions to users for improving photo quality based on the quality indicators. *Id.*, 3:24-28.

The '682 Patent admits the “[p]rior art has used certain independent quality indicators” and “quantif[ed] the quality by means of a total quality indicator.” EX1001, 2:37-57. The '682 Patent purports to distinguish the prior art by asserting that: “the weight of one indicator will take into account data from other quality indicator/s.” *Id.*, 2:58-62. But that feature is not found in the majority of Challenged Claims, and, regardless, it was known in the prior art. *See* §VI.A.2, below.

B. Priority Date

The '682 Patent claims priority to Provisional Application No. 61/717,216, filed on October 23, 2012, and Provisional Application No. 61/759,643, filed February 1, 2013. Neither provisional provides support for all the limitations of any Challenged Claim. *Studiengesellschaft Kohle, M.B.H. v. Shell Oil Co.*, 112 F.3d 1561, 1564 (Fed. Cir. 1997) (“35 U.S.C. § 120 requires an applicant to meet the disclosure requirement of § 112, ¶1 in a single parent application in order to obtain an earlier filing date for individual claims.”). For example, neither provisional discloses “obtaining a third value (QI3) associated with motion of at least one of said objects” in claim 1 nor “analyzing the captured image via deep learning algorithms for detecting or recognizing one or more objects in, or one or more characteristics of image or at least one of object characteristics to obtain a third value (QI3) associated with the analysis” as required by the only other independent claim, claim 17. Therefore, the '682 Patent is not entitled to either the October 23, 2012, or February 1, 2013, priority date. *See* 35 U.S.C. § 119(e), 37 CFR § 1.78(a)(3)-(4); *see also Droplets, Inc. v. E*TRADE Bank*, 887 F.3d 1309, 1316 (Fed. Cir. 2018).

C. Prosecution History

The '217 application underwent substantive examination by the USPTO. The examiner issued a non-final Office Action dated July 29, 2019, in which the original 21 claims were rejected under pre-AIA 35 U.S.C. §102 and §103, applying U.S.

patent application publication 2012/0177352 to Pillman et al. (“Pillman”), EX1015. Pillman was central to the examiner’s rejections, cited for teaching a camera device with features such as motion detection, automatic photo-capturing, exposure adjustment, and selection of photographs based on motion blur and brightness data. EX1016, 96-101.

In response to the Office Action, Applicant filed an amendment dated December 25, 2019 cancelling claims 1-20 and introducing new claims 21-40, shifting the focus from device claims to method claims.² In a Notice of Allowance dated January 14, 2020, claims 21-40 were allowed. The Examiner quoted independent claims 21 and 37 in the statement of reasons for allowance and indicated that “[t]he prior art does not teach” the quoted claim language. However, the Examiner did not have the benefit of Anon and Takeuchi, among other closely related prior art applied in the Grounds below. Claims 21-40 were renumbered 1-20, respectively in the ’682 patent.

² Although the application presented 21 original claims for examination, Applicant only cancelled claims 1-20 and presented new claims 21-36 for examination. No explanation was provided whether original claim 21 was cancelled or otherwise amended.

D. Person of Ordinary Skill in the Art

As Dr. Schonfeld explains in his declaration, a POSA at the time of the '682 Patent would have had at least a bachelor's degree in electrical engineering, computer science, or a related field, and at least two years of experience with image processing and analysis. Individuals with different education and additional experience could still be of ordinary skill in the art if that additional experience compensates for a deficit in their education and experience. EX1003, ¶¶53-55.

IV. CLAIM CONSTRUCTION

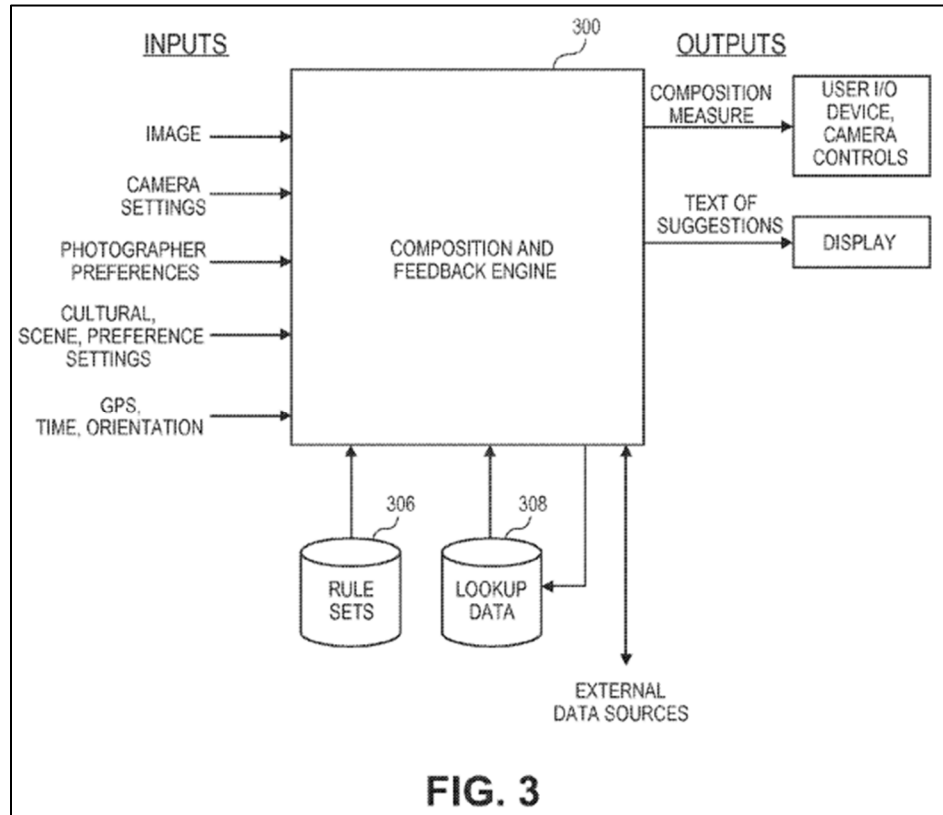
Claims in an IPR are construed under *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). For purposes of this proceeding only, terms in the Challenged Claims need not be construed. If PO raises claim construction arguments, Petitioner reserves the right to respond.

V. OVERVIEW OF THE PRIOR ART

A. Anon

Anon discloses “[a]n image capturing device” that “determine[s] a plurality of image-based characteristics for a proposed image,” including “a likely quality of a composition and/or recommendations for improvement usable while the image or video is being taken.” EX1004, Abstract, 2:64–3:1. Anon “compute[s] a composition measure for the proposed image” from the plurality of image-based characteristics, which is used to “provide suggestions for altering at least one

characteristic of the proposed image.” EX1004, 1:59-2:8. Anon explains that thereby “the photographer is provided with real time feedback as to composition and recommendations, or can be provided with such feedback after the fact.” *Id.*, 3:22–26. Anon’s system is illustrated below:



The composition and feedback engine (“CFE”) performs its evaluation and computation of a composition measure using a “weighted, combination of parameters.” *Id.*, 8:32-35. Anon’s CFE can make use of inputs from the image capturing device, such as the image itself, the device settings, and metadata, combine it with rule sets 306 and lookup data 308, and output recommendations to improve image quality.

B. Takeuchi

Takeuchi relates to an “image evaluation apparatus and camera which are capable of evaluating an image which is comprehensively good.” EX1005, Abstract, ¶[0006]. Like Anon, Takeuchi’s system provides a comprehensive evaluation of image quality, including, for example, explicit detection and quantification of overexposure and underexposure, and offers feedback or correction suggestions to the user. *See e.g.*, EX1005, ¶¶[0147], [0290]. Takeuchi also teaches using a “total evaluation result” for an image using a weighted combination of different quality evaluation methods. *Id.*, ¶[0269].

C. Aisaka

Aisaka discloses an image processing apparatus that evaluates and selects images based on the sharpness and acceptability of the subject, utilizing a subject extraction process that combines multiple feature maps—such as luminance, color, edge, face, and motion information—into a subject map through weighted addition. The apparatus employs deep learning, specifically “neural-network-based learning,” to determine the optimal weights for generating the subject map, thereby enabling more reliable subject detection across diverse images. As described, “the weight being used to generate a subject map for specifying a region of a subject on an image” is learned by “extracting a feature value of a feature of the region of the subject from a learning image that includes the subject and that is used for the

learning, and generating an information map representing the feature value in each region of the learning image.” EX1007, ¶¶[0014], [0020].

The process involves “performing weighted addition of, using the weight, the plurality of information maps representing the feature value of the feature, which are different from each other,” and “calculating an amount of change by which the weight is to be changed using the subject map and an image label that is determined in advance and that represents the region of the subject in the learning image; and updating means for adding the amount of change to the weight and updating the weight.” *Id.*, ¶¶[0014], [0021], [0022].

VI. SPECIFIC GROUNDS FOR PETITION UNDER 37 C.F.R. § 42.104(B)

A. Ground 1A: Claims 1, 2, 5-8, 11, and 14-16 are Obvious in View of Anon, Takeuchi, and Jasinski

1. Independent Claim 1

i. [1.pre.]

To the extent that the preamble is limiting, Anon discloses a method for estimating image quality by analyzing multiple image-based characteristics from a plurality of images, computing a composition measure—quality measure—and providing real-time suggestions to the user. *See* EX1004, 2:9-14, 2:16-28, 2:33-38, 3:14-26.

Anon describes “[a]n image capturing device includ[ing] an image sensing device, a processor, and a memory.” *Id.*, Abstract, 1:59-2:8. Anon explains that

“light passing through **lens 102** impinges on **CCD 104** to form a digital, electronically readable image” (*Id.*, 5:54-56) and “Camera 100 is equipped with a processor 106 ... and a composition and feedback engine” 108 (5:56-59). A POSA would have understood this to mean that Anon’s device comprises at least one optical lens for focusing received light from a scene and an image sensor (i.e., CCD) coupled to the lens for capturing an image of the scene. EX1003, ¶60.

Anon contemplates that the device is a single, integrated unit, explaining that “[i]n a typical operation, the photographer uses a device that is either a camera ... or a multi-purpose device that includes a camera” and that “[t]he photographer uses a device ... to stage a shot ... and then capturing the image.” EX1004, 3:14-20. A POSA would have understood from this that the camera components are housed within a single enclosure, as is standard for digital cameras and camera-equipped mobile devices. EX1003, ¶61. Anon’s exemplary camera is a digital camera. *See e.g.*, EX1004, Fig. 1, 3:11-14.

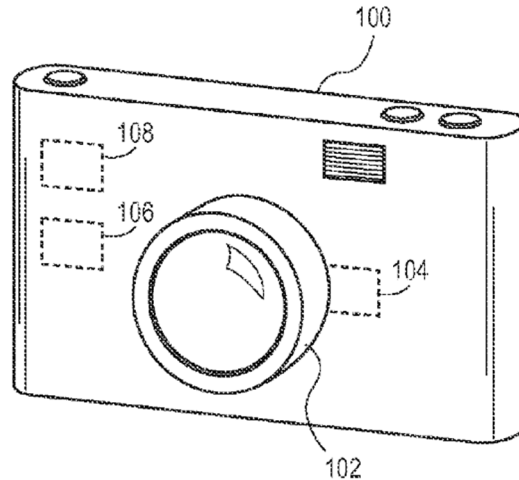


FIG. 1

Anon explains that “[c]amera-specific external inputs might include the camera’s current geographic location, time of day, orientation and the like,” *id.*, 4:24-33, and expressly discloses the use of motion sensors such as an “accelerometer for orientation.” *Id.*, 4:28-31; *see also id.*, 7:4-7.

Anon describes an “engine” which is coupled to the image sensor, CCD 104, and other camera components. *Id.*, 5:62-64. Anon further explains that the engine “could be implemented as ... software elements executed on a **processor**” 6:34-41. Figure 3, below, shows that the engine has various inputs including an image, camera settings, and GPS, time, and orientation inputs, illustrating that as implemented on a processor, e.g., processor 106, that processor is coupled to at least one image sensor and to the digital camera for receiving data therefrom. *Id.*, 3:53-60, cl. 9 (“a processor, coupled to the image sensor”). A POSA would have understood that, to receive an image as an input, the engine comprises a processor

coupled to the image sensor and the camera itself and that it performs a method comprising use of at least one value and weight as outlined below. EX1003, ¶63.

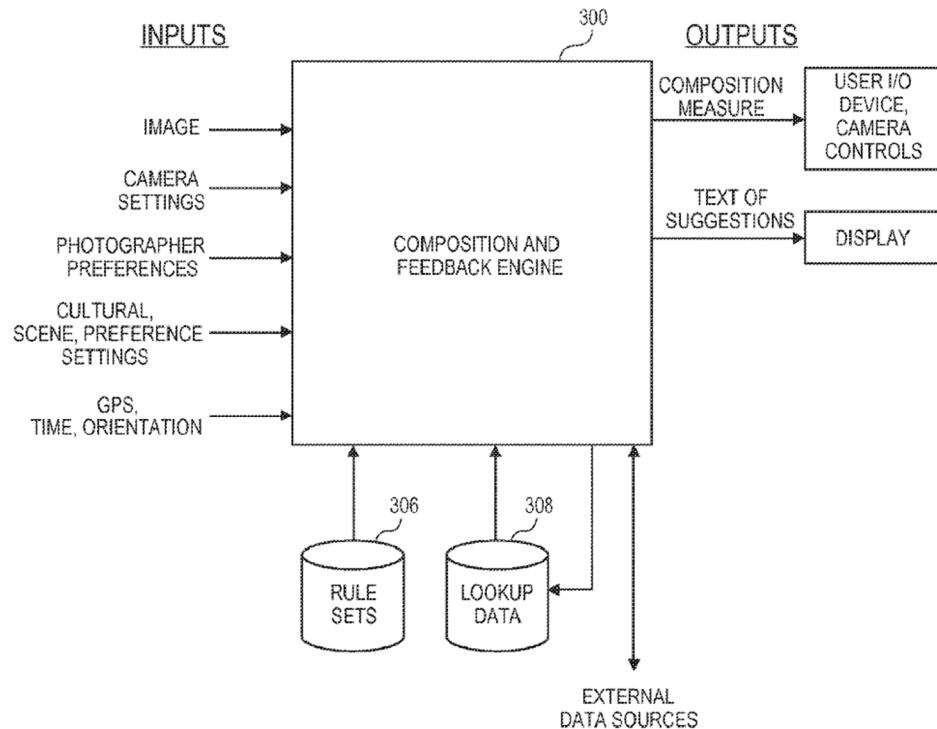


FIG. 3

Anon teaches performing its analysis on at least one image from a “plurality of images.” EX1004, 10:8-20 (“engine might provide a filter to provide suggestions for images from a large body of images that are the more aesthetic images”), 2:45-48, 3:2-10, cl. 10.

ii. [1.a]

Anon discloses that inputs to engine 300 include the image itself, camera settings, photographer preferences, cultural preferences, scene preferences, as well as *location*, time, and *orientation* inputs. *Id.*, Fig. 3, 4:24-34, 7:4-29. Anon explains

that “parameters from the camera may be used to make the judgment, such as the orientation of the camera, where the camera is focused-upon, where within the scene is a face recognized, and the like” (*id.*, 8:28-31) and that “[c]amera-specific external inputs might include the camera's current geographic location, time of day, orientation and the like.” *See id.*, 4:24-26. For example, Anon explains that “the GPS coordinates of the front of Cinderella's Castle™ in Disneyland” may be used to “suggest centering on the castle rather than rule of thirds.” *Id.*, 5:3-7. A POSA would have understood that GPS coordinates constitute a value—e.g., a longitude value and a latitude value. EX1003, ¶65.

Anon also discusses the use of motion sensors “that can provide the engine with inputs as to how the camera is moving.” *Id.* 10:27-46. Anon explains, for example, that “it might be a preference when a subject is moving quickly in a scene to frame more of the scene in front of the subject than in back of the subject and this could be suggested by the engine to a videographer.” *Id.* 10:31-35.

iii. [1.b]

Anon's engine determines a plurality of image-based characteristics for a proposed image, and then “compute[s] a composition measure for the proposed image and the given settings that depends from at least two of the plurality of image-based characteristics of the proposed image.” *See* EX1004, 1:64-67. Anon's engine can take into account both intrinsic image characteristics (such as color, focus,

brightness, and energy) and external characteristics (such as geographic location, time of day, user preferences, and cultural rules), and specifically indicates that “[a] typical [CFE], according to embodiments of the present invention, will consider more than one independent value for some characteristic of an image and provide recommendations that might not be optimal for one characteristic versus another characteristic.” *Id.*, 5:26-30. This would have indicated to a POSA that the system weighs different characteristics, sometimes even trading off optimality in one for a better overall composition measure. EX1003, ¶67.

Anon also expressly discloses assigning a weight to each of the inputs into the engine: “In various embodiments, these parameters may be input into a fuzzy logic set, or the like, and an evaluation, *e.g. weighted, combination of parameters* may be performed by the [CFE].” EX1004, 8:32-35. Thus, a POSA would understand that Anon’s engine “estimat[es] a first weight (c1) associated with the first” value responsive to device motion as claimed. EX1003, ¶68.

To the extent PO contends that “estimating” should be narrowly construed to require a real-time, context-dependent determination of the claimed “weight,” Anon discloses this. Anon expressly teaches that an input into the CFE (e.g., object detection, location, and characteristics) influences the determination of the *weights* attached to other characteristics.

Other inputs might include an indication of where in the image the subject is (e.g., find faces and draw a rectangle around the most prominent face in the image, find an object with a defined border that has a color distribution that is wildly different from the histogram of the rest of the image ...). This input can be used to influence how various characteristics are weighted.

EX1004, 3:53-4:3.

To the extent that Anon is argued to not disclose dynamic estimation of weights, Jasinski remedies any deficiency. For each new set of images, Jasinski describes computing weights for each image region dynamically, based on the current image data. See, e.g., EX1013, ¶¶[0120]-[0122]. These weights are recalculated for every image or sequence, enabling the system to adapt instantly to changing scene conditions. *Id.*, ¶¶[0119]-[0122]. As Jasinski explains: “[t]he weighting coefficients w_i can be determined using any method known in the art. In a preferred embodiment, the weighting coefficients w_i are determined to be representative of the estimated relative importance of the image regions to a user.” *Id.*, ¶[0120]. Jasinski discloses attributes that can be considered in the determination of the relative importance, *id.*, ¶[0120], including:

- Image detail: “image regions 365 with high levels of image detail can be weighted more highly,” *id.*, ¶[0121].

- Scene brightness: “local scene brightness level can also be an indication of the suitability of an image region... the choice of image regions with a higher local brightness level avoids areas where low signal-to-noise can interfere with the calculation of accurate motion velocities,” *id.*, ¶[0114]
- Region position or presence of important features: “image regions 365 in a face zone or an autofocus zone can be weighted more heavily than other image regions 365 because they are more likely to be a main subject,” *id.*, ¶[0120]
- Confidence in the measurement: “the shape of the fitting function 475 can provide an indication of the relative confidence level,” *id.*, ¶[0122]

Jasinski’s dynamic weighting is not limited to motion estimation, but can be more broadly applied to determining image capture settings. *See id.*, ¶[0031].

A POSA would have understood that using dynamic estimation of weights (as taught by Jasinski) as part of a weighted combination of parameters (as taught by Anon) would allow for accounting of changes in the reliability, relevance, and importance of parameters over different regions of the image or over time. EX1003, ¶69. A POSA would have appreciated that dynamically weighting Anon’s composition inputs as taught by Jasinski would have allowed the system to adapt to the most current and relevant scene conditions, thereby providing a more accurate

assessment of quality. Jasinski’s region-based weighting fits naturally with Anon’s teaching that object and region detection influences the weights of other quality characteristics. This combination is the use of a known technique (Jasinski’s dynamic weights) to improve similar devices in the same way. For these reasons, a POSA would have been motivated to combine the complementary teachings of Anon and Jasinski with a reasonable expectation of success. EX1003, ¶69.

iv. [1.c]

Anon determines and assigns values to a range of input characteristics as part of its image quality assessment process. Anon expressly describes inputs—each constituting a value QI2—that are associated with Anon’s digital camera: “[t]he inputs that the engine has to work with ***can include image inputs***, such as the values of the pixels currently being sensed by a charge-coupled diode array of the camera, ***higher-level aspects of the image*** being sensed (e.g., the lack of sharp edges that might indicate a lack of appropriate focus), ***as well as camera settings (F-stop, aperture, shutter speed, film speed, detectors, color optimizers, etc.)***. ***In addition to these intrinsic camera inputs***, the engine might work with camera-specific, photographer-specific, or cultural-specific external inputs.” EX1004, 3:53-62. Anon also explains that “***parameters from the camera*** may be used to make the [quality] judgment, such as the orientation of the camera, ***where the camera is focused upon***.” *Id.* 8:27-31.

v. [1.d]

As discussed in *supra* Section VI.A.1.iii, Anon expressly discloses, or Anon and Jasinski render obvious, estimating and assigning weights to each of Anon's quality-indicator inputs. This "weighted, combination of parameters," EX1004, 8:32-35, would include values associated with the digital camera as set forth in Section VI.A.1.vi *supra*.

vi. [1.e]

Anon explicitly contemplates the detection and recognition of objects within the image. For example, Anon discloses "[o]ther inputs might include an indication of where in the image the subject is.... This input can be used to influence how various characteristics are weighted." EX1004, 3:62–4:3; EX1003, ¶72.

Takeuchi also makes extensive use of object detection as part of its image quality evaluation process. For example, Takeuchi's system detects the position of what is estimated to be a person's face within an image. *See* EX1005, ¶[0115]. This is achieved using a database of pattern images with common facial features and applying pattern matching to the image data. When a region matches a face pattern, it is estimated to be a face, and this information is used for main subject estimation. During the main subject estimation, "the body side microcomputer 21 segments the picture of the target image into a plurality of blocks and compares this image with the face detection region information obtained in Step S103 ... [then] adds a

predetermined number of points to the region where a face image is detected.” *Id.*, ¶[0134]. According to Takeuchi, in the main subject estimation computation, the contribution of each item “may be adjusted by appropriately setting the size of the number of points to be added for each item.” *Id.*, ¶[0136].

Takeuchi computes motion vectors for each block by comparing the current frame to the previous one, typically using pattern matching or similar methods. *Id.*, ¶[0113]. The frequency distribution of these motion vectors is analyzed to detect changes in the scene, such as the movement of a subject. *Id.*, Fig. 4, ¶[0122] and [0166]. The number of peak frequencies in the motion vector distribution is used to infer the number of moving subjects or the degree of movement, and images captured shortly after significant changes in motion are given higher evaluation scores. *Id.*, Fig. 9 and ¶¶[0166]-[0168].

Takeuchi compares the motion vector distribution of a captured image to a model distribution representing a “preferable” image, further using motion as a basis for evaluation. *See id.*, ¶¶[0171]-[0177]. The evaluation can be refined to focus on the motion in the vicinity of the main subject, such as a detected face or central region, and can distinguish between subject motion and camera shake by shifting the origin of the motion vector histogram. *Id.*, ¶¶[0173], [0174].

A POSA would have been motivated to use Takeuchi’s object detection and point system and motion analysis as an input to Anon’s quality estimation engine (QI3) for several reasons:

- Anon explicitly acknowledges that a “good” image is often defined by the subject being in focus, well-exposed, and well-composed. For example, Anon explains that a subject being in focus can constitute a good image. EX1004, 8:19-26. Takeuchi’s system directly quantifies aspects at the detected subject, providing a granular, subject-aware quality score of an image. *See e.g.*, EX1005, ¶[0142].

- Anon’s system is designed to automate the process of evaluating images, and it is explicitly open to using a variety of “image-based characteristics” as inputs to its composition/quality measure. *See* EX1004, 3:53-59. Takeuchi’s point system is a high-level input that encapsulates multiple technical quality factors in a single, objective score.

By leveraging Takeuchi’s object-based scoring, Anon’s system would more efficiently and accurately identify images where the main subject is well-captured, reducing the need for manual review by the user and improving the user experience—an explicit goal of both systems. EX1003, ¶75.

A POSA would have had a reasonable expectation of success in modifying Anon’s system to analyze a captured image for detecting or recognizing one or more

objects and obtaining a third value (QI3) associated with the motion of at least one object, in view of Takeuchi, because Takeuchi provides detailed methods for segmenting images, detecting main subjects (such as faces or regions with distinct color distributions), and evaluating motion vectors within those regions to generate characteristic values reflecting subject movement. *See e.g.*, EX1005, ¶¶[0113]-[0115], [0122]. Integrating Takeuchi's object-based motion analysis into Anon's CFE would have allowed the system to automatically assess not just static compositional features but also the dynamic quality of the main subject—such as whether the subject is in motion or well-captured at a decisive moment—thereby enabling more nuanced and context-aware image evaluation. This would have directly enhanced Anon's goal of reducing user burden in selecting high-quality images and improving the overall user experience by automating the identification of images where the main subject is optimally captured, as both Anon and Takeuchi emphasize comprehensive, automated image assessment to assist users in obtaining better photographic results without extensive manual intervention. EX1003, ¶75.

vii. [1.f]

As discussed above in *supra* Section VI.A.1.iii, Anon expressly discloses, or Anon and Jasinski render obvious, estimating and assigning weights to each of Anon's quality-indicator inputs. Based on the teachings of Anon and Takeuchi discussed in the previous section—*supra* Section VI.A.1.vi—a POSA would have

understood that this “weighted, combination of parameters,” EX1004, 8:32-35, would include assigning a weight to apply to the third value (*e.g.*, the value related to object and object motion). EX1003, ¶76.

viii. [1.g]

Anon teaches recognizing characteristics of a detected object in an image. Specifically, Anon describes that the system can “find faces and draw a rectangle around the most prominent face in the image, find an object with a defined border that has a color distribution that is wildly different from the histogram of the rest of the image, as might be the case when photographing a red and yellow bird with a background of green and brown of the surrounding trees.” EX1004, 3:63–4:3. Furthermore, Anon explains that “parameters from the camera may be used to make the judgment, such as the orientation of the camera, where the camera is focused-upon, where within the scene is a face recognized, and the like,” and that “the classification of the subject is one of a person's face, an animal, a landscape object, a primary object of interest, a building or a landmark.” *Id.*, 8:28-31, cl. 6.

To the extent that Anon does not determine a value associated with recognition of object characteristics, Takeuchi assigns evaluation points or values based on recognized characteristics of a main subject (*i.e.*, the location of the detected object in an image). For example, points are awarded if a face is detected in a region, especially if it is near the center or in a user-specified area. *See* EX1005,

¶¶[0134], [0135]. The evaluation points can be increased if the main subject is large and centrally located. *Id.*, ¶[0164]. Notably, Takeuchi's final image evaluation is a composite value that incorporates motion, focus, color, face recognition, and other detected characteristics of the main subject. *Id.*, ¶¶[0149], [0299].

A POSA would have been motivated to use a value associated with Takeuchi's recognition of object characteristics (QI4) as an input for Anon's image evaluation process because both systems are fundamentally concerned with improving the quality and usefulness of captured images by providing feedback or automated selection based on image content. EX1003, ¶79. Takeuchi's approach demonstrates that recognizing and quantifying specific object characteristics—such as face presence, size, position, and focus—enables a more nuanced and context-aware evaluation of image quality, particularly in scenarios where the main subject's attributes are critical to the perceived value of the photograph (*e.g.*, portraits, group photos, or action shots). *See* EX1005, ¶[0299]. Anon's system, while focused on real-time composition feedback, is designed to analyze multiple image-based characteristics and provide actionable suggestions to the user. *See* EX1004, 6:47-50.

Integrating Takeuchi's object characteristic values would have allowed Anon's system to offer feedback to a user that is directly responsive to the presence and quality of key subjects in the frame, such as alerting the user if a face is out of

focus, poorly positioned, or not optimally exposed. This would have aligned with Anon's stated goal of helping users capture more aesthetically pleasing and contextually appropriate images, and would have been a logical extension of the system's existing capabilities. EX1003, ¶79.

A POSA would have had a reasonable expectation of success in making this modification because both Anon and Takeuchi rely on digital image processing techniques that were well-established and compatible within the field. EX1003, ¶80. Takeuchi's methods for detecting and evaluating object characteristics—such as face detection, color analysis, and focus estimation—are based on standard pattern recognition and image segmentation algorithms, which were routinely implemented in camera firmware and image processing pipelines. *Id.* Anon's system is explicitly designed to accept a variety of image-based inputs and to compute a composite measure of image quality or composition, with the flexibility to incorporate additional rule sets, templates, or characteristic measures. *See* EX1004, 10:47-50.

Furthermore, both Anon and Takeuchi describe the use of learning algorithms, user preference adaptation, and rule-based evaluation, all of which were conducive to incorporating new types of input data without requiring fundamental changes to the system architecture. As such, a POSA would have reasonably expected that combining these approaches would have yielded a more robust and context-sensitive

real-time evaluation process, with predictable and beneficial results for end users. EX1003, ¶80.

ix. [1.h]

As discussed above in *supra* Section VI.A.1.iii, Anon expressly discloses, or Anon and Jasinski render obvious, estimating and assigning weights to each of Anon’s quality-indicator inputs. Based on the teachings of Anon and Takeuchi discussed in the previous section—*supra* Section VI.A.1.viii—a POSA would have understood that this “weighted, combination of parameters,” EX1004, 8:32-35, would include assigning a weight to apply to the forth value (*e.g.*, the value related to object characteristics). EX1003, ¶81.

x. [1.i]

Anon describes a process in which its engine receives a proposed image, determines a plurality of image-based characteristics (such as color, focus, brightness, and compositional elements), and then computes a “composition measure” for the proposed image and the given settings. This composition measure is a value that depends on, among other inputs, at least two image-based characteristics of the proposed image, including aesthetic quality. *See* EX1004, 3:43–4:23. For example, Anon explains that images featuring vivid colors are typically perceived as having higher “energy” compared to those with subdued hues. Additionally, vertical lines in a picture are considered to contribute less energy,

while horizontal lines add more, and diagonal lines impart the greatest sense of energy. In terms of color, shades like red, orange, and yellow are seen as more energetic than colors such as green, blue, or brown. Based on these principles, there may be an ideal energy level for an image, and certain modifications—like zooming in to remove areas with less energetic backgrounds—could be recommended to enhance the overall energy of the photograph. *Id.*, 4:7-16. Thus, in Anon, the composition measure is intended to reflect the aesthetic quality of the image, particularly as it relates to compositional rules and guidelines. Anon explains in mathematical terms that each characteristic of an image is assigned a value, here QI5 as claimed. *Id.*, 5:40-47.

Takeuchi incorporates aesthetic quality as an input by evaluating images based on multiple characteristic amounts, including the position and attributes of the main subject, and by using model images that represent preferable aesthetic standards. *See e.g.*, EX1005, ¶[0226] (“According to the present embodiment, it is possible to highly evaluate an image which suits the user's tastes, in an evaluation of an image”). This approach enables Takeuchi to use aesthetic quality—defined by both models and user preferences—as a dynamic input for comprehensive image evaluation. EX1003, ¶83.

Takeuchi repeatedly refers to the “model frequency distribution of the motion vectors” as a histogram, which a POSA would have known to be a collection of

values representing the occurrence of motion vectors at different frequencies or positions. See EX1003, ¶83; see also e.g., EX1005, Fig. 4, ¶¶[0122], [0177].

To the extent that Anon fails to explicitly teach obtaining a fifth value (QI5) associated with aesthetic quality of an image based on composition, a POSA would have been motivated to modify Anon’s system to obtain the fifth value (QI5) in view of Takeuchi’s teachings, because Takeuchi explicitly describes comprehensive image evaluation methods that go beyond technical parameters to assess overall image quality, including aesthetic considerations. EX1005, ¶¶[0005], [0006], [0296], [0299]. Takeuchi explains that the evaluation apparatus “is possible to comprehensively evaluate the entirety of an image” by analyzing not only technical features such as motion vectors and defocus but also the “position of the main subject” within the scene, thereby enabling the selection of images that are “comprehensively good” and preferable to the user. *Id.* Anon’s system is designed to provide feedback on image composition and quality, and contemplates the use of higher-level image features, such as “where in the image the subject is” and “templates, or samples, wherein the user is provided with example images that have high composition measures.” EX1004, 3:62-66, 2:38-44. Given that Anon’s CFE is configured to incorporate additional evaluative criteria and external rule sets, a POSA would have recognized that integrating Takeuchi’s approach to aesthetic evaluation—by quantifying compositional quality and subject placement—would

have been a natural and predictable enhancement, fully within the capabilities of the existing system. EX1003, ¶84-85.

See §§VI.A.1.vi and viii for the rationale regarding reasonable expectation of success in combining Anon and Takeuchi.

xi. [1.j]

As discussed above in *supra* Section VI.A.1.iii, Anon expressly discloses, or Anon and Jasinski render obvious, estimating and assigning weights to each of Anon’s quality-indicator inputs. Based on the teachings of Anon and Takeuchi discussed in the previous section—*supra* Section VI.A.1.x—a POSA would have understood that this “weighted, combination of parameters,” EX1004, 8:32-35, would include assigning a weight to apply to the fifth value (*e.g.*, the value related to aesthetic quality). EX1003, ¶86.

xii. [1.k]

Anon and Takeuchi when considered in combination would have taught a POSA to calculate a total quality value for an image by combining multiple quality indicators—specifically, device motion (QI1), camera parameters (QI2), object motion (QI3), and aesthetic composition (QI5)—using weighted values. EX1003, ¶87. Anon describes a system that computes a total quality value known as a “composition measure,” where “the composition measure depends from at least two of the plurality of image-based characteristics of the proposed image,” and further

provides that, “[i]n mathematical terms, if each characteristic is an axis in an n-dimensional space...an overall composition measure for the image” is calculated, with the possibility of weighting each characteristic differently. EX1004, Cl. 1, 5:40-44. Anon further indicates that these characteristics can include “focus characteristic, a brightness characteristic, and an energy characteristic,” and that the system can “output an indication of the composition measure to a user” based on these weighted factors. *Id.*, Abstract, Cl. 2.

Takeuchi teaches including a weighted value for object recognition, such as face detection, as part of the total quality value. For example, Takeuchi teaches that “the contribution ratio of each item can be adjusted by appropriately setting the number of points added for each item.” EX1005, ¶[0148]. Anon describes using “an indication of where in the image the subject is...to influence how various characteristics are weighted.” EX1004, 3:62–4:3.

A POSA would have been motivated to combine Anon and Takeuchi to calculate a total quality value for an image by combining that above multiple quality indicators using weighted values because both references teach comprehensive, multi-factor image evaluation systems that are designed to optimize overall image quality by integrating diverse technical and aesthetic criteria. EX1003, ¶88. As discussed above, Anon’s CFE evaluates images based on a plurality of weighted characteristics to generate a rating. *See* §§VI.A.1.iii, VI.A.1.x; EX1004, 3:53-66.

Takeuchi similarly teaches a system that evaluates images by calculating and combining multiple characteristic values—such as motion vectors, defocus, subject position, and compositional features—using adjustable weightings to reflect their relative importance, and further provides mechanisms for learning and adapting these weights based on user preferences or scene type. EX1005, ¶¶[0148], [0253]–[0257]. Given that both systems are structured to aggregate multiple evaluative metrics and allow for flexible weighting, a POSA would have recognized that combining these approaches to produce a single, weighted total quality value would have been a straightforward and predictable enhancement, enabling more robust and user-tailored image assessment. EX1003, ¶88.

See §§VI.A.1.vi and viii for the rationale regarding reasonable expectation of success in combining Anon and Takeuchi.

2. Claim 2

As discussed above with respect to Claim 1, Anon teaches that the estimation of one value—object detection and characteristics—influences the determination of the weights attached to other characteristics. See §§VI.A.1.ii–vi (e.g., c1, c2, or c4) and EX1004, 3:53-4:3 (“*This input can be used to influence how various characteristics are weighted*”). A POSA would understand this disclosure from Anon as teaching that at least one weight is estimated responsive to at least one quality indicator input value, e.g. QI3, QI4. EX1003, ¶90.

3. Claim 5

Anon recognizes that “most cameras can analyze an image and automatically focus the lens, so that the user is freed from having to estimate distances or manually set the focus.” EX1004, 1:42-49. To the extent that Anon does not teach controlling the auto-focus functionality according to, or based on, the second value (QI2) or the total value, Takeuchi’s microcomputer “selects the focus detection point based on the focus detection information computed from the defocus information acquired in a prescribed period,” and “captures and follows the photographed subject, and can obtain information concerning where the subject, in the frame acquired at the current time, is distributed in the planar direction in the picture.” EX1005, ¶¶[0118], [0119]. Takeuchi then “computes the driving amount of the photographic lens...and transmits the same to the lens side microcomputer,” which “controls the lens driving portion...and carries out the focus adjustment of the photographic lens 13 by driving the distance ring.” *Id.*, ¶[0138]. This process is performed as part of an automatic evaluation and correction loop, where the camera can “automatically correct the photographic conditions during photography,” including focus adjustment, “based on ... evaluation results of a plurality of images stored in the buffer.” *Id.*, ¶[0281]. Thus, the auto-focus functionality in Takeuchi is processor-controlled and can be adjusted based on either a camera-associated value or a total image quality value.

A POSA would have been motivated to modify Anon to include the responsive auto-focus feature taught by Takeuchi because integrating auto-focus control based on image quality metrics would have enhanced the overall photographic outcome by ensuring that focus adjustments are directly responsive to real-time evaluations of image quality, as suggested by Takeuchi's processor-controlled system. EX1003, ¶93. Takeuchi demonstrates "processing to automatically correct the photographic conditions" under certain conditions and indicates that those conditions include "focus adjustment." EX1005, ¶[0281]. Given that Anon already provides real-time feedback and suggestions to improve image composition and quality, a POSA would have recognized that incorporating Takeuchi's responsive auto-focus would synergistically improve the system's ability to capture high-quality images. EX1003, ¶93.

See §§VI.A.1.vi and viii regarding reasonable expectation of success in combining Anon and Takeuchi.

4. Claim 6

Anon recognizes that "[s]ome cameras can even detect smiles ... and closed eyes to control when to take a photograph," and "find faces and draw a rectangle around the most prominent face in the image". EX1004, 1:47-49, 3:63-64. Anon teaches the use of face detection and recognition to enhance composition and feedback. *Id.*, 3:63-65. Takeuchi describes detecting faces in images, using face

detection region information for main subject estimation, and allowing user input or weighting to adjust the importance of detected faces. EX1005, ¶[0115]. Takeuchi also discusses assigning scores or points based on the confidence of object detection. *Id.*, ¶[0116].

A POSA would have been motivated to modify Anon to assign scores or points based on the confidence of face detection, as taught by Takeuchi, because incorporating confidence measures enables more accurate and reliable main subject estimation and image evaluation, directly improving the system’s ability to prioritize well-detected faces and reduce the influence of false positives or uncertain detections. *See* EX1003, ¶96; *see also* EX1005, ¶[0116] (“[the] portion with the highest score is the main subject, or the like”). Anon supports integrating various image-based characteristics and user-driven weighting into its composition engine, making it straightforward to incorporate confidence-based scoring for detected faces. Given that Takeuchi demonstrates the effectiveness of using confidence or score-based evaluation for face regions and that Anon’s architecture is designed for extensibility and user customization. EX1003, ¶¶96-97.

See §§VI.A.1.vi and viii regarding reasonable expectation of success in combining Anon and Takeuchi.

5. Claim 7

Anon discusses evaluating composition using a variety of image-based characteristics and external factors, and refers generally to “rules” and “rule sets” for composition. EX1004, 7:15-29. Anon computes a “composition measure” for a proposed image, which “depends from at least two of the plurality of image-based characteristics of the proposed image,” including “energy,” for the reasons discussed in Section VI.A.1.x. *See id.*, 1:63-67, 2:9-15, 4:4-23.

Furthermore, Anon discusses “the appropriate balance between the amount of land, sky and water[.]” *Id.*, 5:7-10. A POSA would have understood that these teachings encompass the evaluation of visual balance, the influence of shapes and lines (including diagonal dominance), and the relative position of salient regions in the image as part of the aesthetic quality assessment. EX1003, ¶¶99-100.

6. Claim 8

A POSA would recognize the claimed “formula” to be the conventional method of combining weighted parameters. EX1003, ¶101. Anon teaches a conventional weighted average: input parameters can be weighted and combined and the overall “composition measure” may be generated using fuzzy logic as described in Section VI.A.1.iii. EX1004, 8:32-35. Further, the resulting “composition measure,” which “provides *rating of the composition of an image* that is a ‘proposed’ image not yet captured,” *id.*, 6:42-45, is a measure “grading the image

quality” as claimed. *See also id.*, 8:16 (“judge a properly composed image”); *see generally id.*, 8:14-35.

7. Claim 11

Anon’s CFE can automatically adjust or suggest changes to camera parameters such as focus, aperture, and exposure in response to determining image quality. EX1004, 2:29–36 (“the image capturing device will ***automatically make the change***”); 1:42-49. “For example, the engine may recommend or directly change the focus point if a subject is detected in a particular area, adjust ISO or aperture in response to external conditions like location or lighting, and optimize settings to improve image quality according to contextual and sensor data before capturing an image.” *See id.*, 8:36-43, 2:29–36, 1:42-49.

Takeuchi also teaches automatically correct[ing] the photographic conditions during photography including “aperture value, shutter speed and the like, focus adjustment, and photographic sensitivity,” which a POSA would have understood includes focus point, ISO, and the aperture. *See* EX1003, ¶105; *see also* EX1005, ¶¶[0281]-[0283]. A POSA would have recognized that this is beneficial because it does not require a user to manually change settings and is thus more convenient for the user. EX1003, ¶105; EX1004, 1:42-49. Consumer cameras have long had automatic adjustment of focus, ISO, and aperture settings, as Anon recognizes. EX1003, ¶105; EX1004, 1:42-49. Thus, to the extent PO argues Anon alone fails to

disclose this limitation, a POSA would have been motivated to include Takeuchi's automatic correction of focus and photographic sensitivity in Anon's camera system with a reasonable expectation of success. EX1003, ¶105.

8. Claim 14

Anon teaches using a neural network, which a POSA would have understood constitutes a deep learning algorithm. See EX1004, 8:47-48 (“This training set might be determined by professional photographers and the process distilled to a set of rules or the coding of a neural network or fuzzy logic set”); EX1003, ¶106. Anon further discloses that its CFE can execute a learning process based on a training set of pre-determined “good” photographs. *Id.*, 8:44-48. Anon's system is described as being able to use training sets to inform the evaluation of new images, which is a typical application of neural networks in pattern recognition and classification tasks. *Id.* Thus, a POSA would have recognized that Anon contemplates the use of a neural network to process multiple quality indicators—such as focus, exposure, composition, and subject recognition—by learning from labeled examples and applying this learned model to new images. EX1003, ¶106.

9. Claim 15

As just discussed, Anon teaches using a neural network. EX1004, 8:32-35. A POSA would have understood that the neural network would be trained to map from a set of input characteristics (features) to a quality measure or rating, which would

then be used as the “composition measure” or total quality value for the image. EX1003, ¶107.

A POSA would have recognized that, in the context of Anon, the neural network is used to combine multiple input features into a single output value representing total image quality. EX1003, ¶107. This was a standard application of neural networks in pattern recognition and regression tasks: the network learns to approximate a function that maps from a set of input features to a target value (in this case, the quality rating or composition measure).

10. Claim 16

Anon focuses on overall image quality and composition feedback but does not specifically disclose a value that is a combination of these claimed camera parameters. Takeuchi, however, discloses estimating values associated with the digital camera that combine exposure, focus, and under or over exposure as part of a comprehensive image evaluation process. Takeuchi evaluates images based on multiple factors, including exposure and focus, and assigns evaluation points or values accordingly. EX1005, ¶¶[0140], [0141]. For example, Takeuchi describes that, “[a]s the evaluation based on the position of the main subject...there are the items of the evaluation of the focus/blurring as below, the evaluation of the white balance, evaluation of the exposure and the like. The body side microcomputer 21

adds points to execute the evaluation for at least one among these items.” *Id.*, ¶[0141].

Furthermore, Takeuchi provides feedback and correction values for exposure and focus, stating: “if there are many regions of overexposure (whiteout), a recommended correction value for exposure correction to the underexposure side is displayed.... in the evaluation of the focus...a suggestion is displayed to fine tune the focus position of the autofocus to approach the front or rear.” *Id.*, ¶¶[0290], [0291]. Thus, Takeuchi discloses estimating a value (such as QI4) that is a combination of digital camera exposure, focus, and under or over exposure.

A POSA would have been motivated to modify Anon to estimate a value associated with the digital camera as a combination of at least one of digital camera exposure, focus, and under or over exposure, as taught by Takeuchi, because it was well recognized that comprehensive image quality assessment and optimization require consideration of multiple interrelated camera parameters. EX1003, ¶111. Takeuchi teaches evaluating images based on a combination of exposure, focus, and the presence of underexposure or overexposure, and demonstrates that these parameters can be automatically analyzed and used to provide feedback or corrections to improve photographic results. EX1005, ¶¶[0281], [0290]. The motivation for such a modification would have arisen from the need to deliver higher quality images and more reliable camera operation, especially in automated or user-

assistive systems, by leveraging the synergy between these parameters—since improper exposure or focus can independently or jointly degrade image quality. EX1003, ¶111.

See §§VI.A.1.vi and viii for the rationale regarding reasonable expectation of success in combining Anon and Takeuchi.

B. Ground 1B: Claims 17, 19, and 20 are Obvious in View of Anon, Takeuchi, Jasinski, and Aisaka

1. Independent Claim 17

i. [17.pre.]

To the extent that the preamble is limiting, Anon discloses a method for estimating image quality of at least one image from a stream of images from a video. Anon explains that, “unless otherwise indicated, what is explained about a photographer using a camera to capture a photograph can equally apply, unless otherwise indicated, to a videographer using a video camera to capture a video sequence....” EX1004, 3:2-10. Anon analyzes multiple image-based characteristics, computing a composition measure, and providing real-time suggestions to the user. *See id.*, 2:9-14, 2:16-28, 2:33-38, 3:14-26. As set forth in *supra* Section VI.A.1.i, Anon discloses this preamble.

ii. [17.a]

Anon discloses this element. §VI.A.1.ii.

iii. [17.b]

For the reasons explained above in §VI.A.1.iii, incorporated herein, this element is disclosed or rendered obvious.

iv. [17.c]

Anon does not expressly disclose obtaining a measurement value indicating whether an image is under or over exposed. Takeuchi, however, determines a value that is a combination of multiple factors, including digital camera exposure, focus, and under- or over-exposure. Takeuchi evaluates exposure, including integrating several factors, for the reasons discussed in §VI.A.10. *See also* EX1005, ¶¶[0084], [0090], [0137]. This evaluation causes Takeuchi's system to adjust the image quality score accordingly by adding or subtracting points. *See id.*, ¶[0147].

In addition to exposure, Takeuchi's evaluation incorporates focus information. The system analyzes whether the main subject is in focus by detecting edge sharpness and comparing the focus position to the estimated location of the main subject. If the main subject is properly focused, additional points are awarded; if the image suffers from front focus, back focus, or general blurring (such as from camera shake), points are deducted. *See id.*, ¶¶[0142]-[0143].

Thus, Takeuchi's approach to image quality evaluation is comprehensive, determining a value that reflects a combination of exposure, focus, and the presence of under- or over-exposed regions. This multi-factor assessment ensures that the

final image quality score accounts for the interplay between these critical photographic parameters. EX1003, ¶118.

Both Anon and Takeuchi are directed to the problem of evaluating and improving the quality of digital images, albeit with different emphases. Takeuchi's system provides a comprehensive evaluation of image quality, including explicit detection and quantification of overexposure and underexposure, and offers feedback or correction suggestions to the user. *See e.g.*, EX1005, ¶¶[0147], [0290]. Anon's system, on the other hand, is focused on real-time feedback regarding image composition and overall quality, using a variety of image-based characteristics (such as color, focus, brightness, and energy) to compute a "composition measure". *See* EX1004,1:59–2:8.

A POSA would have recognized that exposure quality—specifically, the presence of overexposed or underexposed regions—is a fundamental aspect of overall image quality. Poor exposure can result in loss of detail, which directly impacts the aesthetic and technical value of a photograph. EX1003, ¶120. Anon's system is designed to provide feedback and suggestions to improve image quality, and explicitly contemplates using multiple image-based characteristics, including brightness, as part of its composition measure. EX1004, 2:9-15. A POSA would have been motivated to combine Takeuchi's exposure determination with Anon's composition feedback system for the reasons described in §§VI.A.1.vi and viii.

v. [17.d]

As discussed above in *supra* Section VI.A.1.iii, Anon expressly discloses, or Anon and Jasinski render obvious, estimating and assigning weights to each of Anon’s quality-indicator inputs. Based on the teachings of Anon and Takeuchi discussed in the previous section—*supra* Section VI.B.1.iv—a POSA would have understood that this “weighted, combination of parameters,” EX1004, 8:32-35, would include assigning a weight to the combination of digital camera exposure, focus, and under- or over-exposure of Takeuchi in combination with Anon. EX1003, ¶122.

vi. [17.e]

Anon discusses the potential use of neural networks or fuzzy logic for evaluating image aesthetics based on training sets, but does not specifically describe the use of deep learning algorithms for object detection or recognition in the captured image. Takeuchi’s methods are based on pattern matching, statistical analysis, and rule-based or user-driven learning, but Takeuchi does not expressly teach analyzing the captured image via deep learning algorithms. Aisaka, however, discloses an image processing apparatus and method that leverage neural-network-based learning to enhance the detection and evaluation of subjects within captured images. EX1007, ¶[0020].

Aisaka's system is designed to generate a "subject map" that specifies the region of a subject in an input image by extracting and combining multiple feature values, such as luminance, color, edge, face, and motion information. *Id.* Aisaka explains that "[t]he subject extraction unit 21 detects the subject ..., generates a subject map that is information for specifying a region including the subject in the input image, and supplies the subject map to the determination unit 22." *Id.*, ¶[0058]. The apparatus employs a learning process in which "difference weights W_a , information weights W_b , and subject weight W_c used at the time of the generation of a subject map are determined using, for example, neural-network-based learning." *Id.*, ¶[0269]. This learning is performed by comparing the generated subject map to an "image label ... that represents the region of the subject in the learning image," allowing the system to iteratively update the weights and improve subject detection accuracy. *Id.*, ¶[0020].

Aisaka emphasizes that this approach enables "more reliable detection of the subject from an image using this subject map," including even "a general object such as an animal, a plant, or a building." *Id.*, ¶¶[0301], [0267]. Furthermore, the system evaluates image quality using sharpness of the detected subject: "the blur determination unit 51 calculates the blur degree representing the blur extent of the region of the subject on the input image from the input image and the subject map." *Id.*, ¶[0256]. This comprehensive, learning-based approach allows for robust and

adaptable subject detection and evaluation across a wide range of image types. EX1003, ¶126.

Aisaka’s deep learning analysis outputs a value because the system is designed to generate quantitative indicators—specifically, “information maps” and “subject maps”—that numerically represent features or characteristics detected in an image. Aisaka’s process involves extracting feature values from the input image, generating information maps for each feature, and then performing “weighted addition” to produce a subject map, which is used for further evaluation. EX1007, ¶¶[0015], [0268]. Aisaka’s final output is a “score” or “index for evaluating the degree to which the subject appears sharp in the input image.” *Id.*, Abstract, ¶¶[0055]-[0057]. This value is calculated based on the detected features and their learned weights: “The determination unit 22 calculates a score serving as an index for evaluating the input image using the supplied input image and the subject map.” *Id.*, ¶[0065]. Thus, the deep learning analysis is structured to output a value that quantitatively reflects the quality or sharpness of the subject in the image.

A POSA would have been motivated to modify the combination of Anon and Takeuchi to analyze a captured image via deep learning algorithms for object or characteristic recognition because both references emphasize the importance of accurately identifying subjects and evaluating image quality based on subject features. EX1003, ¶129. As discussed above in VI.A.1.iii and VI.A.1.vi, Anon’s

system provides composition feedback by analyzing image-based characteristics and external context, and Takeuchi details methods for estimating subject position and evaluating images using multiple features such as motion vectors, face detection, and color distribution. Integrating deep learning algorithms would have been a logical improvement, as these algorithms were well-known for their performance in object detection and feature extraction, enabling more robust and adaptable subject recognition and image evaluation—capabilities directly aligned with the goals of both Anon and Takeuchi. EX1003, ¶129.

A POSA would have had a reasonable expectation of success in making this modification because deep learning-based object recognition was already established in the art as an effective and reliable technique for analyzing image content, and both Anon and Takeuchi provide modular, feature-based frameworks readily adaptable to incorporate such advanced algorithms. EX1003, ¶129.

vii. [17.f]

Anon, Takeuchi, and Aisaka would have collectively taught a POSA to calculate a total quality value of an image by integrating multiple quality indicators (QIs), each reflecting an aspect of image quality. EX1003, ¶130. Anon discusses the use of motion sensors “that can provide the engine with inputs as to how the camera is moving.” EX1004, 10:27-46. Anon and Takeuchi both teach calculating a total quality value using multiple quality indicators reflecting aspects of image

quality for the reasons discussed in §VI.A.1.xii. Aisaka, meanwhile, teaches the use of deep learning algorithms to analyze image content, stating that “a subject map is generated through the extraction of pieces of information ... from an input image,” and that these are combined using neural-network-based learning to detect and score objects or characteristics in the image. EX1007, ¶¶[0268]-[0270]. Thus, the combination of these references teaches calculating a total quality value based on QI1 (device motion), QI2 (exposure/focus/over-under exposure), and QI3 (deep learning-based object/characteristic recognition).

The combination would have used weights for QI1, QI2, and QI3 to reflect the relative importance, reliability, or context-specific relevance of each indicator in the overall quality assessment. Anon teaches a weighted combination of parameters and a neural network as described in §§VI.A.1.ii and VI.A.8. EX1004, 8:15-35. Aisaka’s deep learning approach also uses weights to produce a subject map in the process detailed in §VI.B.1.vi. EX1007, ¶[0268]. These teachings show that weighting enables flexibility and accurately combining QI1, QI2, and QI3 into a single, context-sensitive total quality value, allowing the system to adapt to different photographic scenarios and user preferences.

In computing the composition value, Anon additionally uses “previous” values and previous weights in the context of analyzing the composition value for an image that is a frame from a video. Anon explains that, “what is explained about

a photographer using a camera to capture a photograph can equally apply, unless otherwise indicated, to a videographer using a video camera to capture a video sequence....” EX1004, 3:2-10. Anon further notes that “the video camera might include a motion sensor that can provide the engine with inputs as to how the camera is moving... it might be a preference when a subject is moving quickly in a scene to frame more of the scene in front of the subject than in back of the subject and this could be suggested by the engine to a videographer.” EX1004, 8:28-31, 10:27-46. Thus, a POSA would have understood that Anon explicitly contemplates using values regarding image data from previous frames (*e.g.*, data on a subject’s recent position in an image that indicates how fast the subject is moving) in calculating its composition value. EX1003, ¶132.

A POSA would have been motivated to combine the teachings of Anon, Takeuchi, and Aisaka because each reference addresses complementary aspects of automated image quality assessment, and their integration promises a more robust and comprehensive evaluation system. EX1003, ¶133. Anon teaches the value of aggregating multiple image-based and external characteristics—including motion, exposure, and content analysis—into a unified quality measure, noting that “a pleasing image is often not simply obtained by optimizing each characteristic” and advocating for a system that “compute[s] a composition measure...that depends from at least two of the plurality of image-based characteristics.” EX1004, 1:50-55, 1:59-

67. Given the clear, modular nature of these approaches and their shared emphasis on weighted, multi-factor analysis, a POSA would have reasonably expected that combining them would yield a system capable of more accurate, context-sensitive, and user-adaptive image quality assessment, with no technical barriers to such integration. EX1003, ¶133.

viii. [17.g]

Anon assists users in managing large sets of images by automatically identifying those with higher aesthetic or compositional value. EX1004, 10:8-20. According to Anon, “[i]n one embodiment, a user may direct the automatic selection of images to be placed within an album. Such selection may be based upon the above-described composition judging techniques.” *Id.*, 10:13-16. Takeuchi explicitly discloses that the processor “evaluates the image information stored in the photographed image storage area of the buffer 25 based on a characteristic amount which changes in a chronological sequence in the photographic frame when images of a plurality of frames are imaged,” and then “selects at least one image whose image evaluation points are equal to or greater than a predetermined threshold value, from among the plurality of images stored... and deletes from the buffer 25 the [other] images and their evaluation results.” EX1005, ¶¶[0121], [0157], [0221]. Accordingly, Anon and Takeuchi both teach using a digital camera processor to select an image from a stream based on a calculated total quality value.

2. Claim 19

This claim is disclosed for the reasons discussed in §VI.A.8.

3. Claim 20

This claim is disclosed for the reasons discussed in §VI.A.810.

C. Ground 1C: Claim 3 is Obvious in View of Anon, Takeuchi, Jasinski and Alhadeef

1. Claim 3

Alhadeef addresses the need to compensate for sensor inaccuracies and drift in the process of determining camera position and orientation. Alhadeef explains that it is important, and sometimes essential, to address errors caused by drift that result from the inherent properties of inertial measurement devices. The readings from gyrometers are known to change over time due to factors like temperature and magnetic fields, making it necessary to recalibrate these sensors on a regular basis, both when the device is stationary and when it is in motion. Additionally, accelerometers are also subject to drift, exhibiting a periodic fluctuation with a cycle of approximately 84 minutes, a phenomenon referred to as “Shuler’s law.” EX1011, 10:35-44.

Furthermore, Alhadeef describes the use of GPS and other auxiliary sensors to “permit redundant determinations and, thereby, improve the accuracy of the measurements,” and details the use of “predictive modeling ... based upon the use of so-called ‘Kalman’ filters” to compensate for sensor drift and error. *Id.*, 9:35-39 and

11:4-6. These passages demonstrate Alhadeef accounts for the precision error, resolution, and temporal drift of motion or location sensors (including accelerometers, gyroscopes, and GPS), and that such error characteristics are used to adjust or weight the contribution of each sensor in the overall position estimation, thereby teaching the estimation of a first weight (c1) based on these sensor-specific error metrics. EX1003, ¶139.

It would have been obvious to modify the combination of Anon and Takeuchi in view of Alhadeef's teachings to incorporate a first weight (c1) estimated according to, or based on, the precision error, reading resolution, or drift in time of a motion or location sensor—such as an accelerometer, gyroscope, GPS, or step counter—because Alhadeef explicitly addresses the need to compensate for sensor inaccuracies and temporal drift in determining camera position and orientation. EX1011, 9:35-39 and 11:4-6. A POSA would have recognized that integrating sensor-specific error metrics as weighting factors would have improved the reliability and accuracy of motion or location estimates in camera systems, especially since both Anon and Takeuchi already contemplate the use of sensor data for image evaluation and feedback. EX1003, ¶140.

Given the well-established practice of sensor fusion and error compensation in the field, as well as Alhadeef's detailed guidance on how to quantify and correct for sensor errors, a POSA would have had a reasonable expectation of success in

implementing such a modification, as it would simply require, for example, assigning lower weights to less reliable sensor data and higher weights to more accurate readings, thereby enhancing the overall system performance in a predictable manner. EX1003, ¶140.

D. Ground 1D: Claims 4 and 9 are Obvious in View of Anon, Takeuchi, Jasinski, and Ramesh

1. Claim 4

Anon does not expressly disclose estimating a third weight (c3) based on, an estimated error in the analyzing of the captured image for detecting or recognizing objects in the image. However, Ramesh describes a computer vision system for detecting and tracking multiple objects (*e.g.*, people in crowds) using a probabilistic framework. Ramesh estimates the number of a people in a scene by using a “weighted sum of partial evidences.” EX1006, ¶[0034]. An “objects location and attributes are updated using online uncertainty estimation 110.” *Id.*, ¶[0025]. Ramesh teaches that “less certain guesses” (*i.e.*, guesses with greater error) “are weighted less.” *Id.*, ¶[0030].

In Anon’s real-time image evaluation, the reliability of different features (such as object detection) can vary due to noise, ambiguous scenes, or changing conditions. Ramesh’s probabilistic approach provides a principled way to quantify and propagate uncertainty in such situations. Associating an estimated error (*e.g.*,

standard deviation, confidence interval) with weighted factors would have allowed Anon’s system to adaptively adjust the weight of each characteristic based on its reliability and combine output values from multiple sources in a statistically optimal way. EX1003, ¶143.

A POSA would have had a reasonable expectation of success in modifying Anon in view of Ramesh’s teaching of detecting and tracking multiple objects using a probabilistic framework because Ramesh explicitly describes a flexible, adaptable system for “automatically detecting and tracking each one of a plurality of people in a scene”. EX1006, ¶[0005]; EX1003, ¶144. Ramesh’s probabilistic, hypothesis-driven multi-object detection and tracking framework is expressly designed to be integrated into existing camera systems like Anon’s, providing a POSA with both the technical guidance and the reasonable expectation of success in combining the features of Anon and Ramesh. EX1003, ¶144.

2. Claim 9

Anon does not use a probabilistic approach to evaluating the quality of images. Ramesh, however, uses Bayesian inference, probability distributions, and statistical models to estimate the number and locations of objects, update hypotheses, and fuse information from multiple sources. *See* EX1006, ¶¶[0024], [0026]. This approach involves generating hypotheses, refining them using statistical models, and updating the “world state” based on posterior probability

distributions. Ramesh's system is adaptive, using uncertainty estimates and predictive distributions to improve tracking and detection robustness. *Id.*

A POSA would have recognized that both Anon and Ramesh address the challenge of evaluating complex, multi-dimensional image data in real time, but with different emphases: Anon focuses on real-time composition feedback for photography, while Ramesh focuses on probabilistic tracking and detection in video streams. EX1003, ¶147. Given the flexibility and extensibility of Anon's system—explicitly designed to incorporate training sets, rule sets, and context-dependent evaluation—a POSA would have been motivated to improve the robustness and adaptability of Anon's composition measure, especially in situations where image characteristics are ambiguous, noisy, or context-dependent. EX1003, ¶147.

Ramesh's probabilistic approach would have provided a well-established framework for handling uncertainty, combining multiple sources of evidence, and updating beliefs as new data arrives. The use of probability distributions, Bayesian inference, and uncertainty estimation allows for more nuanced, data-driven decision-making, which is highly relevant to real-time image evaluation where conditions can change rapidly and user preferences may be uncertain or evolving. EX1003, ¶148.

As discussed above in §VI.D.1, a POSA would have been motivated to combine Anon and Ramesh with a reasonable expectation of success.

E. Ground 1E: Claim 10 is Obvious in View of Anon, Takuechi,

Jasinski, and Steinberg

1. Claim 10

Anon describes that its “engine has to work with ... higher-level aspects of the image being sensed ... as well as camera settings” and parameters “such as the orientation of the camera, where the camera is focused-upon, where within the scene is a face recognized, and the like.” EX1004, 3:53–4:3, 8:27–31. Takeuchi “detects the correlation value between the image information of the previous acquisition, and the image information of the current acquisition, for the image information acquired at a frame rate, for example of 30 fps.” EX1005, ¶[0113]. A POSA would have understood this to mean that Takeuchi uses a plurality of former values for evaluation of a motion vector of an object in the images. EX1003, ¶151.

Steinberg complements Anon and Takeuchi by teaching that “multiple preview images may be captured while a single main image is captured,” and that “statistical interpolation, spline or other curve interpolation based on discrete sampling points” is used to estimate motion of the camera and the existence of motion blur in an image, with “discrete sampling points” implying to a POSA the use of a plurality of former values. EX1012, 11:25-26, 26:46-48; EX1003, ¶152.

Steinberg describes that “the process of determining the right [point spread function] PSF may be performed in various regions of the image, to ***determine the variability of the PSF*** as a function of location within the image.” *Id.*, 25:59-63.

The PSF is a manner of calculating blur due to camera motion or other optical imperfections during exposure. *Id.*, 28:15-29. In practical terms, the PSF characterizes the extent and nature of blur present in the image and a POSA would have understood Steinberg to be determining the standard deviation of PSF (i.e., a quality indicator of an image) due to camera motion (i.e., over time). EX1003, ¶153.

Steinberg further explains that “the step of finding the PSF may include some statistical pattern matching or statistical combination of results from multiple regions within an image[.]” EX1012, 25:52-58. A POSA would have understood this to mean that the system is using results of a quality indicator value (*e.g.*, sharpness) from multiple regions and/or images, and then determining its mean or aggregate value to inform the correction of motion blur in the main image. EX1003, ¶153.

Accordingly, Anon, Takeuchi and Steinberg collectively disclose, or at the very least suggest, calculating statistical measures such as mean and standard deviation from a plurality of former QI values, where QI1–QI5 are values associated with device motion, camera settings, detected objects, object characteristics, and aesthetic quality, respectively. EX1003, ¶154.

A POSA would have been motivated to modify Anon in view of Takeuchi and Steinberg to calculate the mean value (μ) and the standard deviation value (σ) based on a plurality of former values for QI1–QI5 because these statistical measures provide reliable evaluation of image quality parameters over time, which is

beneficial for dynamic and real-time feedback in camera systems. Steinberg notes that its motion and blur detection process described above can be performed rapidly, “in ‘real time’,” so that “[t]he photographer may be informed and/or a new image capture can take place on the spot[.]” EX1012, 28:15–29; *see id.*, 26:46-48. Thus, the benefit of Steinberg’s process is twofold: (1) it enables the correction of motion-induced blur for higher quality images, and (2) it provides immediate feedback to the user, allowing for corrective action if excessive blur is detected, thereby improving the overall reliability and usability of digital imaging devices. EX1003, ¶155.

A POSA would have had a reasonable expectation of success in modifying Anon in view of Takeuchi and Steinberg to calculate the mean (μ) and standard deviation (σ) based on a plurality of former values for QI1–QI5 because each reference provides modular frameworks for image quality assessment that are compatible and designed for extensibility. A POSA would have recognized that calculating statistical measures like mean and standard deviation over time for QI1–QI5—where each QI corresponds to a specific, well-defined image or sensor-based metric—would have been a straightforward and predictable extension, leveraging established statistical and image processing techniques to enhance the robustness and reliability of real-time image quality assessment and feedback. EX1003, ¶156.

F. Ground 1F: Claim 12 is Obvious in View of Anon, Takeuchi,

Jasinski and Liu

1. Claim 12

As discussed above for limitation [1.g], Anon’s composition measure reflects aesthetic quality. Liu teaches that “[various] image quality assessment methods have been developed to reflect human visual quality experience” and describes many types of aesthetic quality algorithms, which are listed in Table 1 of Liu. EX1009, 1793. Each algorithm in Table 1 is an example of a claimed “aesthetic algorithm.” Liu also discloses that one of the algorithms is the “Peak Signal-to-Noise Ratio” (*i.e.*, the claimed “Peak Signal-to-Noise Ratio (PSNR) calculation”). Liu teaches that it is “possible to achieve significantly better performance by fusing multiple methods.” *Id.* For example, Liu describes its Multi-Method Function approach:

[W]e collect a number of image quality evaluation methods. Then, we set the new MMF score to be the nonlinear combination of scores from multiple methods with suitable weighting coefficients. Clearly, these weights can be obtained by the regression approach.

Id., 1793. A POSA would have understood that the “number of image quality evaluation methods” constitute the claimed “respective second value[s] (QI2i) associated with each of multiple algorithms” and that the “MMF score” is the claimed “QI2” that is based on the multiple (QI2i) values from the multiple algorithms.

A POSA would have been motivated to use Liu's MMF method with the Anon-Takeuchi system for several reasons. For example, Liu teaches the benefits of a multi-method fusion approach—"there is not a single quality index that significantly outperforms others" and that "[s]ome method may be superior for one image distortion type but inferior for others." EX1009, 1793. As a result, "the idea of multi-method fusion (MMF) *arises naturally*." *Id.* Liu also explains that a single method is challenging, but "it is possible to achieve significantly better performance by fusing multiple methods." *Id.* A POSA would have recognized these benefits based on Liu's teachings and would have been motivated to achieve them in the Anon-Takeuchi system by using Liu's Multi-factor fusion approach to aesthetic qualities algorithms. Anon teaches that "what characteristics are used to determine what is a 'good' image are very flexible and can be enhanced or changed completely over time." EX1004, 10:47-50. A POSA would have thus understood that Anon's composition engine is meant to be modified and improved and would look to Liu for such an improvement. EX1003, ¶161.

G. Ground 1G: Claim 13 is Obvious in View of Anon, Takeuchi, Jasinski and Cheatle

1. Claim 13

Takeuchi discloses a system in which values or weights are estimated based at least partly on the recognition of object characteristics, specifically faces, and

these can be configured or prioritized, aligning with the concept of a “list of configured faces.” EX1005, ¶[0134]. Takeuchi detects faces within an image and assigns evaluation points or weights to regions where these faces are found, allowing for differentiated treatment based on the detected face's importance or characteristics. *Id.* Takeuchi explains that “the body side microcomputer 21 adds a predetermined number of points to the region where a face image is detected,” and further explains that “the contribution ratio of each item can be adjusted by appropriately setting the number of points added for each item.” *Id.*, ¶¶[0134], [0148]. A POSA would have understood this to mean the evaluation (such as a fourth value QI4 or weight c4) would be influenced by a pre-configured list of faces, as the system can assign higher weights or points to faces deemed more important or relevant, thus directly associating the value or weight with the recognition of object characteristics (faces) and their configured importance. EX1003, ¶103.

A POSA would have been motivated to modify Anon to estimate weights based at least partly on the recognition of object characteristics—specifically faces as taught by Takeuchi—because both references emphasize the importance of tailoring image quality assessment to the content and context of the scene, and Takeuchi explicitly teaches using face detection to identify main subjects and adjust evaluation parameters accordingly. EX1005, ¶¶[0115], [0134], [0148]. Anon’s system incorporates the use of external and image-based characteristics, including

subject recognition and user preferences, to influence composition measures and suggests that weighting can be adapted based on scene or subject type. EX1004, 3:53-66. By integrating Takeuchi’s approach of recognizing faces to inform the weighting of quality indicators—such as giving greater weight to focus, exposure, or composition when a face is detected—a POSA would have enhanced the relevance and accuracy of Anon’s overall quality metric, ensuring that the evaluation reflects the photographic importance of detected subjects. EX1003, ¶104.

To the extent PO argues this limitation is not rendered obvious by Anon in view of Takeuchi, it is also obvious in further view of Cheatle. Cheatle provides implementation details for how to achieve Takeuchi’s facial recognition. For example, Cheatle discloses “analysis tests” that are “customized to deal with faces.” EX1014, ¶[0042]. Cheatle teaches that “images where the face is known to the user might be preferred.” *Id.* Cheatle teaches a “pre-stored list of configured faces” as claimed: “keep[] a database of facial features [so] a comparison could be made with the subject area of the captured key frame.” *Id.* A POSA would be motivated to use Cheatle’s “database of facial features” (*i.e.*, a pre-stored list of configured faces) to implement Takeuchi’s facial recognition feature with a reasonable expectation of success. A POSA would be motivated to use Cheatle’s “database of facial features” because it is a known technique used to improve similar devices in the same way. It

is also a simple substitution of one known element for another to obtain predictable results. EX1003, ¶167.

See §§VI.A.1.vi and viii for the rationale regarding reasonable expectation of success in combining Anon and Takeuchi.

**H. Ground 1H: Claims 14 and 15 are Obvious in View of Anon,
Takeuchi, Jasinski and Yang**

1. Claims 14 and 15

As discussed above in §§VI.A.9 and VI.A.10, Anon discloses a neural network. EX1004, 8:44-47. To the extent that Anon's neural network does not constitute a deep learning algorithm, Yang resolves that perceived deficiency.

Yang teaches the use of deep learning algorithms, specifically convolutional neural networks (CNNs), for extracting and evaluating features from images, including personal characteristics such as age and gender, and demonstrates the adaptability and effectiveness of such models in real-world image analysis tasks. EX1010, ¶¶[0014], [0015]. The combination of Anon and Yang would have rendered it obvious to use deep learning algorithms to compute at least one of the quality indicators in Anon's system, as Yang provides a clear teaching that CNNs can be trained to extract complex, high-level features from images and produce consistent, reliable outputs for image evaluation, thus offering a more robust and adaptable approach to image quality assessment than traditional rule-based or hand-

crafted feature methods. Furthermore, the combination of Anon and Yang would have rendered it obvious to use deep learning algorithms to compute a total quality value of an image because Anon discloses a system that evaluates multiple image-based and contextual characteristics to generate an overall composition or quality measure, while Yang teaches the application of deep learning, specifically CNNs, for extracting and evaluating complex features from images to produce consistent, high-level outputs.

A POSA would have been motivated to incorporate deep learning algorithms, as taught by Yang, into Anon's image quality evaluation system to improve the accuracy, adaptability, and automation of quality indicator computation. EX1003, ¶171. The motivation arises from the demonstrated advantages of deep learning in handling diverse and complex image data, as well as its ability to generalize across varying conditions and subjects, which addresses the limitations of rule-based systems described in Anon. Given the widespread adoption and proven effectiveness of deep learning models in image analysis by the relevant time period, a POSA would have had a reasonable expectation of success in applying such algorithms to compute quality indicators in Anon's system, anticipating improved performance and reliability in real-world scenarios. EX1003, ¶171.

I. Ground 1I: Claim 18 is Obvious in View of Anon, Takeuchi,

Jasinski, Aisaka, and Ishiwata

1. Claim 18

Anon does not disclose estimating a value that combines accelerometer, gyro, and camera/lens module data to produce a value responsive to camera motion. In Ishiwata, however, a focus lens 101 output is integrated with the gyro sensor to enable camera shake detection and correction by having the gyro 111 detect the inclination and shake of the image pickup apparatus, with the detection result input into the control section 110, which then performs “processing such as camera shake correction...on the basis of the detection result” EX1008, ¶[0057]. The focus lens 101 is driven for focus control, and its operation is coordinated with the gyro sensor's output so that the control section can adjust image processing or stabilization functions in response to detected camera movement, thereby improving image quality by compensating for shake during focus adjustments. *Id.*

A POSA would have been motivated to modify Anon to combine accelerometer data, gyro data, and the camera/lens module as taught by Ishiwata in order to achieve more robust and accurate detection and correction of camera shake and subject movement. Anon already contemplates the use of various sensors and external inputs (such as accelerometers, GPS, and orientation sensors) to improve image quality and provide real-time feedback to the user. EX1004, 4:24-33. Ishiwata further teaches the integration of a gyro sensor with the camera/lens module

to detect inclination and shake, with the detection result input into the control section for processing such as camera shake correction. EX1008, ¶[0057]. By combining these sensor inputs, a POSA would have recognized the benefit of leveraging complementary data sources to enhance the reliability and responsiveness of image stabilization and feedback systems, thereby improving the overall photographic outcome. EX1003, ¶175.

The modification would have had a reasonable expectation of success because both Anon and Ishikawa describe the use of sensor data to inform camera control and image processing, and the integration of such sensors is well within the capabilities of a POSA. As described above, Anon explicitly discusses the use of multiple sensor types and external data to optimize camera operation and user feedback, while Ishiwata demonstrates the practical implementation of combining gyro sensor output with camera control logic for shake correction. The technologies involved—accelerometers, gyros, and camera modules—are compatible and commonly used together in consumer electronics, and their integration for the purpose of motion detection and correction is straightforward. Thus, a POSA would have reasonably expected that combining these elements would function as intended to improve camera performance. EX1003, ¶176.

J. Ground 1J: Claims 19 and 20 are Obvious in View of Anon,

Takeuchi, Jasinski, Aisaka, and Yang

1. Claims 19 and 20

As discussed above in §§VI.A.9 and VI.A.10, Anon discloses a neural network. EX1004, 8:44-47. To the extent that Anon's neural network does not constitute a deep learning algorithm, Yang resolves that perceived deficiency for the reasons discussed in §VI.H.1.

VII. SECONDARY CONSIDERATIONS

Petitioner is unaware of any evidence of alleged secondary indicia that would support non-obviousness of the '682 Patent. To the extent Patent Owner subsequently presents such evidence, Petitioner respectfully requests the right to respond.

VIII. MANDATORY NOTICES

As set forth below and pursuant to 37 C.F.R. § 42.8(a)(1), the following mandatory notices are provided.

A. Real Party in Interest Under 37 C.F.R. § 42.8(b)(1)

Samsung Electronics Co., Ltd., Samsung Electronics America, Inc.

B. Related Matters

SnapAid, Ltd. v. Samsung Electronics Co., Ltd. et al., No. 2-25-cv-00378 (E.D. Tex.) (alleging infringement of the '682 Patent).

C. Lead and Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Lead Counsel	Back-Up Counsel
Robert A. Appleby (Reg. No. 40,897) Kirkland & Ellis LLP, 601 Lexington Avenue, New York, NY 10022, Telephone: 212.446.4800 Facsimile: 212.446.4900	W. Todd Baker (Reg. No. 45,265) Kirkland & Ellis LLP, 1301 Pennsylvania Avenue, N.W., Washington, D.C. 20004 Telephone: 202.389.3135 Facsimile: 202.389.5200

D. Service Information Under 37 C.F.R. § 42.8(b)(4)

Petitioner concurrently submits a Power of Attorney, 37 C.F.R. § 42.10(b), and consents to electronic service by email at Samsung-IPR-SnapAid@kirkland.com.

IX. PAYMENT OF FEES UNDER 37 C.F.R. § 42.103

The undersigned authorizes the Office to charge the fee set forth in 37 C.F.R. § 42.15(a)(1) for this Petition to Deposit Account No. 506092, consistent with the requested review of twenty claims, and any additional fees that may be due in connection with this Petition to be charged to the above-referenced deposit account.

X. GROUNDS FOR STANDING UNDER 37 C.F.R. § 42.104(A)

Petitioner certifies pursuant to 37 C.F.R. §42.104(a) that the '682 Patent is available for IPR and that Petitioner is not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein.

XI. CONCLUSION

Petitioner requests institution of IPR and cancellation of the challenged claims.

Petition for *Inter Partes* Review of U.S. Patent No. 10,659,682

Dated: September 5, 2025

Respectfully submitted,

/Robert A. Appleby/

**Robert A. Appleby
Counsel For Petitioner
Reg. No. 40,897**

APPENDIX – CLAIM LISTING

Claim [Element]	Claim Language
1 [1.pre]	A method for estimating quality of at least one image from a plurality of images, for use with a device that comprises in a single enclosure a digital camera module or functionality that comprises at least one optical lens for focusing received light from a scene and an image sensor coupled to the optical lens for capturing an image of the scene; a motion or location sensor for sensing the device motion; and a processor coupled to at least one image sensor and to the digital camera for receiving data therefrom, the method by the processor comprising use of at least one value and weight;
1 [1.a]	obtaining a first value (QI1) responsive to the device motion from the motion or location sensor;
1 [1.b]	estimating a first weight (c1) associated with the first value;
1 [1.c]	obtaining a second value (QI2) associated with the digital camera;
1 [1.d]	estimating a second weight (c2) associated with the second value;
1 [1.e]	analyzing the captured image for detecting or recognizing one or more objects in the image and obtaining a third value (QI3) associated with motion of at least one of said objects;
1 [1.f]	estimating a third weight (c3) associated with the third value;
1 [1.g]	obtaining a fourth value (QI4) associated with recognition of object characteristics;
1 [1.h]	estimating a fourth weight (c4) associated with the fourth value;
1 [1.i]	obtaining a fifth value (QI5) associated with aesthetic quality of image based on composition;
1 [1.j]	estimating a fifth weight (c5) associated with the fifth value; and

Claim [Element]	Claim Language
1 [1.k]	calculating a total quality value according to, or based on values QI1, QI2, QI3 and QI5 and weights c1, c2, c3, c4 and c5.
2	The method according to claim 1, wherein the estimating of the first weight (c1) is responsive to at least one of second, third, fourth or fifth value (QI2, QI3, QI4, QI5); or wherein the estimating of the second weight (c2) is responsive to at least one of the first, third, fourth or fifth value (QI1, QI3, QI4, QI5); or wherein the estimating of the third weight (c3) is responsive to at least one of first, second, fourth or fifth value (QI1, QI2, QI4, QI5); or wherein the estimating of the fourth weight (c4) is responsive to at least one of the first, second, third or fifth value (QI1, QI2, QI3, QI5); or wherein the estimating of the fifth weight (c5) is responsive to at least one of the first, second, third or fourth value (QI1, QI2, QI3, QI4).
3	The method according to claim 1, wherein the first weight (c1) is estimated according to, or based on, a precision error, reading resolution, or drift in time, of the motion or location sensor, and wherein the motion or location sensor consists of, or comprises, an accelerometer, a gyroscope, a Global Positioning System (GPS), or a step counter.
4	The method according to claim 1, wherein the third weight (c3) is estimated according to, or based on, the estimated error in the analyzing the captured image for detecting or recognizing objects in the image.
5	The method according to claim 1, wherein the digital camera further comprises an auto-focus functionality, wherein the auto-focus functionality is coupled to the controlled by the processor, and wherein the method further comprising controlling the auto-focus functionality according to, or based on, the second value (QI2) or the total value.

Claim [Element]	Claim Language
6	The method according to claim 1, wherein object characteristics are at least one of recognized smile, looking at camera, face importance to user or confidence of object recognition.
7	The method according to claim 1, wherein aesthetic quality of image based on composition includes at least one of: rule of thirds, golden triangle, golden spiral, shapes and lines, amputation avoidance, visual balance, diagonal dominance, non-reference quality indication or relative position of salient regions in the image.
8	The method according to claim 1, further comprising grading the image quality according to, or based on, the total value, and wherein the total value is calculated as a weighted average value according to, or based on, $c1*QI1+c2*QI2+c3*QI3+c4*QI4+c5*QI5$.
9	The method according to claim 1, for use with a probability distribution function using a mean value (μ) and a standard deviation value (σ), wherein the estimating of at least one of the weights ($c1, c2, c3, c4, c5$) is according to, or based on, the respective probability of the at least of the values ($QI1, QI2, QI3, QI4, QI5$), according to the probability distribution function.
10	The method according to claim 1, for use with a plurality of former values of the respective QI , further comprising calculating the mean value (μ) and the as the standard deviation value (σ) based on the plurality of former values.
11	The method according to claim 1, wherein the acting comprises affecting the digital camera in response to the total value.
12	The method according to claim 1, wherein: the device comprises multiple motion or location sensors for sensing the device motion selected from a group consisting of a gyroscope, accelerometer, Global Positioning System (GPS), 9 Degrees of Freedom

Claim [Element]	Claim Language
	<p>(DOF) sensing component, and 10 Degrees of Freedom (DOF) sensing component, wherein the method comprising obtaining a corresponding first value (QI1i) from each of the multiple motion or location sensors responsive to the device motion from the respective motion or location sensor; and</p> <p>estimating or calculating the first value (QI1) based on the multiple first values (QI1i) from the multiple motion or location sensors,</p> <p>or wherein:</p> <p>the analyzing of the captured image comprises applying multiple algorithms selected from a group consisting of an aesthetic algorithm, an artificial neural network employing deep learning algorithm, a corner detection algorithm, a blur detecting algorithm, and Peak Signal-to-Noise Ratio (PSNR) calculation, and the method further comprising obtaining a respective third value (QI3i) associated with each of multiple algorithms, and calculating or estimating the third value (QI3) based on the multiple third values (QI3i) from the multiple algorithms.</p>
13	The method according to claim 1, wherein estimating fourth value (QI4) or forth weight (c4) is based at least partly on a list of configured faces.
14	The method according to claim 1, wherein algorithms of deep learning are used to compute at least one of the values (QI1, QI2, QI3, QI4, QI5).
15	The method according to claim 1, wherein algorithms of deep learning are used to compute the total quality value.
16	The method according to claim 1, wherein the second value is a combination of at least one of digital camera exposure, focus and under or over exposure.
17 [17.pre]	A method for estimating quality of at least one image from a stream of images from a video, for use with a device that comprises in a single enclosure a digital

Claim [Element]	Claim Language
	camera module or functionality that comprises at least one optical lens for focusing received light from a scene and an image sensor coupled to at least one optical lens for capturing an image of the scene; a motion or location sensor for sensing the device motion; and a processor coupled to the image sensor and to the digital camera for receiving data therefrom, the method by the processor comprising use of at least one value and weight;
17 [17.a]	obtaining a first value (QI1) responsive to the device motion from the motion or location sensor;
17 [17.b]	estimating a first weight (c1) associated with the first;
17 [17.c]	obtaining a second value (QI2) value is a combination of at least one of digital camera exposure, focus and under or over exposure;
17 [17.d]	estimating a second weight (c2) associated with the second value;
17 [17.e]	analyzing the captured image via deep learning algorithms for detecting or recognizing one or more objects in, or one or more characteristics of image or at least one of object characteristics to obtain a third value (QI3) associated with the analysis;
17 [17.f]	calculating a total quality value according to, or based on values QI1, QI2, QI3 and weights c1, c2, c3 and previous values QI1, QI2, QI3 and previous weights c1, c2, c3 in said image stream; and
17 [17.g]	selecting by said processor at least one image from the plurality of images at least partly on said total quality value.
18	The method according to claim 17, where a first value (QI1) can be a combination of accelerometer data, gyro data and camera/lens module.
19	The method according to claim 17, wherein algorithms of deep learning are used to compute at least one of the values (QI1, QI2, QI3, QI4, QI5).

Claim [Element]	Claim Language
20	The method according to claim 17, wherein algorithms of deep learning are used to compute the total quality value.

CERTIFICATE OF COMPLIANCE

This Petition complies with the type-volume limitations as mandated in 37 C.F.R. § 42.24, totaling 13,839 words. Counsel has relied upon the word count feature provided by Microsoft Word.

/Robert A. Appleby/

Robert A. Appleby (Reg. No. 40,897)

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing document with accompanying exhibits was served on September 5, 2025, via overnight delivery directed to Patent Owners, SnapAid, Ltd., at the following address:

May Patents Ltd.
c/o Dorit Shem-Tov (131926)
P.O.B. 7230
Ramat-Gan 5217102
Israel

A copy was also served via electronic mail on the attorneys of record listed below for the following related matters:

SnapAid, Ltd. v. Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (Case 2:25-cv-00378-RWS-RSP, E.D. Tex)

James R. Nuttall
jnuttall@steptoe.com
James Winn
jwinn@steptoe.com
Jacob Michalakes
jmichalakes@steptoe.com
STEPTOE LLP
227 West Monroe Street
Suite 4700
Chicago, IL 60606
Telephone: (312) 577-1300

/Robert A. Appleby/
Robert A. Appleby (Reg. No. 40,897)