

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM INC.,

Petitioner

IPR2025-00627

U.S. Patent No. 7,689,001

**DECLARATION OF NIKOS PAPANIKOLOPOULOS, PH.D.,
UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW**

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I, Nikos Papanikolopoulos, Ph.D., do hereby declare as follows:

I. INTRODUCTION

1. I am making this declaration at the request of Amazon.com, Inc. in the matter of the *Inter Partes* Review of U.S. Patent No. 7,689,001 (“the ’001 patent”) to Kim et al.

2. I am being compensated for my work in this matter at my standard hourly rate. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this proceeding. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

3. I have been asked to provide my opinions regarding whether the subject matter of claims 1-12 (“the Challenged Claims”) of the ’001 patent would have been obvious to a person having ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the prior art. It is my opinion that the Challenged Claims would have been obvious to a POSITA.

4. In the preparation of this declaration, I have studied:

- a. the ’001 patent, Ex. 1001;
- b. the prosecution history of the ’001 patent (“’001 File History”), Ex. 1002;
- c. U.S. Patent 7,845,560 to Emanuel et al. (“Emanuel”), Ex. 1005;

- d. U.S. Provisional Application No. 60/635,813 (“Emanuel-
Prov”), Ex. 1006;
- e. U.S. Patent 6,650,776 to Ihara et al. (“Ihara”), Ex.1007;
- f. U.S. Patent Application Publication 2004/0189856 to Tanaka
 (“Tanaka”), Ex.1008;
- g. U.S. Patent 5,137,354 to deVos et al. (“deVos”), Ex.1011; and
- h. U.S. Patent 6,677,894 to Sheynblat et al. (“Sheynblat”),
Ex.1012.

5. In forming the opinions expressed below, I have considered: the documents listed above; the relevant legal standards, including the standard for obviousness; and my own knowledge and experience based upon my work in the field of location recognition arts as described below, as well as portions of the following additional materials:

- a. Cognex In-Sight Product Guide (“Cognex-Guide”), Ex. 1009;
- b. Cognex In-Sight 5100 and 5400 Brochure (“Cognex-
Brochure”), Ex.1010;
- c. Erwin et al., “Modular Computer Architecture Strategy for
Long Term Missions,” AFIPS '69 (Fall): Proceedings of the November 18-
20, 1969, Fall Joint Computer Conference, 337-345 (1969) (“Erwin”)
Ex.1013;

- d. Markus Zahn, “Electromagnetic Field Theory: A Problem Solving Approach,” Wiley, 1-4 (1979) (“Zahn”), Ex.1014.;
- e. Sekimori et al., “High-Speed Obstacle Avoidance and Self-Localization for Mobile Robots Based on Omni-directional Imaging of Floor Region,” RoboCup 2001, 205-206 (2001) (“Sekimori”), Ex.1015;
- f. U.S. Patent 3,887,273 to Griffiths et al. (“Griffiths”), Ex.1016.
- g. Athanas et al., “Real-Time Image Processing on a Customer Computing Platform,” IEEE February 1995, 17-24, (“Athanas”), Ex.1017.
- h. U.S. Patent 4,771,307 to Kuno et al. (“Kuno”), Ex.1018.
- i. John J. Craig, “Introduction to Robotics,” Pearson Prentice Hall, 21-40 (2005) (“Craig”), Ex.1025.
- j. Dan B. Marghitu, 2001 “Mechanical Engineer’s Handbook,” Academic Press, 70 (“Marghitu”), Ex.1026.
- k. Yasuda et al., “Object Recognition and Self-Localization for Interactive Soccer Robots,” Proceedings of the 2004 IEEE International Conference on Robotics and Biomimetics (2004) (“Yasuda”), Ex.1027.
- l. Hightower et al., “Location Systems for Ubiquitous Computing,” IEEE Computer (2001) (“Hightower”), Ex.1028.

m. Holtman et al., “Building a Large Location Table to Find Replicas of Physics Objects,” *Computer Physics Communications* Vol. 140 (2000) (“Holtman”), Ex.1029.

6. Unless otherwise noted, all **emphasis** in any quoted material has been added. Claim terms are *italicized*.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

7. My complete qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in Exhibit 1004. The following is a brief summary of my relevant qualifications and professional experience.

8. I have been a professor at the University of Minnesota (originally as an assistant professor, and then as an associate professor, and finally as a full professor) since the Fall 1992. Between Fall 2001 and Spring 2004, and between Fall 2010 and Spring 2013, I was the Director of Undergraduate Studies of the Department of Computer Science and Engineering.

9. In 1992, I received my Ph.D. in Electrical and Computer Engineering from Carnegie Mellon University. My thesis was entitled “Controlled Active Vision” and focused on using computer vision in a controlled fashion to locate, track, and manipulate objects in the environment. The work revolved around the use of images from a single camera mounted on a robot manipulator to detect

features on objects, track them, localize and recognize the objects, and possibly grasp them (see Figure 3-4 from my thesis below with target (object) space shown). Some of the features used included edges, object profiles, and corners. My thesis covered the number and locations of features that you need in order to have a problem that is numerically stable (highly relevant to the '001 patent (Claim 6) that uses three or more location recognition tags to provide more accurate location measurements). The work had as an ultimate objective accurate 3D reconstruction of the target object and the surrounding space.

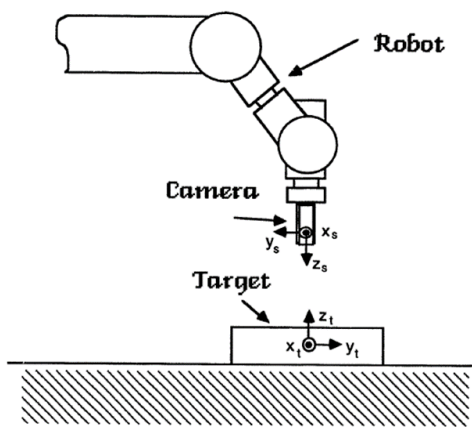


Figure 3-4: Experimental setup.

10. In 1988, I also received my M.S. in Electrical and Computer Engineering from Carnegie Mellon University. My B.S. in Electrical Engineering was received in 1987 from the National Technical University in Athens, Greece.

11. For over thirty years, my research and teaching work has focused on machine vision, automation, intelligent transportation systems, and robotics. This research has included detection/localization and tracking of objects such as

industrial parts, vehicles, humans, and faces using information from stationary or moving cameras (indoors or outdoors). It has also included main object (for the image) detection and recognition including work with artificial intelligence and pattern recognition systems for inspection applications.

12. I currently teach or have been teaching three courses related to machine vision: (i) CSci 5561 Computer Vision, (ii) CSci 5511 Artificial Intelligence, and (iii) CSci 5551 Introduction to Intelligent Robotic Systems. In particular, I have been teaching the class in Computer Vision since 1992.

13. I am currently serving as a Senior Editor in the IEEE Transactions on Intelligent Transportation Systems with responsibility in the area of imaging. I was Associate Editor in the same journal for twelve years.

14. I have received research grants for various projects involving machine vision and image processing as applied to inspection, medicine and surveillance, including industrial part detection and tracking of objects. My industrial experience includes founding a robotics company in 2005 named ReconRobotics Inc. that develops different robotic platforms. I have also been a consultant since 1997 for numerous companies and provided technical expertise in developing machine vision algorithms for human tracking, object localization and recognition, fingerprint recognition, vehicle tracking, camera calibration, inspection, and precision agriculture. In one of my consulting assignments, I had to

develop machine vision algorithms for inspection of industrial parts by using different illumination sources (Banner Engineering). I have licensed my algorithms to several industries with the most recent one being Sentera Inc., which is using image processing and image segmentation for precision agriculture.

15. My research has produced more than 380 journal and conference publications. More than 90 publications are in refereed journals including top journals in imaging and machine vision such as IEEE Trans. on Pattern Analysis and Machine Intelligence, IEEE Trans. on Image Processing, and International Journal of Computer Vision. Many of my publications and research grants relate to object detection, localization, and tracking systems. Some examples include:

- a. Morton, S., Bosch, B., and Papanikolopoulos, N., “Self Feeding Aerial Robots, Methods for Detection and Localization of Standard Wall Outlets”, Proceedings of the 24th Mediterranean Conference on Automation and Control (MED '16), pp 420-425, Athens, Greece, June 21-24, 2016.
- b. Cook, D., Morris, T., Morellas, V., and Papanikolopoulos, N., “An Automated System for Persistent Real-Time Truck Parking Detection and Information Dissemination,” Proceedings of the 2014 IEEE Int. Conference on Robotics and Automation, Hong Kong, China, May 31 – June 7, 2014, pp 3989-3994.
- c. Anderson, M., and Papanikolopoulos, N.P., “Reducing Sensitivity to Localization Error through Local Search”, Proceedings of the 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS '07), pp 1339-1342, San Diego, CA, Oct. 29 – Nov. 2, 2007.
- d. Rybski, P., Roumeliotis, S., Gini, M., and Papanikolopoulos, N., “A Comparison of Maximum Likelihood Methods for Appearance-Based Minimalistic SLAM”, Proceedings of the

2004 IEEE Int. Conference on Robotics and Automation, pp 1777-1782, New Orleans, LA, April 26 - May 1, 2004.

- e. Perrin, D., Kadioglu, E., Stoeter, S., and Papanikolopoulos, N., “Localization of Miniature Mobile Robots Using Constant Curvature Dynamic Contours”, Proceedings of the 2002 IEEE Int. Conference on Robotics and Automation, pp 702-707, Washington, DC, May 11-15, 2002.
- f. Papanikolopoulos, N.P., Nelson, B., and Khosla, P.K., “Six Degree-of-Freedom Hand/Eye Visual Tracking with Uncertain Parameters”, IEEE Trans. on Robotics and Automation, Volume 11, No 5, October 1995, pp 725-732.
- g. Papanikolopoulos, N.P., and Khosla, P.K., “Adaptive Robotic Visual Tracking: Theory and Experiments”, IEEE Trans. on Automatic Control, Volume 38, No. 3, March 1993, pp 429 - 445.
- h. Papanikolopoulos, N.P., Khosla, P.K., and Kanade, T., “Visual Tracking of a Moving Target by a Camera Mounted on a Robot: A Combination of Control and Vision”, IEEE Trans. on Robotics and Automation, Volume 9, No. 1, February 1993, pp 14 - 35.
- i. Papanikolopoulos, N.P., “Controlled Active Vision”, Ph.D. Thesis, ECE, Carnegie Mellon University, 1992.

16. The paper Papanikolopoulos et al.: “Visual Tracking of a Moving Target...” presented a control scheme (shown below) for real-time robotic visual tracking of arbitrary 3-D objects moving at unknown speeds in a 2-D plane, with known depth, using an eye-in-hand configuration. The visual tracking challenge was approached as an integration of control theory and machine vision. One of the goals among others was to inspect the localized objects. We developed a mathematical model of a control problem that incorporated visual feedback about

the location of objects, a novel and significant sensory input. Our formulation was unique in that it used the relationships between object, camera, and world frames to enable swift and precise camera control.

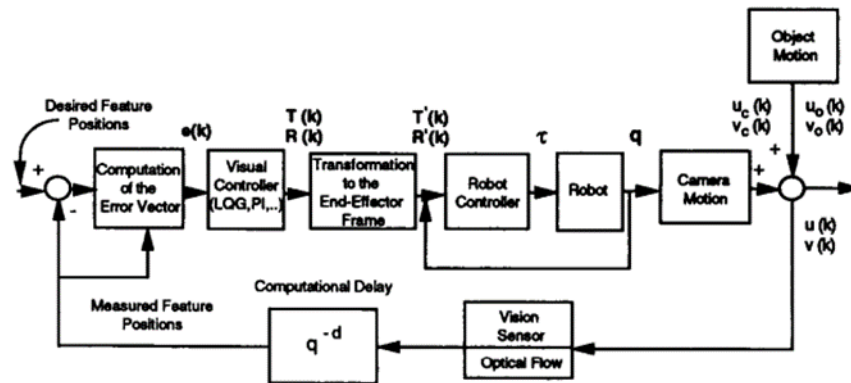


Fig. 6. Structure of the robotic visual tracking scheme.

17. We experimented with various control systems: a PI controller, a pole assignment controller, or a discrete steady-state Kalman filter. In the Kalman filter scenario, the filter estimated the system's states and external disturbances, while a discrete LQG controller determined the required robotic system movement. The controller outputs were then transmitted to a Cartesian robotic controller that guided the robot. We evaluated the effectiveness of these proposed algorithms using the CMU Direct-Drive (DD) Arm II.

18. My work in vehicle detection and tracking (which is a particular case of object localization) has focused on using image and video processing techniques, including object localization, tracking, and recognition, to accurately track vehicles in real-time. These algorithms have been applied to different

scenarios, such as urban traffic monitoring and surveillance. Moreover, machine learning techniques have helped in the improvement of these methodologies.

19. My work has been extended to tracking autonomous vehicles, where the challenges are different from traditional vehicle tracking that uses information from static sensors (e.g., cameras). My interests include developing tracking algorithms and systems that can handle the complexities of autonomous vehicles, including predicting their future movements and understanding their intentions. The work has been extended to monitor the intentions of pedestrians (where pedestrians are segmented as the main objects).

20. These vehicle tracking systems enable continuous monitoring and tracking of vehicles, providing valuable information for traffic management, law enforcement, and security purposes.

21. My paper "Detection and Classification of Vehicles", published in the IEEE Transactions on Intelligent Transportation Systems in March 2002 is one of the most cited papers in the history of this journal (more than a thousand citations). The paper among other contributions shows how to segment the main object from videos and images in low-light conditions. I also have nine patents in pertinent areas. One of them is the "Crowd Counting and Monitoring" with P. Kilambi and O. Masoud. It discloses a system and method for accurately estimating the number of people in a crowded area and monitoring their behavior. The invention utilizes

machine vision techniques and machine learning algorithms to analyze video feeds from cameras overlooking the target area. It employs techniques such as background subtraction, main object detection and localization, and tracking to identify individual people within the crowd.

22. The system uses density estimation methods to handle areas where individuals are difficult to distinguish. Advanced features might include the ability to detect and track movement patterns, identify unusual behaviors or potential security threats, and predict crowd flow.

23. Our research work has been funded by several government funding agencies. For example, we have received funding from the Department of Homeland Security to monitor threats at Mass Transit Sites like the 30th Street Station in Philadelphia, PA, and the Light Rail Station in the Minneapolis-Saint Paul International Airport. Localizing objects was an essential task for which we developed a variety of image processing algorithms and tools.

24. For more than a decade, we have been developing machine vision-based systems to assess truck parking availability at truck rest areas. The funding came from FHWA, MnDOT, WiscDOT, and KansasDOT. The approach uses multiple cameras to localize trucks and other vehicles and determine empty spaces. The system operates in all weather conditions around the clock.

25. I have received numerous honors and awards for my research and contributions. I have been a Distinguished McKnight University Professor at the University of Minnesota since 2007 and have been a McKnight Presidential Endowed Professor in Computer Science since 2016. Also in 2007, I was nominated and became an IEEE Fellow. In 2016, I received the IEEE RAS George Saridis Leadership Award in Robotics and Automation as well as the Center for Transportation Studies Research Partnership Award. I have also received the IEEE VTS 2001 Best Land Transportation Paper Award for the paper "A Novel Method for Tracking and Counting Pedestrians in Real-Time Using a Single Camera" (with Osama Masoud).

26. As a result of my work and research, I am familiar with the design, operation, and functionality of systems such as those described in the '001 patent.

27. I have reviewed the '001 patent, and relevant excerpts of the prosecution history of the '001 patent. Based on my experience and education, and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to offer opinions as to the knowledge and level of skill of one of ordinary skill in the art at the time of the invention of the '001 patent (which I further describe below).

III. LEVEL OF ORDINARY SKILL IN THE ART

28. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

29. A POSITA in the field of the '001 patent, as of its earliest possible priority date of November 28, 2005, would have been someone knowledgeable and familiar with location recognition arts available in the early-2000s. Such a POSITA would have a bachelor's degree in electrical engineering, computer engineering, computer science, mechanical engineering, or equivalent training, and approximately two years of experience working with location recognition or location tracking technologies. Additional work experience can substitute for specific educational background, and vice versa.

30. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my own experience and what a POSITA would have understood or known generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the relevant field as of the priority date of the '001 patent.

IV. RELEVANT LEGAL STANDARDS

31. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '001 patent, I am relying on certain basic legal principles that Amazon's counsel has explained to me.

32. I understand that prior art to the '001 patent includes patents in the relevant art that predate the priority date of the '001 patent. For purposes of this Declaration, I am applying November 28, 2005, as the priority date of the '001 patent.

33. I have been informed by Amazon's counsel that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA. I have also been informed by Amazon's counsel that the obviousness analysis considers factual inquiries, including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

34. I have been further informed by Amazon's counsel that there are several recognized rationales for combining references or modifying a reference to show obviousness. These rationales include: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of

one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art or to combine prior art teachings to arrive at the claimed invention.

V. BACKGROUND

A. Machine Vision

35. The terms “machine vision” and “computer vision” will be used interchangeably in this analysis. However, a POSITA could have viewed machine vision as primarily focused on industrial and manufacturing applications, where systems were designed to perform specific inspection, measurement, or quality control tasks in controlled environments. These systems typically operated with predefined parameters, consistent lighting conditions, and specific hardware configurations optimized for reliability in production environments. On the other hand, computer vision research would have been viewed as more general. It was developing fundamental algorithms and approaches that could work across

different applications and scenarios, rather than being optimized for specific industrial tasks.

36. Machine vision systems were already well known before the '001 patent.

37. In industrial settings, machine vision systems were mainly created for quality control, inspection, and assembly line monitoring. These systems employed Charge-Coupled Device (CCD) cameras and increasingly low-cost Complementary Metal-Oxide-Semiconductor (CMOS) cameras. Common tasks included barcode reading, pattern matching, dimensional measurement, and defect detection.

38. The Scale-Invariant Feature Transform (SIFT) algorithm and features had become well-established for feature detection and matching. Face detection systems were becoming more reliable and several benchmark datasets were developed. Object categorization was also already known and advancing.

39. Hardware solutions for machine vision in industrial applications included Digital Signal Processors (DSPs), custom Field Programmable Gate Arrays (FPGAs), and general-purpose CPUs.

40. Support Vector Machines (SVMs) were particularly popular for classification tasks prior to the '001 patent.

41. A software ecosystem for machine vision also existed prior to the '001 patent, with both commercial and open-source solutions available. Libraries

like the Open Source Computer Vision Library (OpenCV) (which had been released a few years earlier) were widely used. Commercial machine vision software was primarily focused on industrial applications, offering specialized tools for tasks like inspection, optical character recognition, and measurement.

B. Location Recognition Systems

42. Location recognition systems based on machine vision were also known prior to the '001 patent. The main approach utilized fixed cameras in controlled environments, where machine vision algorithms could track specially designed markers or natural features associated with particular locations to determine position and orientation. These systems were relevant in industrial robotics.

43. Marker-based systems were the main tool, using high-contrast patterns like fiducial markers that could be reliably located and followed. These systems typically required calibrated cameras and known marker sizes to calculate position and orientation through perspective transformation algorithms. The accuracy could reach millimeter-level in controlled environments.

44. Visual Simultaneous Localization and Mapping (SLAM) was already known and being developed at the priority date of the '001 patent, with research groups working on methods to track camera motion while building a map of the environment.

45. Feature-based tracking systems were also known and becoming more sophisticated with the widespread adoption of algorithms like SIFT and the growing presence of alternatives such as SURF. These systems could track natural features in the environment to estimate camera motion.

46. Multi-camera systems were also known and used for position tracking, particularly in motion capture applications. These systems could provide highly accurate 3D position information. The processing pipelines usually involved detecting and matching features across multiple camera views, triangulating 3D positions, and tracking objects over time.

47. Machine vision systems would be often combined with inertial navigation systems and GPS systems. The inertial navigation systems were primarily used in military and aviation applications, but were becoming more accessible due to the miniaturization of accelerometers and gyroscopes. These systems calculated position through dead reckoning, integrating acceleration and angular velocity measurements over time.

48. Hybrid approaches combining GPS with inertial sensors, Wi-Fi positioning, or cell tower triangulation were also known and being developed. The field was also seeing experiments with Ultra-Wide Band (UWB) technology for precise indoor positioning. As I explain below, the '001 patent is based upon the

above known technologies and does not solve any problem that had not already been solved by POSITAs in the machine vision-based location recognition field.

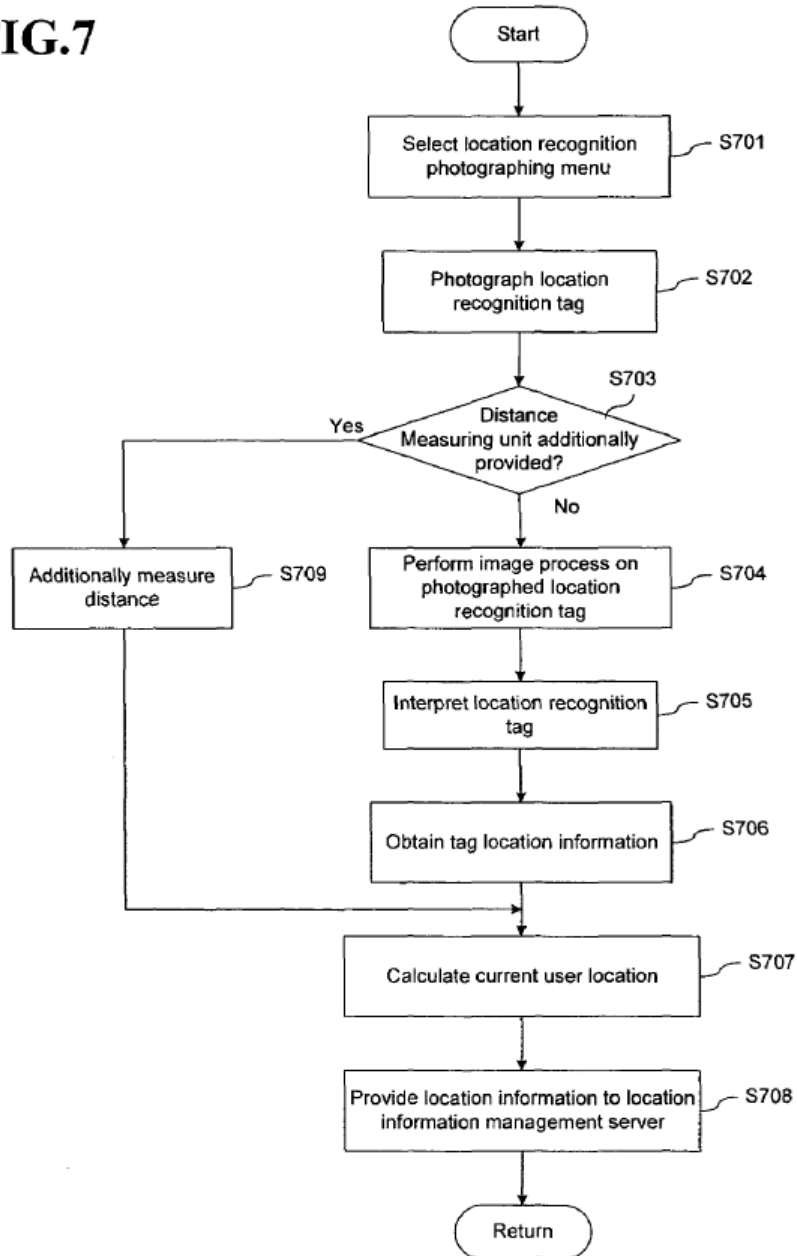
VI. THE '001 PATENT

A. Overview of the '001 patent

49. The '001 patent “relates to a location recognition device for recognizing a location by a terminal having a camera and a method thereof.”

Ex.1001, Abstract. The '001 patent's system is depicted in Figure 7, which shows the steps “for recognizing a user location.” Ex.1001, 1:19-20.

FIG.7



Ex.1001, Fig. 7

50. In step S707, “[t]he location recognizing unit 150 receives the absolute location coordinate, the photographing angle, and the information on the distance to the location recognition tag 30, and calculates the current user location.” Ex.1001, 7:54-59.

51. To calculate the location of a mobile terminal, the location recognition device performs the following steps:

a) a location recognition tag storing location recognition information is photographed, b) a distance to the location recognition tag is measured, c) an image of the photographed location recognition tag is analyzed and location information corresponding to the location recognition tag is recognized, d) direction information of the photographed location recognition tag is recognized.

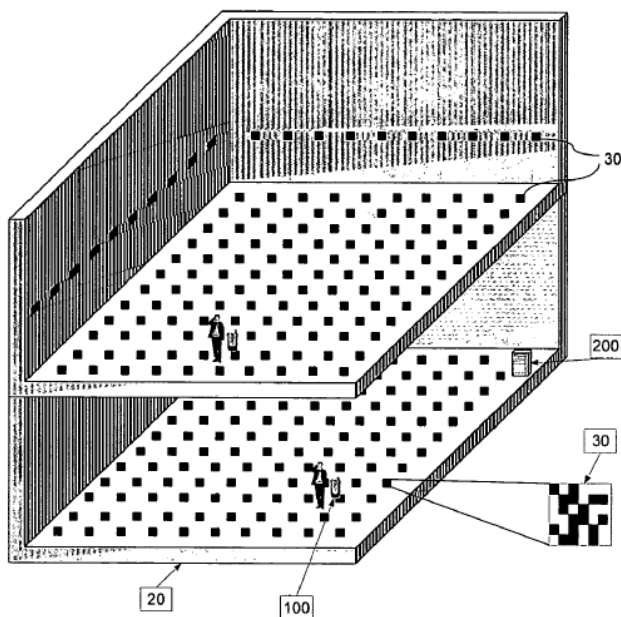
Ex.1001, 2:15-21.

52. Ultimately, “a mobile terminal location is calculated by using the distance information measured in b), the location information recognized in c), and the direction information recognized in d).” Ex.1001, 2:21-24.

53. In another example, “the mobile terminal location is calculated by a triangulation measuring algorithm by using the distance information, the location information, and the direction information corresponding to three or more location recognition tags.” Ex.1001, 2:30-34.

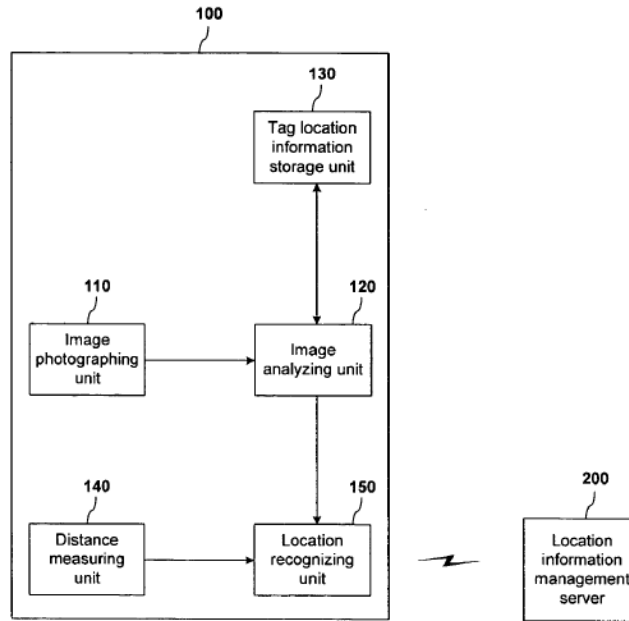
54. Within the '001 patent's system, the location recognition tags are “arranged so that using the location recognition tags achieves a desired precision in a predetermined physical area.” Ex.1001, Abstract. The predetermined physical area may be “an indoor area.” Ex.1001, 5:56-57. Each location recognition tag has “a one-dimensional bar code or two-dimensional bar code” which “is used as the

location identifier.” Ex.1001, 4:47-49. The location recognition tags 30 arranged in the predetermined physical area are depicted in Figure 2:



Ex.1001, Fig. 2

55. In one embodiment, the “location recognition device includes an image photographing unit, a distance measuring unit, an image analyzing unit, and a location recognizing unit.” Ex.1001, 2:36-41. This configuration is depicted in Figure 4:



Ex.1001, Fig. 4

56. As I will explain below, however, all of these concepts were well known as of the priority date of the '001 patent.

VII. CLAIM CONSTRUCTION

57. It is my understanding that in order to properly evaluate the '001 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be given their ordinary and customary meaning as would have been understood by a POSITA in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term. I have also been informed that claim terms only need to be construed to the extent necessary to resolve the obviousness inquiry. I have reviewed the entirety of the '001 patent, as well as its prosecution history. It is my

opinion that for purposes of applying the prior art presented herein to evaluate the patentability of the Challenged Claims, no claim terms require express construction.

58. I have also been informed that in the district court proceeding concerning the '001 patent, the Patent Owner's position in its Infringement Contentions is that no terms invoke §112, ¶6 ("means-plus-function"). In the event the Board finds that any of the "*unit*" terms in claims 8-12 invoke §112, ¶6, for the purposes of this declaration, I apply alternative grounds 5-8 that analyze the claims under §112, ¶6. *See* Sections XIII-XV.

VIII. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

59. The discussion in this Declaration provides a detailed analysis of how the asserted prior art references teach each limitation of the Challenged Claims.

60. As part of my analysis, I have considered, and discuss in detail, the scope and content of the prior art and any differences between the alleged invention and the prior art.

61. It is my opinion that the alleged invention recited in the Challenged Claims would have been obvious in view of the teachings of the asserted prior art and the knowledge of a POSITA before the time of the alleged invention of the '001 patent.

**IX. GROUND 1: EMANUEL AND IHARA COMBINED RENDERS
OBVIOUS CLAIMS 1, 2, 5, 7, 8, AND 10**

A. Emanuel’s Priority Date

62. U.S. Patent No. 7,845,560 to Emanuel et al. (“Emanuel,” Ex.1005)
was filed on December 3, 2005 and claims priority to U.S. Provisional Application
No. 60/635,813 (“Emanuel-Prov,” Ex.1006), filed December 14, 2004.

63. I understand that Emanuel is entitled to the December 14, 2004 filing
date of Emanuel-Prov if at least one claim of the potential reference is supported
by the written description of the relied upon provisional application, which is
satisfied here.

64. As shown in the claim chart below, Emanuel-Prov provides support
for independent claim 1 of Emanuel.

Claim 1 of Emanuel	Support in Emanuel-Prov (Ex.1006)
[1.0] A method of determining the position and the rotational orientation of an object within a predefined coordinate space, the method comprising:	Emanuel-Prov provides equivalent language that matches the claim language in Emanuel: “A method of determining a coordinate position and azimuth orientation (i.e., directional heading) of an object within a predefined coordinate space, the method comprising:” Ex.1006, 12. “The method of the present invention determines a coordinate position and rotational orientation (i.e., directional heading) of an object within a coordinate space. The method comprises the steps of:” Ex.1006, 3.

[1.1] a) providing a plurality of unique position markers having identifying indicia and positional reference indicia thereupon, the markers being arranged at predetermined known positional locations within the coordinate space so that at least one position marker is within view of the object;	Emanuel-Prov provides equivalent language that matches the claim language in Emanuel: a) providing a plurality of unique position markers having identifying indicia and positional reference indicia thereupon, the markers being arranged at predetermined positional locations within the coordinate space so that at least one position marker is within view of the object;” Ex.1006, 12. <i>See also</i> Ex.1006, 3, 5-6.
[1.2] b) using an image acquisition system mounted on the object, acquiring an image of the at least one position marker within view;	Emanuel-Prov provides equivalent language that matches the claim language in Emanuel: “b) Using an image acquisition system mounted on the object, acquiring an image of the at least one position marker within view;” Ex.1006, 3.
[1.3] c) processing the image to determine the identity, the position relative to the object, and the rotational orientation relative to the object of each position marker within view; and	Emanuel-Prov provides equivalent language that matches the claim language in Emanuel: “c) Processing the image to determine the identity of each position marker and the position of each position marker relative to the object, and to determine the orientation of each position marker relative to the object;” Ex.1006, 3.
[1.4] d) calculating the position of the object and the rotational orientation of the	Emanuel-Prov provides equivalent language that matches the claim language in Emanuel: “d) Calculating the position of the object and the rotational orientation of the object in the coordinate

object in the coordinate space and storing the position and rotational orientation information in a memory.	space and storing the position and rotational orientation information in a memory.” Ex.1006, 3.
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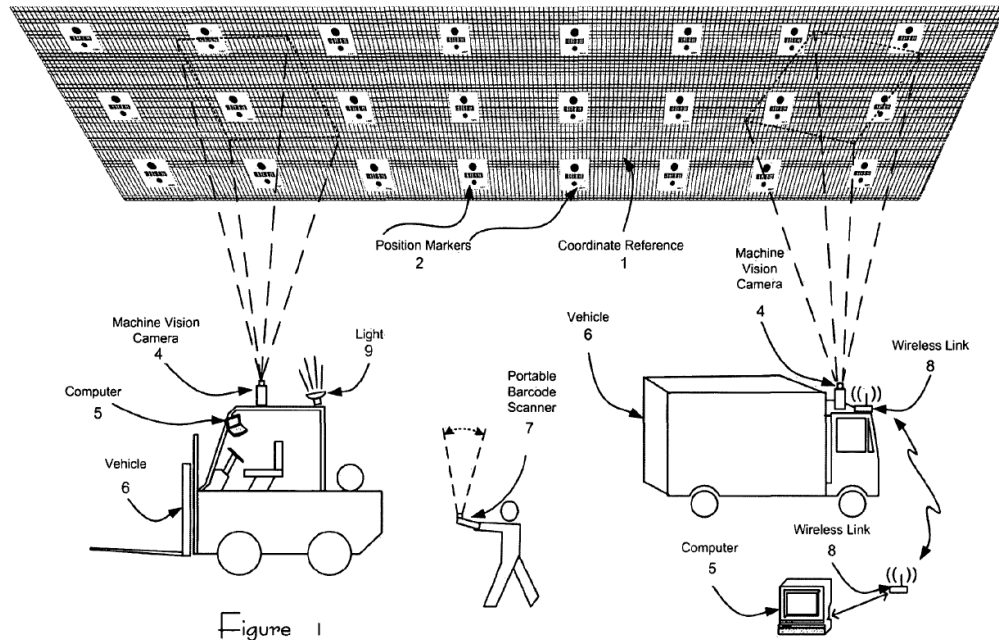
65. In addition, it is my opinion that all portions of Emanuel (Ex.1005) relied upon in this declaration have support in the Emanuel-Prov (Ex.1006) from the point of view of a POSITA. I have indicated where such support is found in the Emanuel-Prov by using dual citations to Emanuel and Emanuel-Prov. For ease of reference, the cited portions of Emanuel-Prov are provided in Ex.1030.

B. Summary of Emanuel

66. Like the '001 patent, Emanuel relates to a “method and apparatus for determining position...of an object within a predetermined area.” Ex.1005, Abstract; Ex.1006, 1. In Emanuel, “[p]osition markers, encoded with their identity, are viewed with a camera, images are captured and processed, and the position...of the object [is] calculated.” Ex.1005, Abstract; Ex.1006, 1.

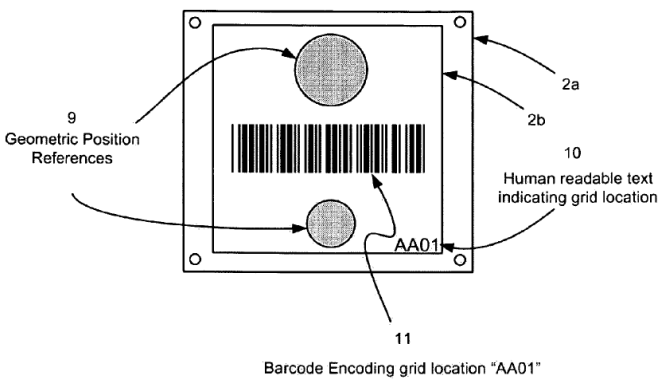
67. In particular, the position of an object is “determined by acquiring images of position markers which are placed to known locations in or near the coordinate space, i.e., the region of interest.” Ex.1005, 5:13-16; Ex.1006, 3. Each position marker has a “one-dimensional or two-dimensional barcode” which

“encode[s] the identity of position marker of the coordinate reference.” Ex.1005, 6:55-57; Ex.1006, 6. Figure 1 of Emanuel shows key elements of the system such as the “position markers 2, machine vision camera 4, [and] data processing device 5.” Ex.1005, 5:40-44; Ex.1006, 4:

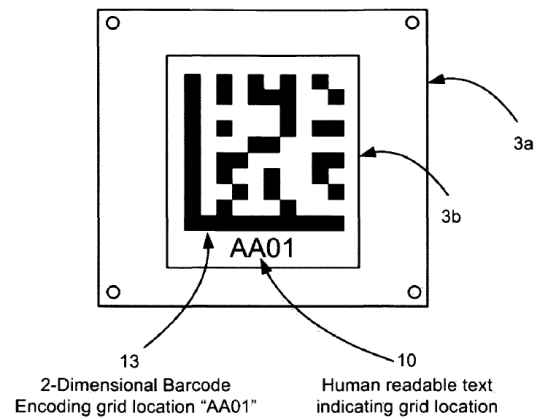


Ex.1005, Fig. 1; Ex.1006, Fig. 1

68. Examples of these bar codes on the position markers are shown in Figs. 3 and 12 and of Emanuel:



Ex.1005, Fig. 3; Ex.1006, Fig. 4



Ex.1005, Fig. 12; Ex.1006, Fig. 5

69. Once “an image is captured 110 by the machine vision camera” in Emanuel’s system, image “analysis begins by locating 120 a readable position marker (image in which the bar code can be decoded).” Ex.1005, 10:31-34; Ex.1006, 8, 10, 13. In Emanuel, the “markers may be directly encoded with position information, or they may be serially encoded with non-meaningful ‘license plate’ numbers.” Ex.1005, 10:46-48; Ex.1006, 8, 10, 17. When directly encoded, “the decoded ID...translate[s] directly into real coordinates; for example, marker 100250 may be encoded to mean ‘100 feet south, 250 feet west.’” Ex.1005, 10:48-51; Ex.1006, 8, 10, 17. Alternatively, when serially encoded, the decoded “ID has no inherent meaning and a look-up table contains references to the actual position [of the marker].” Ex.1005, 10:53-55; Ex.1006, 10, 13. Using either approach, Emanuel’s machine vision system “analyzes the image within the field of view, identif[es] position markers, decod[es] the position markers’ encoded

position information, calculat[es] X-Y coordinates in pixel space, and convert[s] the results to actual position” of the machine vision system. Ex.1005, 10:20-24; Ex.1006, 8.

C. Summary of Ihara

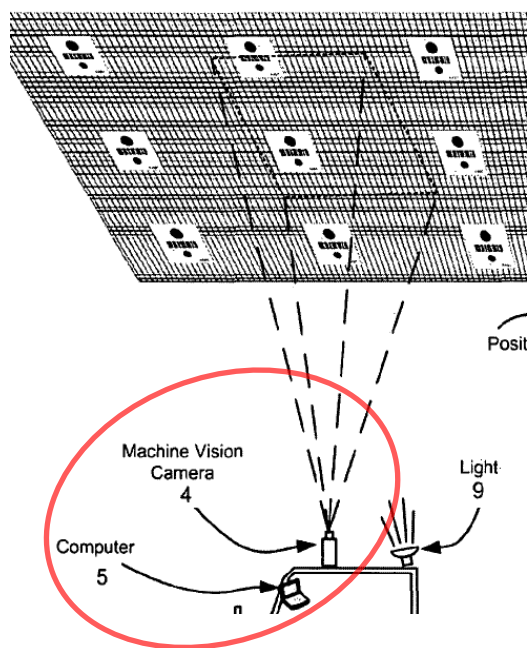
70. U.S. Patent 6,650,776 to Ihara et al. (“Ihara,” Ex.1007) was filed June 28, 1999, and issued on November 18, 2003. Like the ’001 patent and Emanuel, Ihara relates to a computer system for “recognizing code data efficiently and accurately from image data representing two-dimensional [bar]codes.” Ex.1007, 2:13-16. In Ihara, a “video camera” that is built-in to the body of a “personal computer” is used to capture image data of a bar code, such as a “two-dimensional code label.” Ex.1007, 6:21-25. After capturing an image, the computer “proceeds to recognize code data of the captured two-dimensional code label.” Ex.1007, 6:24-26.

Reasons to Combine Emanuel and Ihara

71. It is my opinion that a POSITA would have been motivated to combine the teachings of Emanuel and Ihara. It would have been obvious, beneficial, and predictable to incorporate a built-in camera—as disclosed by Ihara—into Emanuel’s machine vision system, for example, to reduce the number of components and simplify configuration of its machine vision system.

72. As an initial matter, A POSITA would have combined Emanuel with Ihara because they both relate to capturing images of and processing barcodes using a camera. Ex.1005, 10:1-6 (“Camera images may be captured continuously, or on command, such as when the vehicle stops, or at a time chosen by the operator. When the camera 4 captures an image of the overhead position reference 1 the image is transmitted to the machine vision system computational device 5 for analysis.”); Ex.1006, 7-8; Ex.1007, 1:39-44, 7:29-30 (“Image data captured by the CCD video camera 23 are forwarded to a processing part 82 for processing”). As such, both Emanuel and Ihara are analogous art to the ’001 patent, which intends to provide “a location recognition device for recognizing a location by a mobile terminal having a camera and a method thereof.” *See, e.g.,* Ex.1001, Abstract, Fig. 6. In addition, a POSITA would have been motivated to combine Emanuel with Ihara and doing so would have been within a POSITA’s skillset.

73. Emanuel describes a “computational device 5,” such as a computer, that is connected to an external “camera 4” for capturing images. Ex.1005, 10:1-4; Ex.1006, 8.



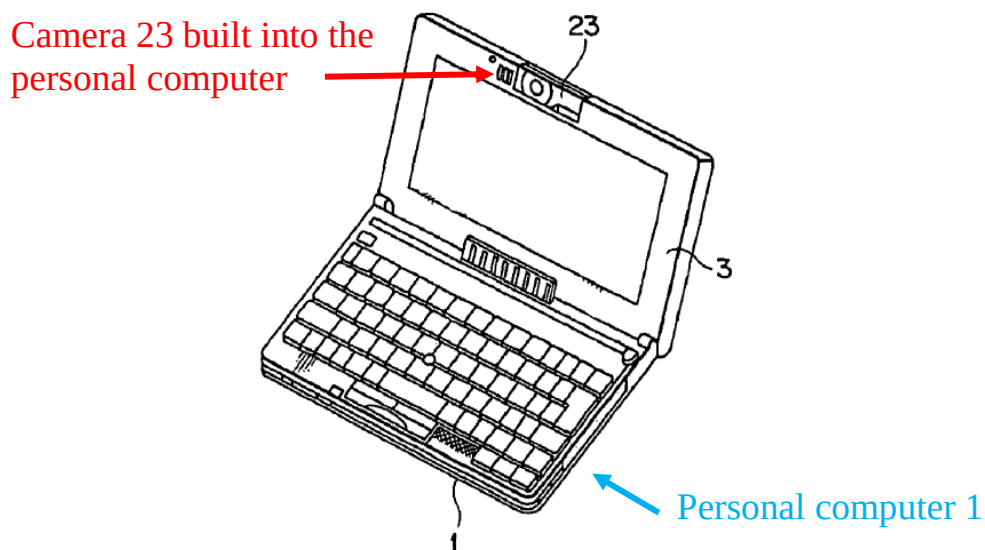
Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

74. In Emanuel, “when the camera 4 captures an image of the overhead position reference 1 the image is transmitted to the machine vision system computational device 5 for analysis.” Ex.1005, 10:3-6; Ex.1006, 8. Thereafter, “analysis begins by locating 120 a readable position marker image (image in which the bar code can be decoded)” and decoding it. Ex.1005, 10:33-34; Ex.1006, 9.

75. To the extent Emanuel does not expressly teach that its camera is “built-in” to the computer, it was well known to a POSITA that computers with built-in cameras were used to capture images of and decode bar codes. In particular, Ihara discloses a “personal computer 1” with a built in “video camera 23” that captures images of a “two-dimensional code label 101” and “recognize[s]

code data of the captured two-dimensional code label 101.” Ex.1007, 6:18-21, 7:4-

5.



Ex.1007, Fig. 1 (annotated)

76. As explained in detail below, a POSITA would have been specifically motivated to incorporate Ihara’s built-in camera technique into Emanuel because it represents merely the use of Ihara’s known technique for integrating a camera and computer into a single device to improve Emanuel’s machine vision system comprising a separate camera and computer. In particular, Ihara provides an implementation that would eliminate the need for a separately house camera, thereby streamlining Emanuel’s system while maintaining its core functionality. A POSITA would have recognized that the combination of Emanuel and Ihara would have resulted into improved portability. A laptop-based system with an integrated camera would have combined the functionality of both devices into one portable

unit. This would have made it easier for personnel to transport and use the equipment in different locations without the need for separate cameras and processing units. By integrating both the camera and the computing power into one compact unit, a POSITA would have recognized the gains in space in environments where equipment size is a concern. This is particularly useful in settings with limited space for tools and machinery.

77. Laptops also came with various connectivity options (USB, Wi-Fi, Bluetooth) at the time of the patent '001, making it easier to connect the camera to other devices or networks. This could be helpful for sharing inspection data with team members or accessing remote analysis tools. Software updates, firmware upgrades, or camera calibration could have been managed directly from the laptop. Users could have easily kept the system up to date and ensured it operated optimally with minimal effort.

78. A POSITA wanting to implement Emanuel's machine vision system as a single, integrated device would look to Ihara for details on how a camera could be built into a computer. Specifically, Ihara discloses details on an embedded camera within a computer to facilitate image capture and processing:

The personal computer 1 is capable of picking up illustratively the object 100 and two-dimensional code label 101 using the CCD video camera 23. The computer 1 proceeds to recognize code data of the

capture two-dimensional code label 101...More
Specifically, the image pickup part 22 is rotatable to any position within a range of 180 degrees in the same direction as the LCD 21 and in the opposite direction thereof (i.e., toward the back). The image pickup part 22 is furnished with the CCD video camera 23.

Ex.1007, 6:21-26, 7:1-5.

79. The combination would have also been obvious because the application of Ihara's technique (integrating a camera into computer) to improve Emanuel's machine vision system (comprising a camera and a computer) ready for improvement would yield predictable results. Here, the improvement provided to Emanuel's machine vision system is a reduction in the number of separate components required to implement its position determining system. By consolidating the camera and computer into a single unit, the need for additional external components is minimized, which simplifies assembly, reduces system bulk, and improves portability and reliability. A POSITA would know that the consolidated camera-computer system would provide a streamlined setup. Moreover, fewer physical components would mean less space required and simpler installation. It should be noted that fewer hardware components typically would lead to fewer potential points of failure in the overall system. Finally, the

consolidated camera-computer system would result in consistent calibration during the system operation.

80. Emanuel's machine vision system would also be improved because the use of an integrated camera and computer would reduce the number of external connections required to communicate image data between the camera and computer, thus reducing the number of possible points of failure and maintenance costs. With fewer external cables and connectors, the likelihood of connectivity issues, signal degradation, and physical wear on components is significantly diminished, leading to a more robust and cost-effective system over time. *See* Ex.1013, 339 ("Several techniques designed to improve the [computer] are required if the computer is to function for several years. One is to build the [computer] with as few components as is possible; assuming equal component reliability the fewer components it has, the longer it will last.")

81. Further, Ihara teaches that the built-in camera can be rotated "to any position within a range of 180 degrees in the same direction as the LCD 21 and in the opposite direction thereof (i.e. toward the back)." Ex.1007, 6:67-7:5. Thus, another improvement provided to Emanuel's machine vision system is the ability to rotate the camera towards the position markers, regardless of how the computer is attached to the vehicle.

82. A POSITA would have had a reasonable expectation of success in combining the teachings of Emanuel and Ihara. For example, Emanuel discloses that a “preferred embodiment” utilizes a commercial machine vision system with a built-in camera. Ex.1005, 10:13-16 (“**The preferred embodiment applies a commercial machine vision system such as Model 5100 or Model 5400** from Cognex, Incorporated. ‘In-Sight Explorer™’ software provided with this system offers a wide array of feature extraction, mathematical, geometric, object identification, and **barcode symbol decoding subroutines.**”); Ex.1006, 8. The Cognex In-Sight 5100 includes a camera that is integrated into the machine vision system for capturing and processing images of bar codes:

		HIGH-RES		COLOR	HIGHEST PERFORMANCE
					
		5100	5101	5100C	5400
Memory	Firmware & Use	16MB	16MB	16MB	16MB
Camera	Resolution	640 x 480	1024 x 768	640 x 480	640 x 480
	Color	No	No	Yes	No
	Acquisition Rate (Max.)	60fps	20fps	60fps	60fps
	Partial Image Acquisition	Yes	Yes	Yes	Yes
	Max. Distance (camera to processor)	N/A	N/A	N/A	N/A
	NEMA/IP Ratings (camera)	NEMA 6/IP67 ⁴	NEMA 6/IP67 ⁴	NEMA 6/IP67 ⁴	NEMA 6/IP67 ⁴
	Max. Operating Temperature	45°C	45°C	45°C	45°C
Display Options	VGA Port	No	No	No	No
	PC (via In-Sight Explorer)	Yes	Yes	Yes	Yes
I/O Options	Trigger	Yes	Yes	Yes	Yes
	Strobe	Yes ¹	Yes ¹	Yes ¹	Yes ¹
	No. of Outputs	2	2	2	2
	I/O Breakout Module (CIO-1350-XX) Support	Yes	Yes	Yes	Yes
	I/O Expansion Module (CIO-1450-XX) Support (adds 8in/8out)	Yes	Yes	Yes	Yes
	I/O Expansion Module (CIO-1460-XX) Support (adds 8in/8out)	Yes	Yes	Yes	Yes
Communication Options	Ethernet I/O Support (up to 512in/ 512out)	Yes	Yes	Yes	Yes
	RS232 Port (w/ Rx/Tx & RTS/CTS)	1 ³	1 ³	1 ³	1 ³
	Ethernet Port	1	1	1	1
Lighting Options	Direct Power	No	No	No	No
Application Development	Control Pad	No	No	No	No
	In-Sight Explorer	Yes	Yes	Yes	Yes
Lens Mount	C or CS ⁶	C	C	C	C
Vision Tool Support	PatMax (optionally available)	Yes	Yes	Yes	Yes
	PatFind	Yes	Yes	Yes	Yes
	IDMax (for Data Matrix 2D codes)	Yes	Yes	Yes	Yes
	Edge	Yes	Yes	Yes	Yes
	Blob	Yes	Yes	Yes	Yes
	Histogram	Yes	Yes	Yes	Yes
	Image Processing	Yes	Yes	Yes	Yes
	OCV/OCR	Yes	Yes	Yes	Yes
	1D Codes: Code 3 of 9, Code 128, Interleaved 2 of 5,	Yes	Yes	Yes	Yes
	Reduced Space Symbology (RSS),	Yes	Yes	Yes	Yes
	UPC/EAN, PostNet, Planet Code, Pharma Code, UPU-57	Yes	Yes	Yes	Yes

Ex.1009, 65 (annotated and partial)

83. Because Ihara also describes a camera built into a computer for capturing and processing images of bar codes, a POSITA would have understood readily that the teachings described in Ihara are applicable to Emanuel. Ex.1007, (“[T]he Video camera picks up an image of a two-dimensional [bar]code 600 for code recognition”); Ex.1005, 10:31-34 (“Upon internal or external command, an

image is captured 110 by the machine vision camera...Analysis begins by locating 120 a readable position marker image (image in which the bar code can be decoded)"); Ex.1006, 7-9. Thus, it would have been within the background knowledge and standard capabilities of a POSITA to modify Emanuel's machine vision system to include a built-in camera.

84. Accordingly, a POSITA would have found it obvious to apply Ihara's teachings to Emanuel's machine vision system and methods because the combination merely amounts to integrating a camera into a system ready for improvement.

D. Detailed Analysis of Claims

1. Claim 1

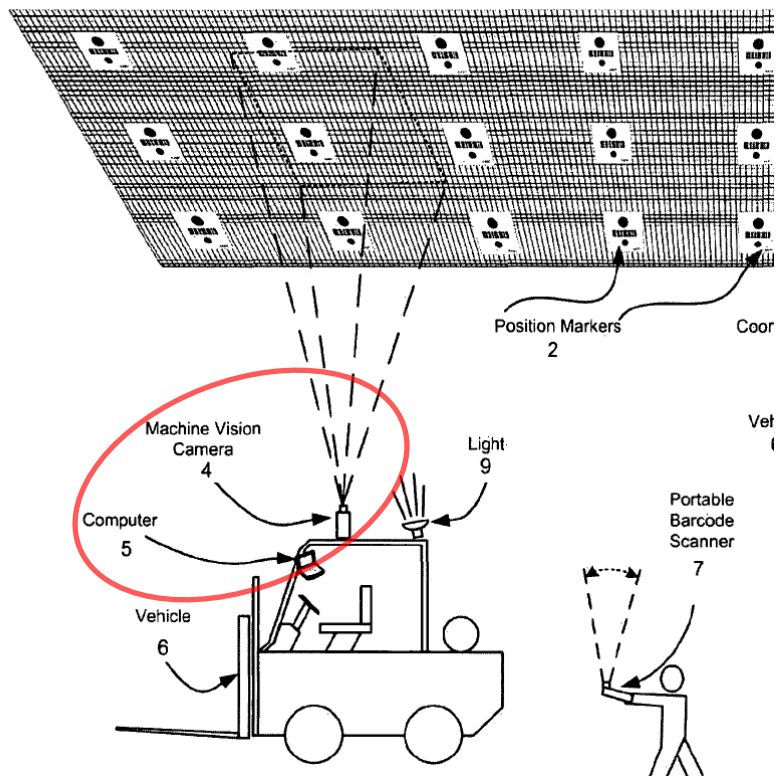
- a. [1.0] *A method for recognizing a location by a mobile terminal having a built-in camera, the method comprising:***

85. Emanuel teaches "a method and apparatus for determining position...of an object within a predetermined area." Ex.1005, Abstract; Ex.1006, 1, 3. Specifically, Emanuel teaches a method to "accurately determine [a] camera's position and orientation" and presents "a general solution to the problem of object location." Ex.1005, 12:11-14, 1:28-29; Ex.1006, 1, 5.

86. Figure 1 of Emanuel illustrates an example of "a machine vision system," where "a machine vision camera 4" mounted to a forklift truck captures an overhead image and transmits the image to an on-board "machine vision system

computation device 5” for analysis Ex.1005, 10:3-6; Ex.1006, 8; Ex.1005, Fig. 1;

Ex.1006, Fig. 1:



Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

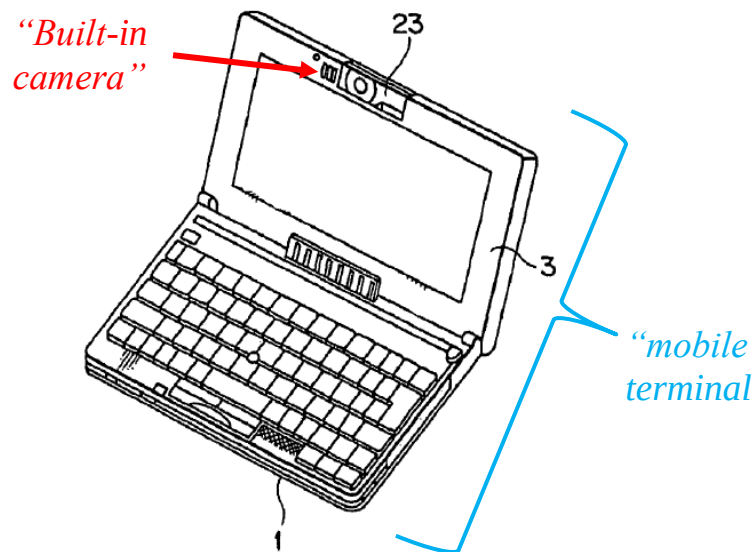
87. Emanuel’s machine vision system is “mobile” because it is affixed to a forklift that moves. Emanuel’s machine vision system is designed to be applied in mobile environments:

The present invention provides a reliable and accurate method and apparatus that can be used in many situations. It is suitable for stationary or **mobile objects**, slow or fast motion, incremental or continuous measurement, indoor or outdoor use, and can serve as the

sensory apparatus and method for a guidance system, navigation system, or position monitoring system. While the specific purpose is **to track industrial vehicles indoors, it can be applied to track objects of almost any sort, including railcars, heavy equipment, storage containers, people, animals, and so on.**

Ex.1005, 38-47; Ex.1006, 1-2.

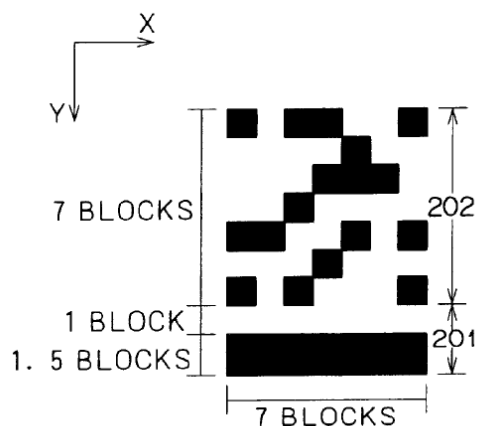
88. Further, although Emanuel's Fig. 1 depicts the machine vision system as comprising separate camera 4 and computational device 5, it would have been obvious to implement the system as a terminal with built-in camera, as such terminals were well known in the machine vision arts. For example, Ihara teaches a laptop computer having built-in camera designed for reading barcodes:



Ex.1007, Fig. 1 (annotated)

89. In Ihara, the “personal computer 1 is capable of picking up illustratively the object 100 and two-dimensional code label 101 using the CCD video camera 23.” Ex.1007, 6:22-25. The built-in camera is “is rotatable to any position within a range of 180 degrees in the same direction as the LCD 21.” Ex.1007, 6:67-7:5.

90. Fig. 2 from Ihara illustrates the two-dimensional code label, which is similar to the two-dimensional barcodes disclosed in the '001 patent and Emanuel:



Ex.1007, Fig. 2

As depicted in FIG. 2, the two-dimensional code label 101 is made of a plurality of square cells (black portions) arranged two-dimensionally in accordance with predetermined layout rules. Such a layout pattern of the cells represents in coded form alphanumeric characters, such as a number 200 in this example.

Ex.1007, 4:19-24.

91. As discussed in Section IX-D, it would have been obvious to implement Emanuel's machine vision system as a *mobile terminal having a built-in camera*, as taught by Ihara. This is especially true given that Emanuel's "preferred embodiment" is based upon a "commercial machine vision system such as Model 5100 or Model 5400 from Cognex Incorporated," which is a mobile terminal having a built-in camera, as illustrated below. Ex.1005, 10:13-16; Ex.1006, 8.

In-Sight 5100 and 5400



The rugged 5100 and 5400 In-Sight vision sensors provide unmatched performance, reliability, and ease of use. The included lens cover is used in applications where wash-down or dust protection is required.

Ex.1010, 1

92. The Cognex Insight-5100 and 5400 models include integrated image processing and analysis capabilities, including "a full library of Cognex vision tools...provid[ing] image processing and analysis tools." Ex.1009, 65; Ex.1010, 1. Further, the Cognex In-Sight 5100 and 5400 models included IDMax Data Matrix

code reading software, allowing for one-dimensional and two-dimensional barcodes to be read and processed (Ex.1009, 5, 7), “measurement tools” for measuring “distance between image features” (Ex.1009, 5), a “high performance processor” (Ex.1009, 22) and 64MB of image processing memory (Ex.1009, 26). In more detail, the Cognex Insight 5100 and 5400 models have the following code-reading tools:

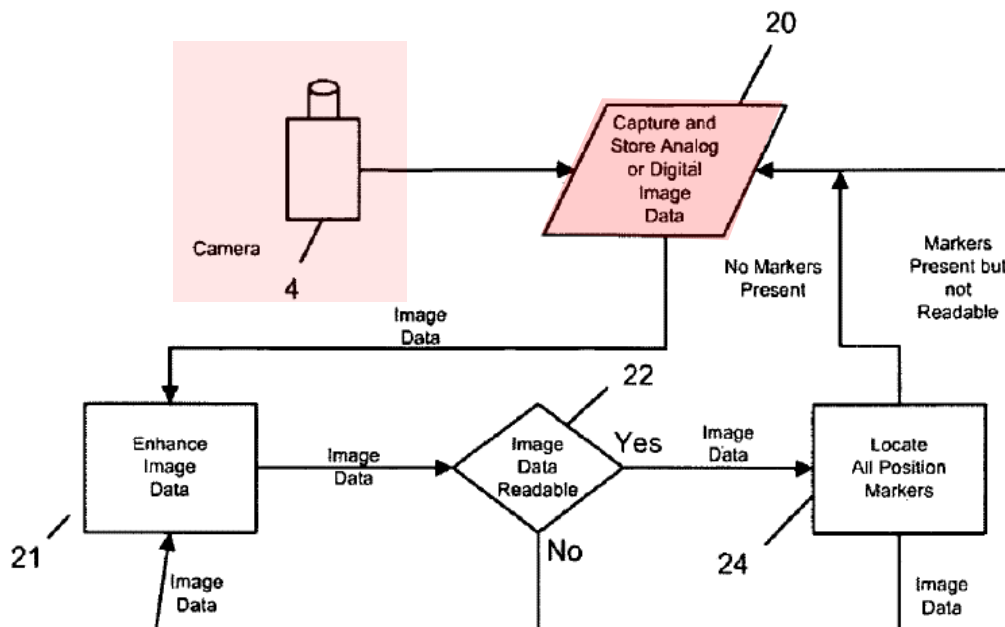
In-Sight code-reading tools, available on all In-Sight vision sensors, utilize advanced recognition algorithms to **provide reliable reading of 1D and 2D codes**. Since reading codes that are directly marked on parts is particularly challenging, In-Sight 5000 Series and 3400 vision sensors incorporate IDMax Data Matrix **code reading software**. Based on the industry-leading Cognex PatMax technology, **IDMax provides the most robust and reliable decoding under all conditions**.

Ex.1009, 7.

93. Thus, Emanuel’s method for recognizing a location by a mobile machine vision system that may be implemented as an integrated system, in view of Ihara’s laptop with built-in camera, renders obvious “*a method for recognizing a location by a mobile terminal having a built-in camera.*”

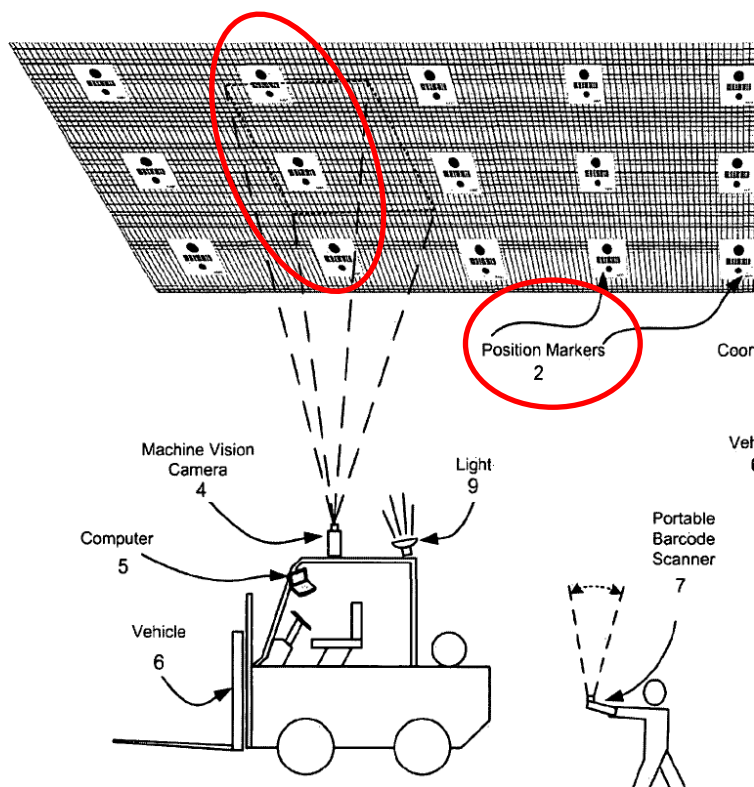
**b. [1.1] a) photographing a location recognition tag
storing location recognition information;**

94. Emanuel's method begins when the "machine vision camera 4...captures analog and/or digital images" of "position markers 2" (location recognition tag). Ex.1005, 11:19-21; Ex.1006, 9. This is depicted in the flowchart provided in Fig. 9 of Emanuel (Ex.1005, Fig. 9; Ex.1006, Fig. 12):



Ex.1005, Fig. 9 (annotated and partial); Ex.1006, Fig. 12

95. The "position markers...are placed at known locations in or near [a] coordinate space." Ex.1005, 5:13-15; Ex.1006, 3. In Emanuel, these position markers are placed on the ceiling within the coordinate space, as illustrated in Fig. 1 below (Ex.1005, Fig. 1; Ex.1006, Fig. 1):



Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

96. Further, these position markers have “**barcodes**” which “encode[] the marker location...in any of several common bar code symbologies.” Ex.1005, 8:5-7, 10:46-50 (barcodes in position markers “may be directly encoded with [marker] position information”); Ex.1006, 6, 7. The position markers may have one-dimensional or two-dimensional barcodes, as illustrated in Fig. 2 of Emanuel (Ex.1005, Figs. 2; Ex.1006, Fig. 2):

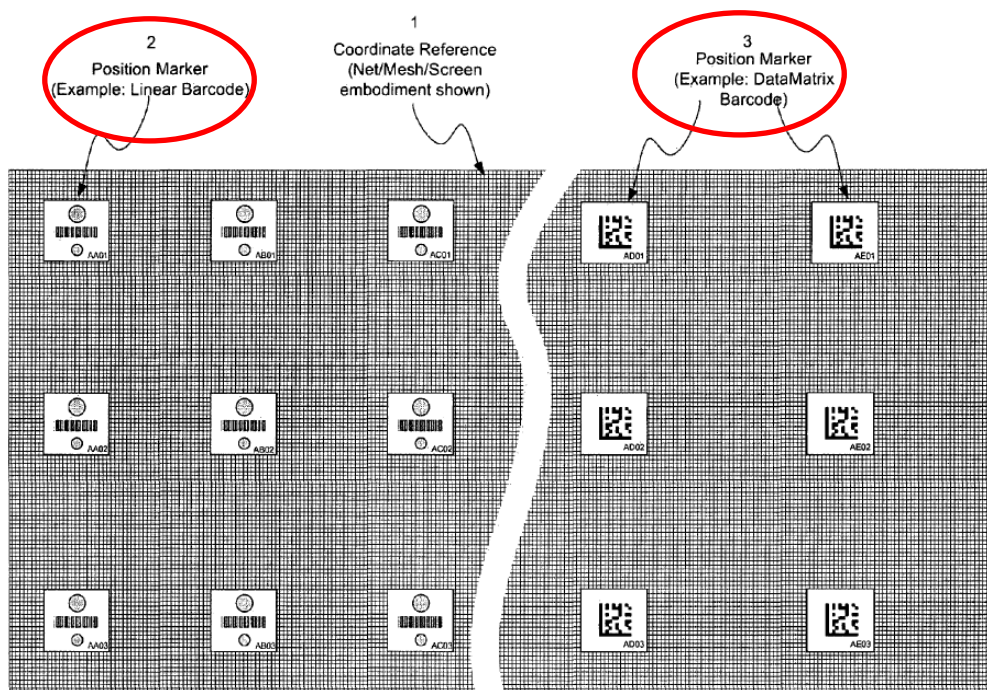


Figure 2

Ex.1005, Fig. 2 (annotated); Ex.1006, Fig. 2

97. Further, the barcodes in these position markers “**may be directly encoded with [marker] position information.**” Ex.1005, 10:46-50; Ex.1006, 7.

More specifically:

Machine readable symbols, such as **one-dimensional or two-dimensional barcodes, encode the identity of each position marker of the coordinate reference...**

Machine recognizable symbols are arranged on the position markers of the coordinate reference **at predetermined positions, allowing machine vision technology to determine position** by analyzing the shapes and symbols on the position markers.

Ex.1005, 6:55-58, 6:65-7:2; Ex.1006, 1, 6, 7.

98. This “direct encoding allows the decoded ID to translate directly into real coordinates; for example, marker 100250 may be encoded to mean ‘100 feet south, 250 feet west.’” Ex.1005, 10:48-51; Ex.1006, 7.

99. Alternatively, the barcode included on a position marker may be “serially encoded” with a “license plate” number (Ex.1005, 10:46-48; Ex.1006, 10), where “a look-up table [that] contains references” may be used to determine the position of the marker. Ex.1005, 10:53-55; Ex.1006, 10, 13. Fig. 3 of Emanuel illustrates an example of a position marker encoded with alphanumeric location “AA01” (Ex.1005, Fig. 3; Ex.1006, Fig. 5):

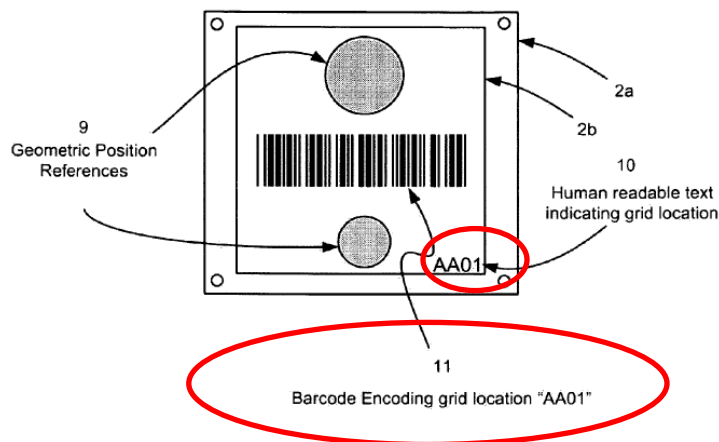


Figure 3

Ex.1005, Fig. 3 (annotated); Ex.1006, Fig. 5

100. Accordingly, Emanuel’s teaching of capturing an image of a position marker directly encoded or alternatively encoded with position information renders

obvious, “*photographing a location recognition tag storing location recognition information.*”

c. [1.2] *b) measuring a distance to the location recognition tag;*

101. Emanuel describes determining “**the distance from the camera 4 to the position marker.**” Ex.1005, 12:64-67; Ex.1006, 10. Emanuel determines this distance by calculating “the ratio of Line Segment AB in the image to the distance AB on the position marker 3.” Ex.1005, 12:62-65; Ex.1006, 10. In particular:

Since the distance AB on the position marker 3 is known and the focal length of the lens of the camera 4 is known, **the distance from the camera 4 to the position marker can be determined** from the ratio of the length of Line Segment AB in the image to the distance AB on the position marker 3.

Ex.1005, 12:62-67; Ex.1006, 10.

The **distance AB on the position marker** is depicted in Fig. 4 of Emanuel (Ex.1005, Fig. 4; Ex.1006, Figs. 8-9):

The distance AB
on the position
marker used to
determine the
“distance to the
location
recognition tag”

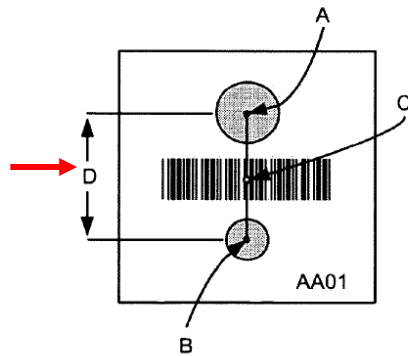


Figure 4

Ex.1005, Fig. 4 (annotated); Ex.1006, Fig. 8-9

102. The Line Segment AB in the image is depicted in Fig. 6 of Emanuel
(Ex.1005, Fig. 6; Ex.1006, Fig. 11):

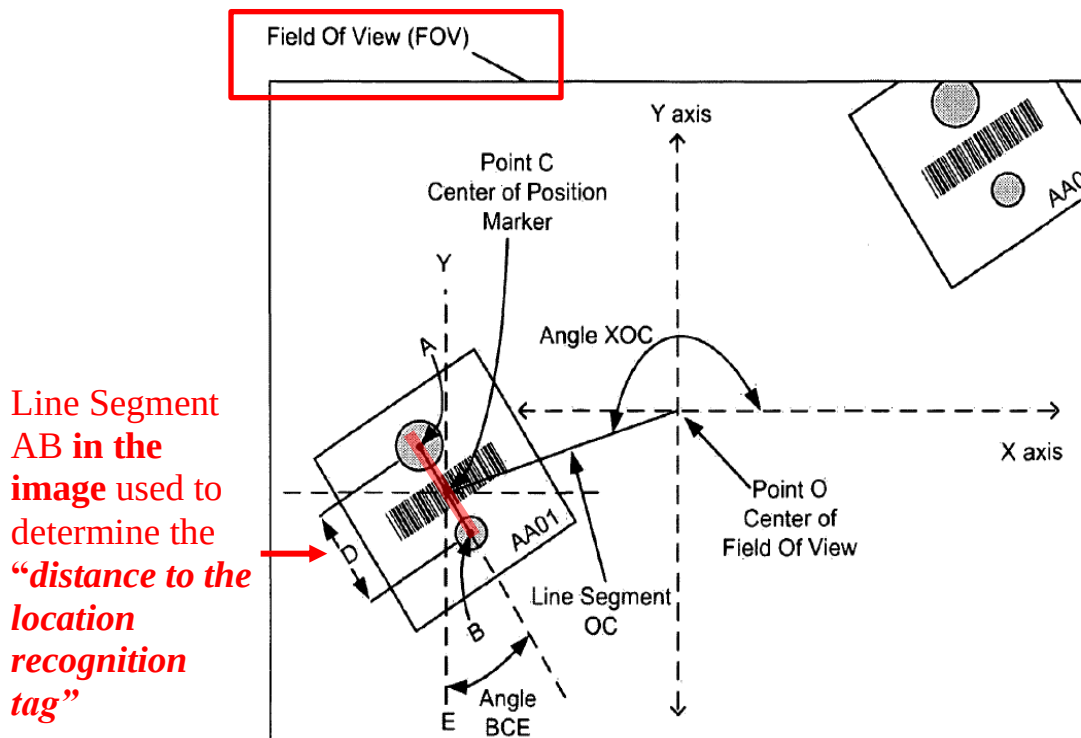
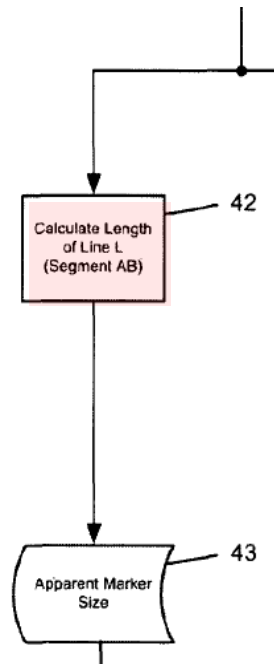


Figure 6

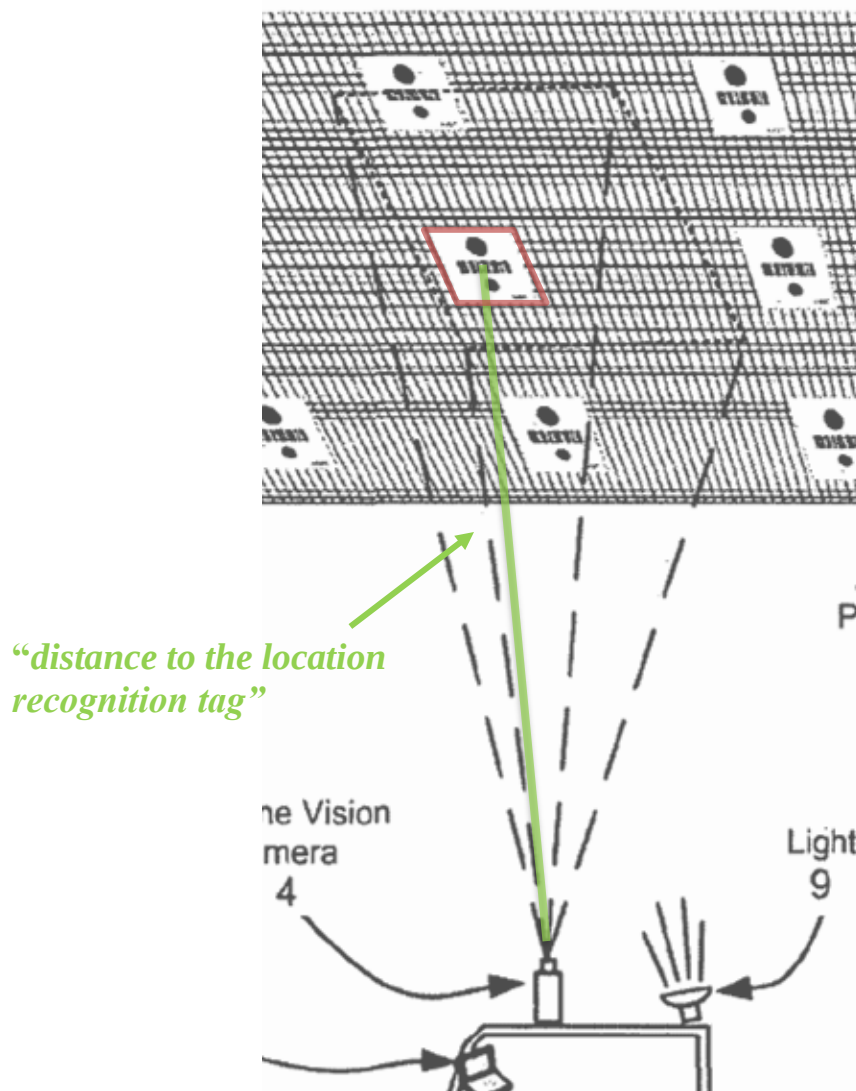
Ex.1005, Fig. 6 (annotated); Ex.1006, Fig. 11

103. The apparent length of Line Segment AB in the image is calculated at step 42 in the flowchart (Ex.1005, Fig. 10; Ex.1006, Fig. 13):



Ex.1005, Fig. 10 (annotated and partial); Ex.1006, Fig. 13

104. Annotated Fig. 1 of Emanuel illustrates “the distance from the camera 4 to the position marker” being calculated (Ex.1005, 12:64-65; Ex.1006, 10) in green below:



Ex.1005, Fig. 1 (annotated and partial); Fig. 1006, Fig. 1

105. Thus, the method through which Emanuel’s machine vision system calculates the distance from the camera 4 to the position marker renders obvious *“measuring a distance to the location recognition tag.”*

- d.** [1.3] *c) analyzing an image of the photographed location recognition tag, and obtaining location*

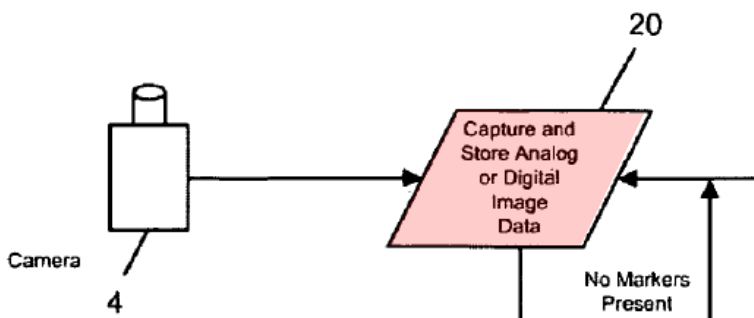
information corresponding to the location recognition tag;

106. Emanuel's machine vision system "analyz[es] the image within the field of view, identif[ies] position markers, [and] decod[es] the position markers' encoded position information." Ex.1005, 10:20-24; Ex.1006, 8. The image analysis process includes the following:

The present invention includes a set of software instructions that calls certain procedures to capture images, adjust images for readability, **analyze images to detect features**, and measure detected features to determine geometric data such as object size or location within the camera's field of view.

Ex.1005, 8:37-42; Ex.1006 9, 10.

107. In more specificity, "an image is captured 110 by the machine vision camera and stored into its memory." Ex.1005, 10:31-32; Ex.1006, 9.



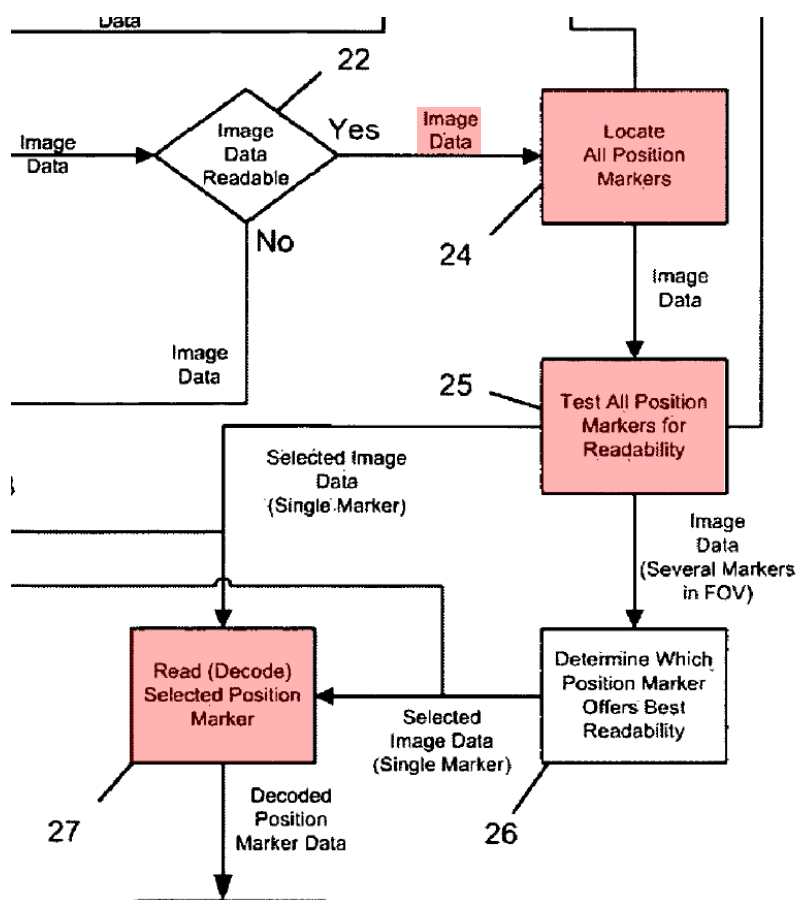
Ex.1005, Fig. 9 (annotated and partial); Ex.1006, Fig. 12

108. Then, “[image] analysis begins by locating 120 a readable position marker image (image in which the bar code can be decoded) within the field of view.” Ex.1005, 10:31-37; Ex.1006, 8-9. This locating analysis process is done as the following:

This stage determines whether single or multiple position markers appear within the field of view, and superfluous image data such as position marker printed text and background objects and the coordinate reference net are ignored. **Position markers found fully visible within the field of view are analyzed for readability 25 to determine if the bar code associated with the marker can be decoded.**

Ex.1005, 11:31-38; Ex.1006, 1, 7.

109. Thereafter, “if a single marker is found, selected image data are passed to a decoder 27.” Ex.1005, 11:38-39; Ex.1006, 9. This “**Decoder 27 ‘reads’ the 45 encoded unique identification code of the position marker and returns alphanumeric data which are stored as decoded position marker identification data 300.**” Ex.1005, 11:44-47; Ex.1006, 9. Emanuel’s Figure 9 is a flow diagram of this process:



Ex.1005, Fig. 9 (annotated and partial); Ex.1006, Fig. 12

110. This “marker identification” data is “translated directly into real X and Y position data for markers that are directly encoded.” Ex.1005, 12:1-8; Ex.1006, 3-4, 8, 12. Emanuel provides an example, where “marker ID 100250 might translate directly as ‘100 feet south and 250 feet west.’” Ex.1005, 12:1-8; Ex.1006, 3-4, 8, 12.

111. The marker may alternatively be serially encoded, where the decoded marker ID has “no inherent meaning.” Ex.1005, 10:52-55; Ex.1006, 10. In this

alternative example, the marker ID is stored in a look-up table associated with the position of the marker (Ex.1005, 10:37-45, 12:36-49; Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32)), as shown in Fig. 7:

Marker ID	Actual X (feet)	Actual Y (feet)	Actual Z (feet)	Actual θ (degrees)	Actual Size (inches)
AA01	1.0	1.0	22.0	0.0	8.0
AA02	1.0	4.0	22.1	+0.8	8.0
AA03	1.1	7.0	21.9	+1.2	8.0
AB01	4.0	1.0	22.0	-1.0	8.0
AB02	4.1	4.0	22.0	-0.4	8.4
AB03	4.2	7.1	22.1	0.0	8.1
AC01	7.1	1.1	22.2	0.0	8.0
AC02	7.2	4.1	22.1	-0.5	8.0
AC03	7.0	7.2	21.9	+2.2	7.8

Figure 7

Ex.1005, Fig. 7; Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32) (describing table)

In particular:

The Position Marker Look-Up Table 31 (FIG. 7) is a database **containing actual X, Y, and Z coordinates and rotational orientations that have been measured and recorded for all position markers** at the time of the coordinate reference installation. Coordinate values are recorded in conventional units, such as feet, meters and degrees. In this embodiment... the coordinate reference ...includes markers AA01, AA02, etc. X values correspond in the example to the north/south coordinate; Y values to east/west coordinate; Z values to marker

height above the floor, θ values correspond to the difference between the marker's rotational angle and its nominal angle, and the size value records the marker's dimensions referenced to the length of line segment AB.

Ex.1005, 12:36-49; Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32).

112. Thus, using the decoded Marker ID “AA01,” the “Actual X,” “Actual Y,” and “Actual Z” coordinates of the position marker can be obtained. Ex.1005, 12:36-40; Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32).

113. In this way, when Emanuel’s machine vision system captures an image of a barcode, and further reads and decodes the barcode to obtain the coordinates or location of the position marker (which is either directly encoded or serially encoded), Emanuel’s machine vision system is “*analyzing an image of the photographed location recognition tag, and obtaining location information corresponding to the location recognition tag,*” as claimed.

e. [1.4] d) obtaining direction information of the photographed location tag;

114. As provided in [1.3], Emanuel’s camera captures a photograph of a position marker (“*the photographed location tag*”).

115. Emanuel teaches obtaining “*direction information*” of the photographed position marker using the marker’s distance and radial angle relative to the center of the field of view of the camera, as illustrated in Fig. 6 (annotated below):

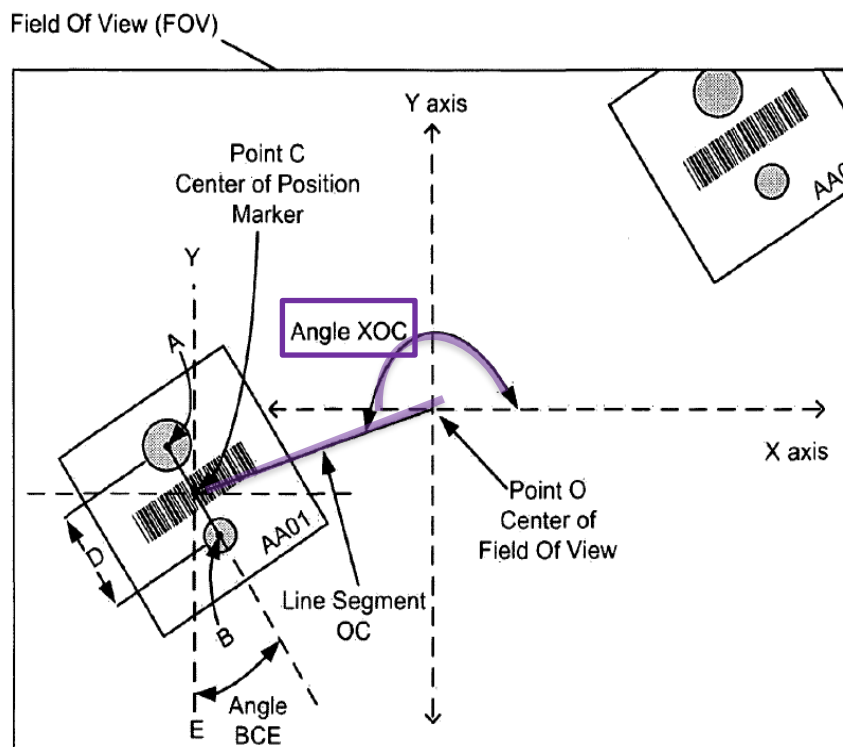


Figure 6

Ex.1005, Fig. 6 (annotated); Ex.1006, Fig. 11

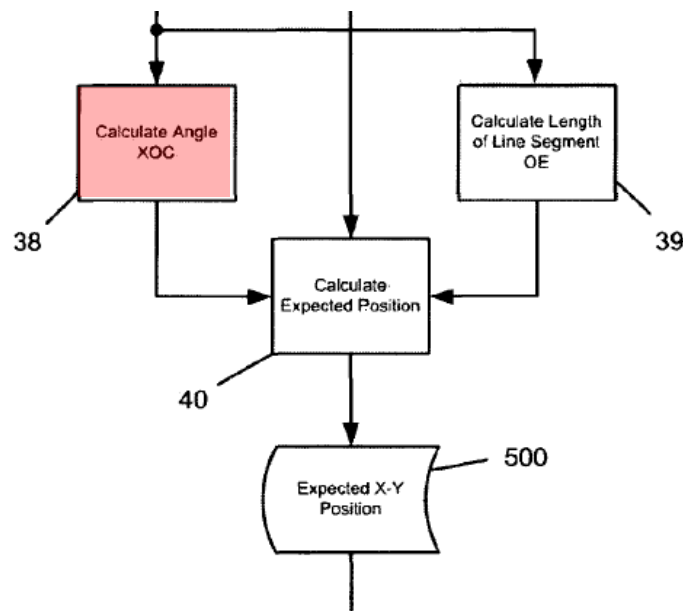
116. Within the “camera’s field of view,” the “(a) angle XOC” and “(b) the length of line segment” are calculated. Ex.1005, 12:18-27; Ex.1006, 10.

117. The length of line segment OC is calculated through “a transformation scalar to convert pixels into feet.” Ex.1005, 10:51-53; Ex.1006, 10. The Angle XOC is calculated through key points on the marker: “X and Y values of pixel coordinates A and [B], 30 are summed and divided by two (37) to establish Point E [sic, Point C]...the midpoint of line segment [AB] and the center of the position marker.” Ex.1005, 12:19-24; Ex.1006, 10. In this way, the Angle XOC is “the

radial angle between the center of the image and the center of the position marker.”

Ex.1005, 12:24-26; Ex.1006, 10.

118. Then, “once these two values have been established, it is possible to calculate a more accurate X, Y camera position using plane geometry.” Ex.1005, 12:24-26; Ex.1006, 10. This is illustrated in the flowchart of Fig. 11 of Emanuel (Ex.1005, Fig. 11; Ex.1006, Fig. 13):



Ex.1005, Fig. 11 (annotated and partial); Ex.1006, Fig. 13

119. The angle XOC is “*direction information*” because it defines the position marker’s direction relative to the camera’s center of field of view (as illustrated in Fig. 6 above). Generally, direction is known through a reference point, which is a well-known concept in basic geometry. Ex.1014, 27 (“Once an origin is selected with coordinate (0, 0, 0), any other point in the plane is found by

specifying its x-directed, y-directed, and z-directed distances from this origin.”);

Ex.1025, 21, Fig. 2.2.

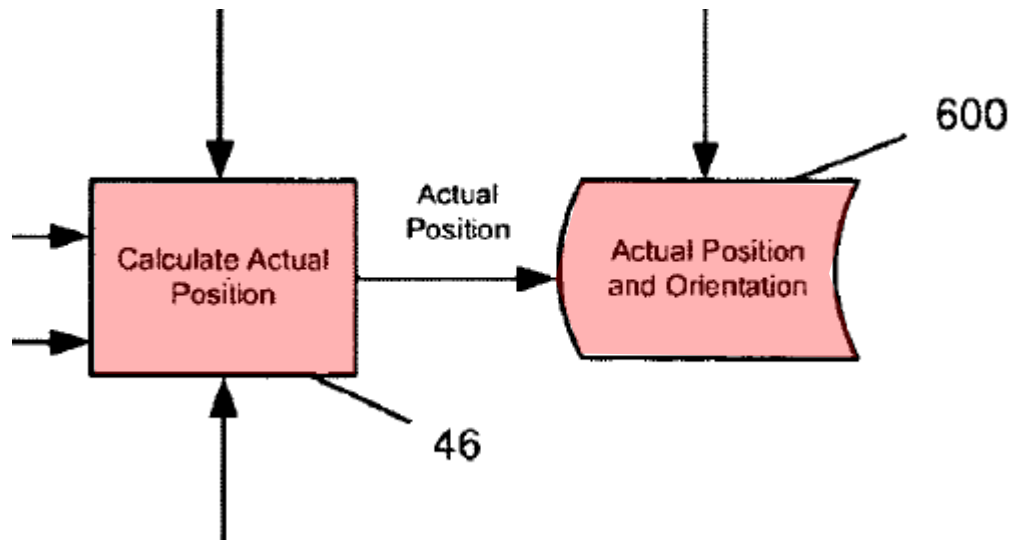
120. Here, the origin is the center of the field of view. The length of line segment OC specifies how far the position marker is from the center of the field of view in the x-directed and y-directed distances, while angle XOC indicates the rotational orientation. **The angle XOC provides the direction the position marker is in relative to the origin, which is the center of the field of view.**

121. In this way, Emanuel’s disclosure of calculating the angle XOC in relation to the position marker in the camera’s field of view, renders obvious “obtaining direction information of the photographed location tag,” as claimed.

f. [1.5] e) calculating a mobile terminal location by using the distance information measured in b), the location information obtained in c), and the direction information obtained in d).

122. As described in [1.0], Emanuel’s machine vision system “determine[es] position...of an object within a predetermined area.” Ex.1005, Abstract; Ex.1006, 1, 3. **“To more accurately determine the camera’s position,”** Emanuel describes calculating the X, Y, and Z coordinate location of the camera using the distance information measured in [1.2], the location information obtained in [1.3], and the direction information obtained in [1.4]. Ex.1005, 12:11-14, 12:18-33 (“it is possible to calculate 40 a more accurate X, Y camera position”), 12:66-13:2 (“the Z coordinate of the object may be readily calculated”).

123. Emanuel's flowchart across Figs. 9-11 illustrates how the position of the camera ("*mobile terminal location*") is calculated, with the final step representing the "actual position":



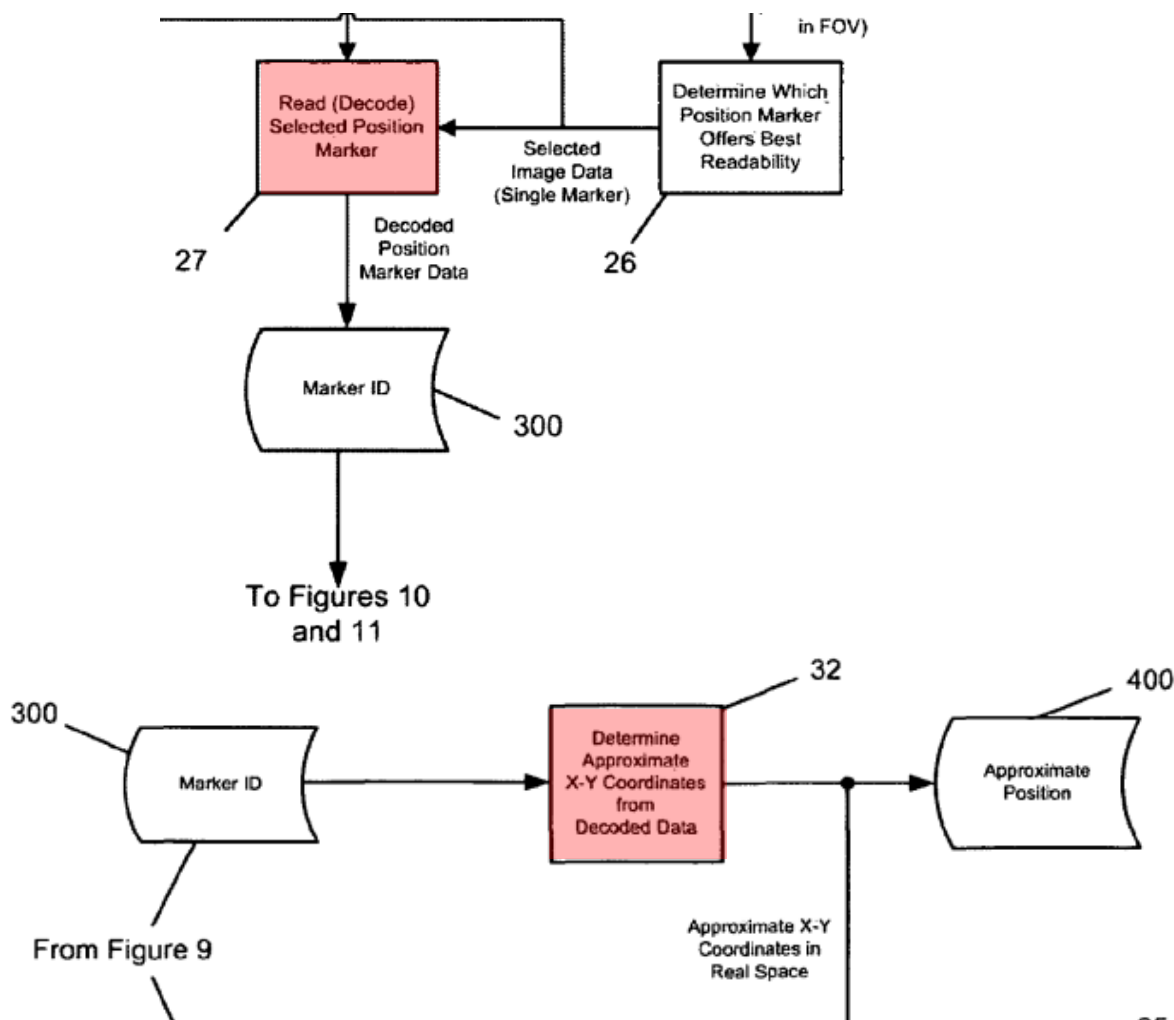
Ex.1005, Fig. 11 (annotated and partial); Ex.1006, Fig. 14

124. Each of the claimed pieces of information ("*the distance information,*" "*location information,*" and "*direction information*") are obtained and utilized within the flowchart to arrive at the final step of determining the "actual position" of the camera. Ex.1005, Figs. 9-11.

125. **First**, as discussed in [1.3], the "*location information*" are the coordinates of the position marker obtained by decoding the position marker bar code or ID. Emanuel's machine vision system "**analyz[es] the image within the field of view**, identif[ies] position markers, [and] **decod[es] the position markers' encoded position information.**" Ex.1005, 10:20-24; Ex.1006, 8.

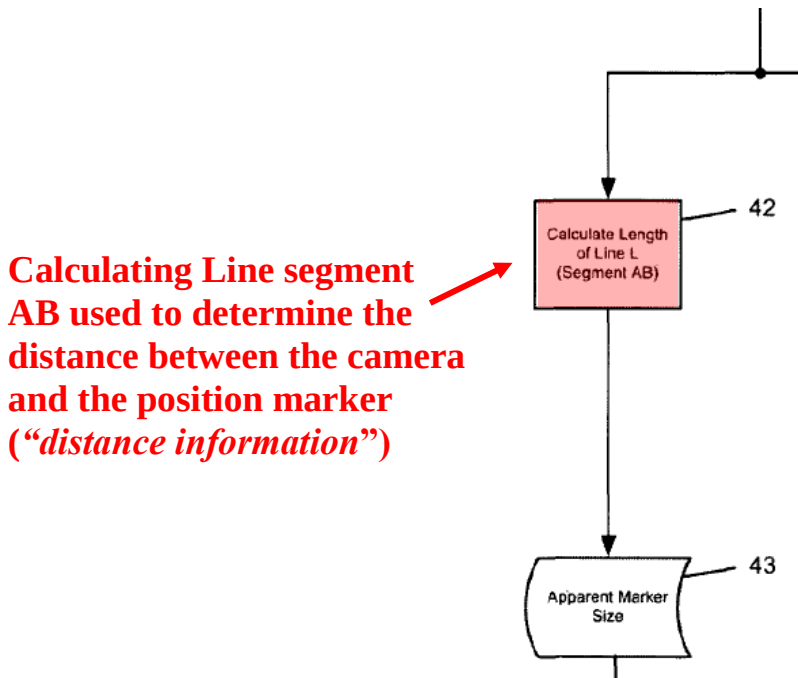
126. As discussed in [1.3], the position markers that are “directly encoded with position information” are then “translate[d] directly into real coordinates.” Ex.1005, cite; Ex.1006, 3-4, 8, 12. For example, “marker 100250 maybe encoded to mean ‘100 feet south, 250 feet west.’” Ex.1005, 12:2-4; Ex.1006, 3-4, 7-8.

127. Alternatively, the position markers that are “serially encoded” require the use of a “look-up table” that stores “marker positions” and is “accessed to return the approximate camera position 400.” Ex.1005, 10:39-42, 12:47-49; Ex.1006, 10, 13-14. In either case, the flowchart of Figs. 9-11 uses the decoded *location information* in its overall goal to calculate camera position:



Ex.1005, Figs. 9-10 (annotated and partial); Ex.1006, Figs. 12-13

128. Second, as discussed in [1.2], in Emanuel “the distance between the camera 4 to the position marker can be determined” (“*the distance information*”) by using “the ratio of the length of Line Segment AB in the image to the distance AB on the position marker.” Ex.1005, 12:64-67; Ex.1006, 10. This is further illustrated in the flowchart spanned across Figs. 9-11, specifically in Fig. 10:



Ex.1005, Fig. 10 (annotated and partial); Ex.1006, Fig. 13

129. This distance is used to “determine the Z coordinate of the position marker.” Ex.1005, 12:60-67; Ex.1006, 10. Then, “with the Z coordinate the position marker 3 also known, the **Z coordinate of the object [i.e. the camera] may be readily calculated.**” Ex.1005, 12:67-13:2; Ex.1006, 10. In other words, the distance between the camera and position marker is used to calculate the Z coordinate of the “*mobile terminal location*” and is one of the three pieces of information used to determine the location of a “*mobile terminal*.”

130. **Third**, as discussed in [1.4], the “*direction information*” includes the angle XOC. Emanuel discloses that “angle XOC” along with “the length of line segment OC, which is the radial distance from the center of the image (center of the camera), Point O, to the center of the position marker, Point E [sic, Point C], ”

can be used to calculate the position of the camera as illustrated in Figure 6
(Ex.1005, 12:24-28; Ex.1006, 10):

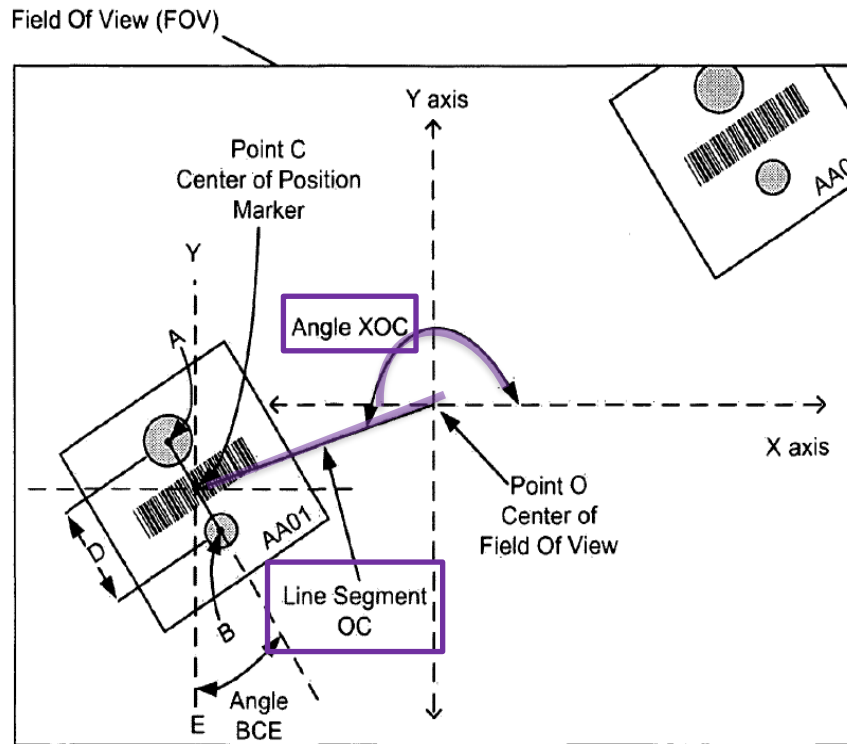


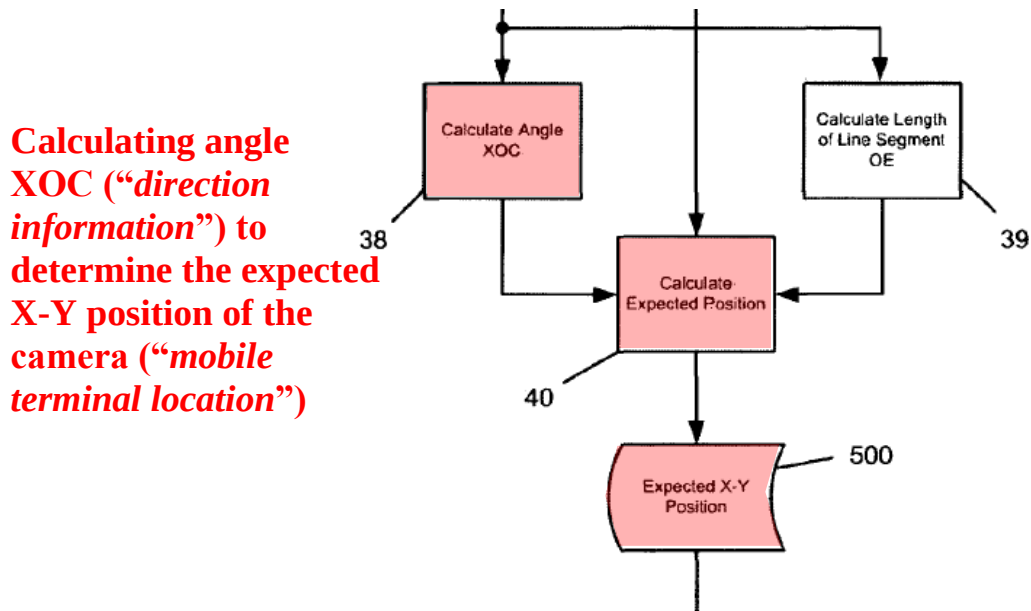
Figure 6

Ex.1005, Fig. 6 (annotated); Ex.1006, Fig. 11

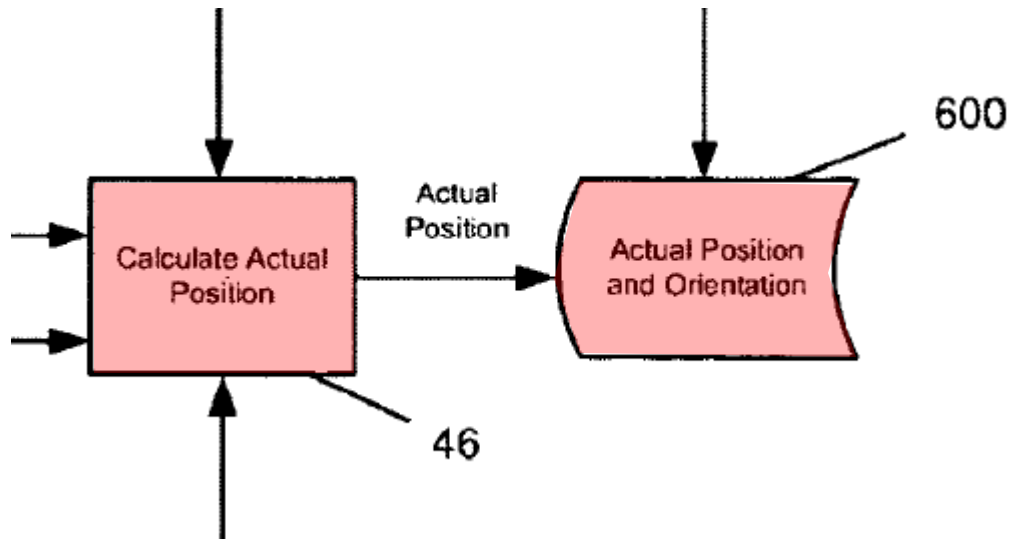
131. Emanuel teaches that “once these two values [i.e. length of line segment OC and angle XOC] have been established, **it is possible to calculate 40 a more accurate X, Y camera position using plane geometry.**” Ex.1005, 12:18-33; Ex.1006, 10.

132. In other words, by using angle XOC and the length of line segment OC, Emanuel’s machine-vision system calculates the X, Y coordinates of the “*mobile terminal location*” based on the known coordinates of the position marker

using plane geometry. This calculation is further illustrated in the flowchart spanning across Figures 9-11, where Figure 10 shows calculating the camera's "expected position" using "directly encoded markers", and where Figure 11 shows calculating the camera's "actual position" when a look-up table is used, among other inputs, to obtain marker position information (i.e. X, Y, and Z coordinates), each of which a POSITA would understand to be a "*mobile terminal location*":

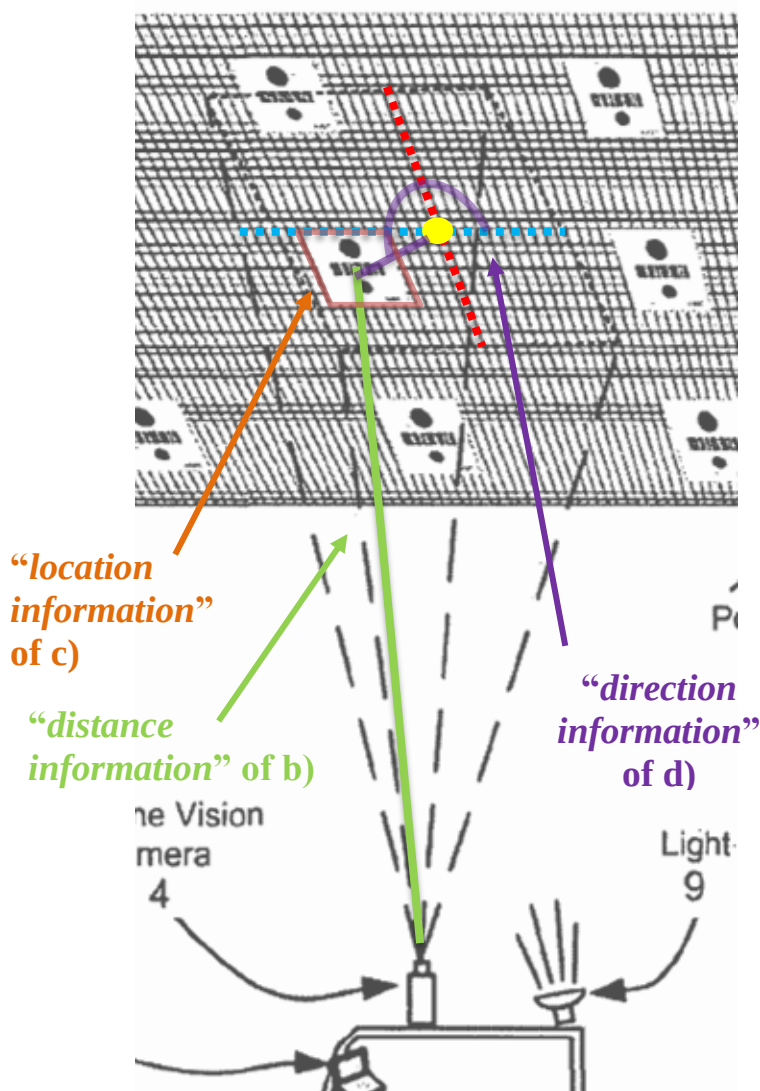


Ex.1005, Fig. 10 (annotated and partial); Ex.1006, Fig. 13



Ex.1005, Fig. 10 (annotated and partial); Ex.1006, Fig. 14

133. All three pieces of information are also demonstrated in the annotated Figure 1 of Emanuel below:



Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

134. Thus, calculating the “expected” or “actual” camera location (e.g. X, Y, and Z coordinates) by using the three types of information obtained by Emanuel in [1.2], [1.3], and [1.4] renders obvious *“calculating a mobile terminal location by using the distance information measured in b), the location information obtained in c), and the direction information obtained in d),”* as claimed.

2. Claim 2

- a. [2.0] *The method of claim 1, wherein the direction information obtained in d) is offset information of an offset state of the location recognition tag based on the mobile terminal,***

135. As described in [1.4], in Emanuel, the angle XOC (“*direction information*”) is obtained. As further described in [1.4], a POSITA would understand that the radial angle (angle XOC) from the position marker to the x-axis centered on the field of view, is “*direction information*” of the photographed location, because they represent the offset state of the location recognition tag. Ex.1025, 23 (“A frame is depicted by three arrows representing unit vectors defining the principal axes [X, Y, and Z] of the frame,”) 31 (“Another interpretation of a rotation matrix is as a rotational operator that operates on a vector AP_1 and changes that vector to a new vector, AP_2 by means of a rotation, R,”) 31-32 (“‘RK ((θ)’ is a rotational operator that performs a rotation about the axis direction k by θ degrees”).

136. In Fig. 6 of Emanuel, the position marker is “offset” relative to the center of the field of view of the camera by an angle (i.e., angle XOC). Ex.1005, Fig. 6; Ex.1006, Fig. 11. In other words, the angle XOC represents “*offset information*.”

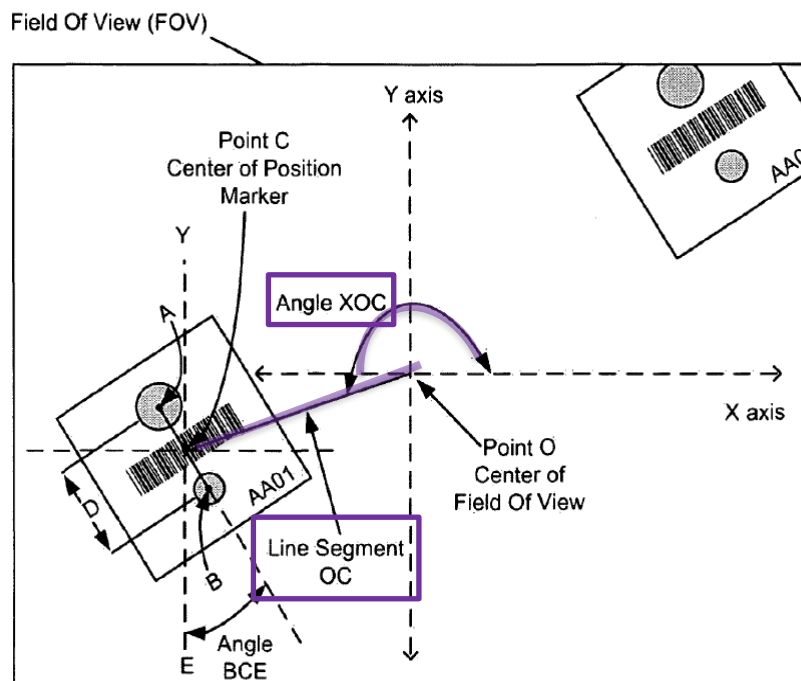
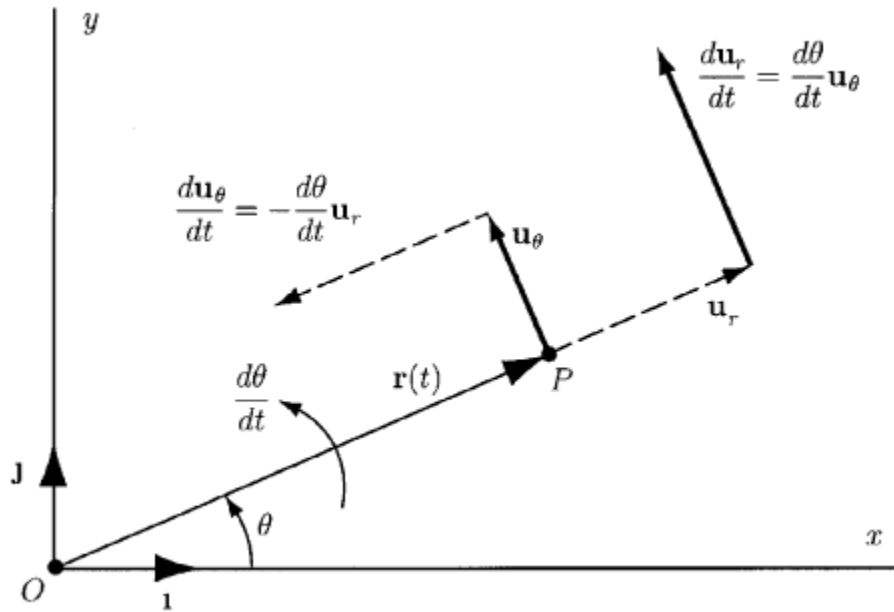


Figure 6

Ex.1005, Fig. 6 (annotated); Ex. 1006, Fig. 11

137. Emanuel's angle XOC represents the "radial angle" from the X axis to the "center of a position marker" within the camera's field of view. Ex.1005, 12:24-27; Ex.1006, 10. The angle XOC is obtained through "a geometric analysis of the marker's position...relative to the [camera's] field of view." Ex.1005, 12:13-15; Ex.1006, 10.

138. The angle XOC is "*offset information*" because the angle XOC indicates the angle by which the center of the position marker is offset from the center of the camera's field of view. This can be seen through the basic concept in geometry known as an origin (O), which is typically the reference point on a plane with a coordinate (0, 0, 0):



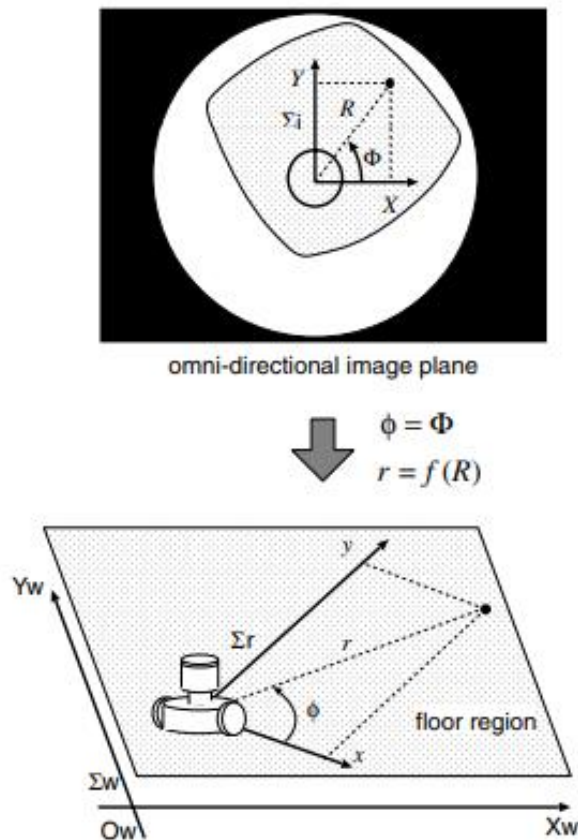
Ex.1026, 70, Fig. 2.14

139. Further,

A point P is considered in the x-y plane of a cartesian coordinate system. The position of the point P relative to the origin O may be specified either by its cartesian coordinates x, y or by its polar coordinates r, θ .

Ex.1026, 70.

140. The radial distance between a point and an object can be denoted by r and the azimuthal angle between the x-axis and the radial distance is denoted by θ . This angle may be used to determine “the distance and direction of [a point]” in relation to an object, as depicted below (Ex.1015, 205):



Ex.1015, 205

141. In Emanuel, the center of the position marker (Point C) of the tag would be represented as an ordered pair, where the radial coordinate (r) would be the line segment OC, and the angular coordinate (θ) would be the angle XOC.

142. As seen in Fig. 6, **because the tag is not at the origin—which is the center of the field of view of the camera—it follows that the tag necessarily must be “offset” from the center of the field of view.**

143. The line segment OC reflects the distance the tag is from the camera's central alignment (the center of the field of view). The camera's center point (O) represents the ideal alignment—in other words—where the position marker would be if it were perfectly centered in the camera's field of view.

144. Thus, Emanuel's angle XOC indicates the angle by which the center of the position marker is offset from the center of the camera's field of view, and renders obvious "*wherein the direction information obtained in d) is offset information of an offset state of the location recognition tag based on the mobile terminal,*" as claimed.

b. [2.1] and the offset information is obtained by analyzing a photographing angle of the photographed location recognition tag.

145. As discussed in [2.0], Emanuel teaches "*offset information*" that includes the angle XOC. Emanuel teaches that the angle XOC is obtained through a geometric analysis of the marker's position relative to the field of view of the camera:

Referring to FIGS. 5, 6, and 10, and applying only to directly encoded markers, **a geometric analysis of the marker's position** and rotation **relative to the field of view** can more accurately determine the camera's position and orientation. Pixel coordinates of Key Points B and C, 30, are used to calculate angle BCE, 34, the rotation angle of the position marker relative to the field of view.

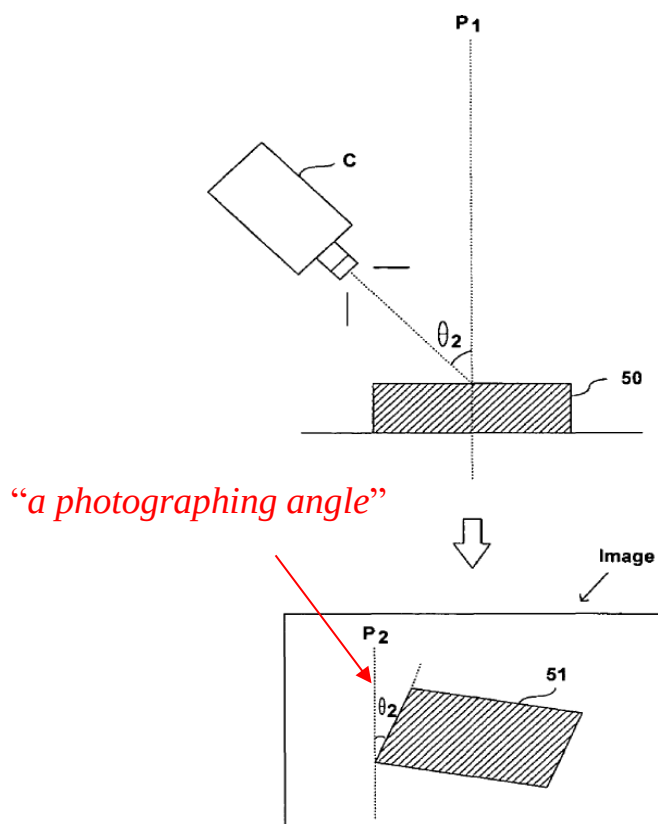
Ex.1005, 12:12-18; Ex.1006, 6, 10.

The present invention includes a set of software instructions that calls certain procedures to capture images, adjust images for readability, analyze images to detect features, and measure detected features to **determine geometric data such as object size or location within the camera's field of view.**

Ex.1005, 8:37-42; Ex.1006, 8, 9; *see also* Ex.1005, 6:67-7:2; Ex.1006, 6.

146. In other words, the angle XOC is obtained by analyzing **within the image itself** “the radial angle between the center of the image and the center of the position marker.” Ex.1005, 12:24-27; Ex.1006, 10.

147. Angle XOC is much like the example of a photographing angle described in '001 patent, as illustrated in Figure 6B:

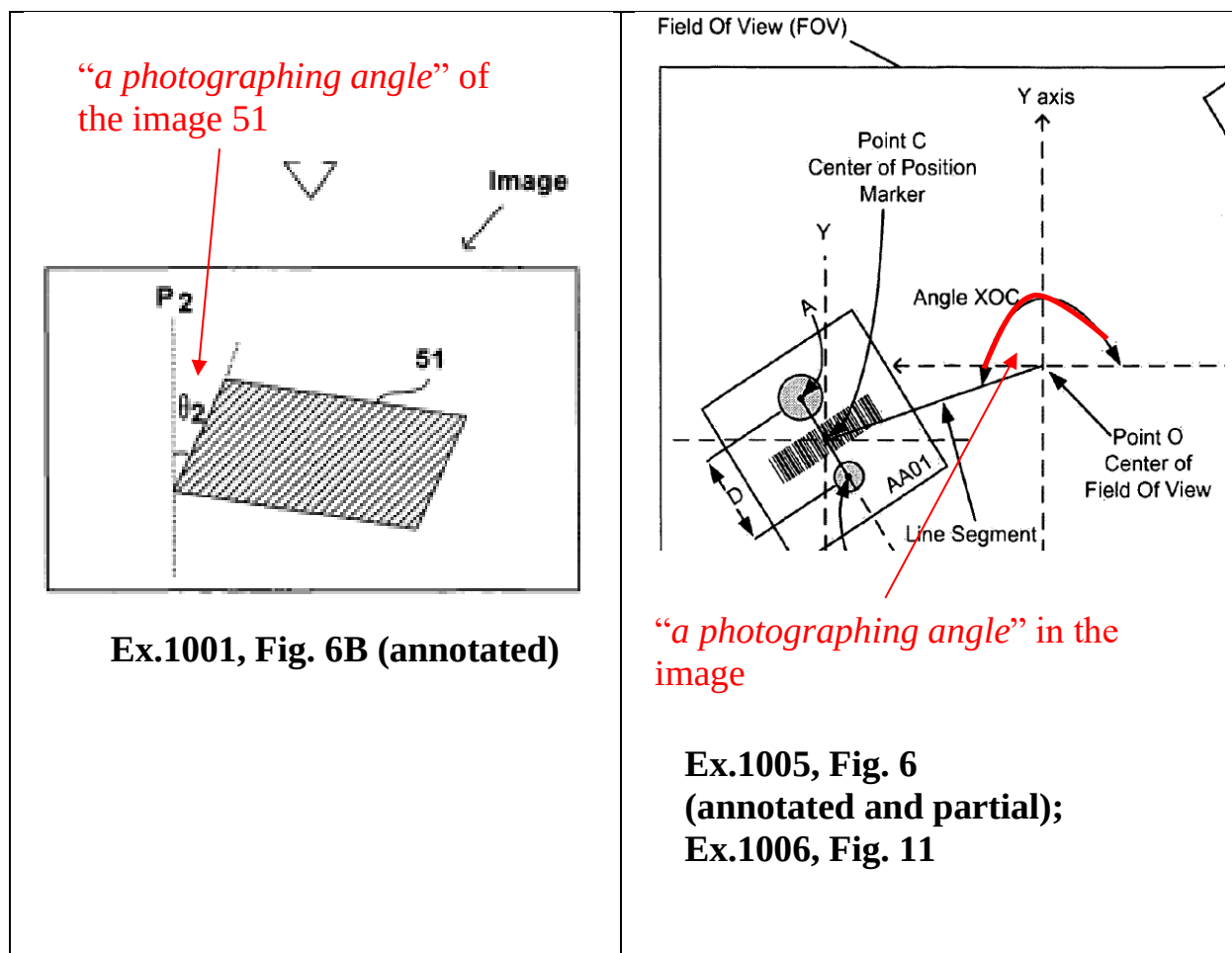


Ex.1001, Fig. 6B (annotated)

148. In particular, as shown in Fig. 6B, when an “offset angle θ_2 of the image increases as the camera C deviates from the axis P_1 , a photographing angle of the image 51 may be determined from the offset angle θ_2 [of P_1].”

Ex.1001, 6:65-67. As seen in Fig. 6B, the “photographing angle” in the ’001 patent—which is based on the P_2 axis—is in the image. Ex.1001, 6:65-67.

149. Accordingly, Angle XOC in Emanuel is much like the photographing angle described in the ’001 patent which describes the marker’s position relative to the camera’s field of view as shown below:



150. In this way, the “*photographing angle*” in the ’001 patent—**which is in the image 51**—is rendered obvious by Emanuel’s angle XOC—**which is also in the image**.

151. Thus, Emanuel’s disclosure of analyzing an image to determine the radial angle (angle XOC) of a marker’s position relative to the camera’s field of view renders obvious “*the offset information is obtained by analyzing a photographing angle of the photographed location recognition tag,*” as claimed.

3. Claim 5

- a. [5.0] *The method of claim 1, wherein the location recognition tags are arranged so that a desired precision for using the location recognition tags at a predetermined physical area may be achieved, and*

152. Emanuel's system provides "a plurality of individually unique position markers having identifying indicia and angular orientation indicia thereupon, the markers being arranged in a predetermined positional pattern within the coordinate space so that at least one position marker is within view of the object." Ex.1005, 4:56-59; Ex.1006, 15.

153. For example, the position markers ("*location recognition tags*") can be positioned "in rows and columns corresponding to a **desired coordinate plan for the designated area.**" Ex.1005, 7:67-8:2, Ex.1006, 7.

154. The position markers are used "**for accurately determining position...within a predefined space**, such as a designated area or volume inside a building." Ex.1005, 4:23-26; Ex.1006, 1, 7. "[A]fter being installed in the warehouse facility, the markers remain stationary. Each marker therefore corresponds to a particular location on the warehouse floor." Ex.1005, 9:28-41; Ex.1006, 1, 7.

155. In some instances, when calculating position, "more than one position marker may be selected...**to verify the calculation and improve the precision** of the position." Ex.1005, Ex.1006, 3.

156. Moreover, Emanuel discloses that position markers can be placed at known locations in or near a coordinate space:

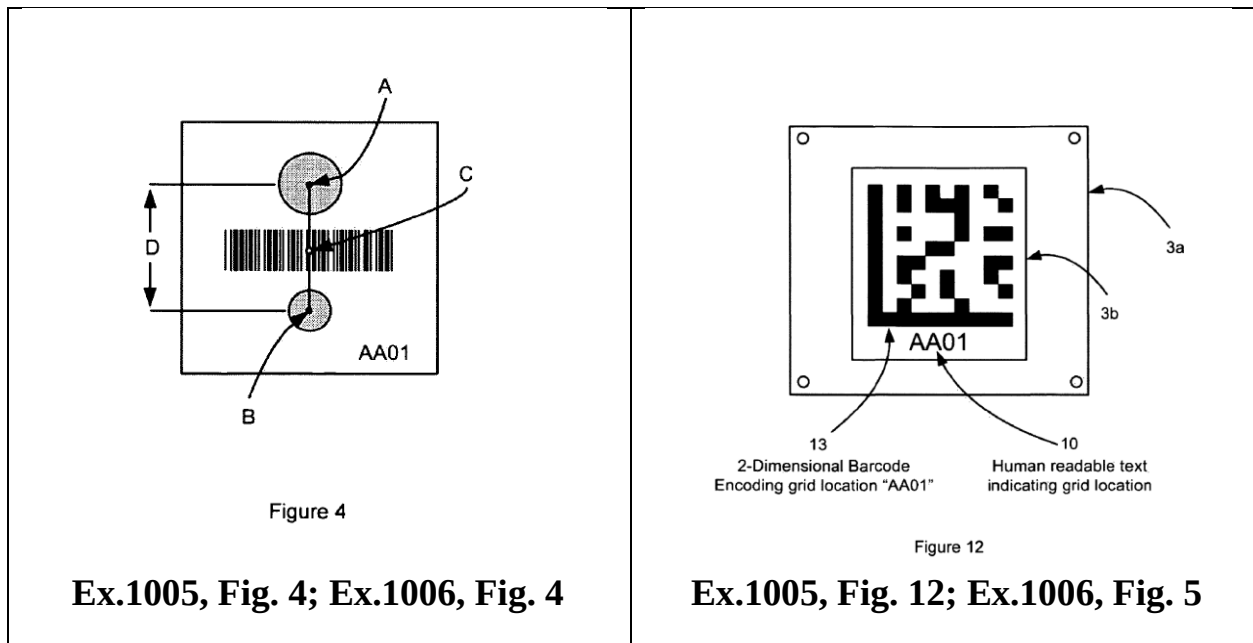
Position and rotational orientation are determined by acquiring images of position markers which are placed at known locations in or near the coordinate space, i.e., the region of interest. Subsequent image analysis is performed by commercially available machine vision equipment consisting of one or more cameras and digital processing device(s). The position and rotational orientation of one or more position markers relative to a camera's view are determined by the machine vision equipment; the position and rotational orientation in "real" space are then computed from machine vision data using a series of programmed instructions which translate the relative positional and rotational orientation data to coordinates expressed in usable units such as feet or meters.

Ex.1005, 5:13-25; Ex.1006, 9.

157. Thus, Emanuel's disclosure of arranging position markers in a "predetermined positional pattern" according to a "desired coordinate plan" for "accurately determining position...within a predefined space" such as a "building," renders obvious "*location recognition tags are arranged so that a desired precision for using the location recognition tags at a predetermined physical area may be achieved,*" as claimed.

b. [5.1] the location recognition tags are formed as one-dimensional or two-dimensional barcode types.

158. On Emanuel's position markers, "[m]achine readable symbols, such as one-dimensional or two-dimensional barcodes, encode the identity of each position marker of the coordinate reference." Ex.1005, 6:55-57; Ex.1006, 12. The one-dimensional and two-dimensional barcodes on position markers are illustrated in Figs. 2, 4, and 12:



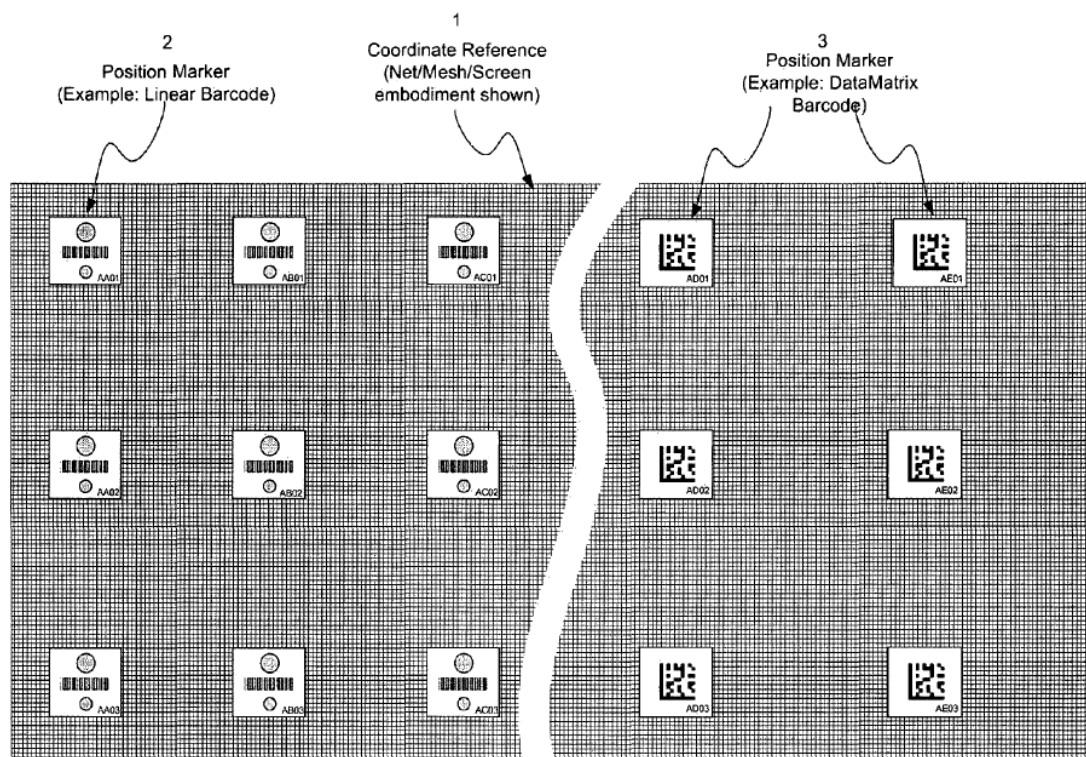


Figure 2

Ex.1005, Fig. 2; Ex. 1006, Fig. 2

159. Thus, the barcodes on Emanuel's position markers render obvious
“the location recognition tags are formed as one-dimensional or two-dimensional
barcode types,” as claimed.

4. Claim 7

- a. [7.0] *The method of any one of claim 1 to claim 6, wherein the location recognition tag stores location information of one among an absolute location coordinate and a logic location coordinate.*

160. A position marker (“location recognition tag”) in Emanuel may store data in the form of a “bar code” which “can be decoded.” Ex.1005, 10:32-34;

Ex.1006, 9. The stored data can either represent the absolute location of the marker or a Marker ID that used to look up the location of the marker (“*logic location coordinate*”).

161. The position marker in Emanuel may store data indicating a specific position within the pre-defined space, such as “100 feet south, 250 feet west.”

Ex.1005, 10:50-51; Ex.1006, 7, 8, 12, 17. A POSITA would understand that this specific position information would be “*an absolute location coordinate*” because the stored values define the position marker’s precise position within the pre-determined physical area:

An absolute location system uses a shared reference grid for all located objects.

For example, all GPS receivers use latitude, longitude, and altitude—or their equivalents, such as Universal Transverse Mercator coordinates—for reporting location. Two GPS receivers placed at the same position will report equivalent position readings, and 47°39’17” N by 122°18’23” W refers to the same place regardless of GPS receiver.

Ex.1028, 58.

162. Similarly, within Emanuel’s “100 feet south, 250 feet west” example, that particular coordinate would be considered an “absolute location coordinate” because Emanuel’s system uses a shared reference grid—that being the position markers that are placed on the ceiling.

163. Alternatively, Emanuel discloses that the stored data can be location information that is “serially encoded” on the position marker whereby “the ID has no inherent meaning and a lookup table contains references to the actual position.” Ex.1005, 10:53-55, Ex.1006, 6-7, 12-14; *see also* Ex.1005, 12:58-60, Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32).

164. The position marker in Emanuel may also store a “marker identification” which “is decoded” and the “decoded marker ID 300 is used...to search [a] look-up table.” Ex.1005, 12:58-60, Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32). The “Position Marker Look-Up Table” contains “actual X, Y, and Z coordinates” which have been “recorded for all position markers.” Ex.1005, 12:36-40; Ex.1006, 10, 13-14, Fig. 13 (refs 31, 32).

165. A POSITA would understand that a serially encoded marker ID is a “logic location coordinate” because it is used to access actual X, Y, and Z coordinates in a look-up table that correspond logically to the marker ID. This concept of a logic location coordinate was well-known at the time:

In an object-oriented database management system, each single object in the database is identified uniquely by a so called object identifier (OID) which can either be **physical or logical**...In direct mapping, **the logical OID is created to encode the exact physical location of a pointer, which in turn specifies the physical location of the object.**

Ex.1029, 2.

166. A POSITA would have recognized that a logic location coordinate would have had an impact on the speed of the location recognition along with fewer system failures due to clutter and noise. Moreover, when the marker ID is used to look up the location of the position marker, it aligns with the '001 patent's description of a logic location coordinate, that is: "the logic location coordinates are identification information [used] for detecting the absolute location coordinates." Ex.1001, 4:14-16.

167. Thus, Emanuel's disclosure of position makers including bar codes that "directly encode" or "serially encode" location information renders obvious "*wherein the location recognition tag stores location information of one among an absolute location coordinate and a logic location coordinate.*"

5. Claim 8

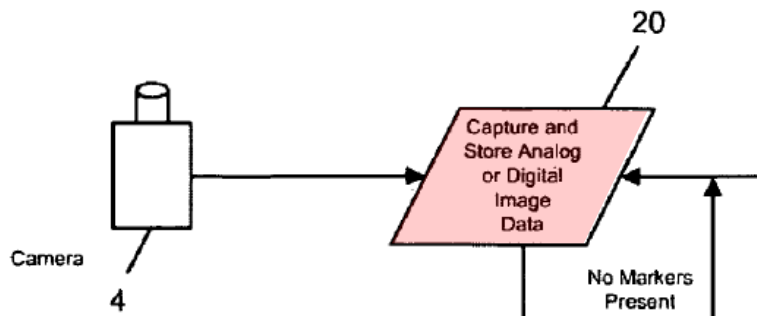
a. [8.0] *The method according to claim 1,*

168. As discussed in [1.0], Emanuel discloses "a machine vision system" (*location recognition device*) for "determining position...of an object within a predetermined area" (*recognizing a location*). Ex.1005, Abstract; Ex.1006, 1, 3. Emanuel's machine-vision system may be implemented as an integrated system, in view of Ihara's laptop with built-in camera (*using a built-in camera*).

169. Thus, for the same reasons as discussed in association with [1.0], Emanuel and Ihara render obvious this limitation.

- b. [8.1] *an image photographing unit for photographing a plurality of location recognition tags that are arranged in a predetermined physical area and respectively store location recognition information, and for performing a digital image process;*

170. First, as discussed in [1.0] and [1.1], Emanuel's machine-vision system includes a "machine vision camera 4...[that] "captures...**digital** images" (*image photographing unit*) of "position markers 2" (*location recognition tags*). Ex.1005, 11:19-21; Ex.1006, 9. In particular, Emanuel describes that "**an image is captured** 110 by the machine vision camera and **stored into its memory**" (*performing a digital image process*). Ex.1005, 10:31-32; Ex.1006, 9-10.



Ex.1005, Fig. 9 (annotated and partial); Ex.1006, Fig. 12

171. Emanuel's disclosure of capturing an image and storing the respective digital image data in memory, is much like the example of the image photographing unit in the '001 patent that "forms an image...and generates digital

image data of the subject.” Ex.1001, 5:35-40. Accordingly, Emanuel renders obvious “*a digital image process.*”

172. Second, as discussed in [1.1] and [1.3] Emanuel teaches that the “position markers...are placed at known locations in or near [a] coordinate space” (*arranged in a predetermined physical area*). Ex.1005, 5:13-15; Ex.1006, 3. These position markers “*stor[e] location recognition information*” because they have “barcodes” which “*encode[] the marker location...in any of several common barcode symbologies*” (*respectively store location recognition information*). Ex.1005, 8:5-7, 10:46-50; Ex.1006, 6.

173. Thus, for the same reasons as discussed in association with [1.0], [1.1], and [1.3], Emanuel and Ihara render obvious this limitation.

c. [8.2] *a distance measuring unit for measuring a distance to the location recognition tag:*

174. Emanuel discloses that its machine vision system includes “machine vision software” for determining “the distance from the camera 4 to the position marker,” as discussed in [1.2] (*distance measuring unit for measuring a distance to the location recognition tag*). Ex.1005, 11:19-24, 12:64-65; Ex.1006, 9, 10.

175. Thus, for the same reasons as discussed in association with [1.2], Emanuel and Ihara render obvious this limitation.

d. [8.3] *an image analyzing unit for analyzing an image of the location recognition tag processed by the image photographing unit, and obtaining corresponding*

***location information and direction information of the
location recognition tag; and***

176. As discussed in [1.3] and [1.4] Emanuel discloses that its machine vision system includes “machine vision software” for analyzing a digital image and obtaining location and direction information (“*image analyzing unit for analyzing an image*”).

177. First, as discussed in [1.3], Emanuel’s machine-vision system “analyz[es] the image within the field of view, identif[ies] position markers, [and] decod[es] the position markers’ encoded position information” (*analyzing an image of the location recognition tag...and obtaining corresponding location information*). Ex.1005, 10:20-24; Ex.1006, 8.

178. The “Decoder 27 ‘reads’ the 45 encoded unique identification code of the position marker and returns alphanumeric data which are stored as decoded position marker identification data 300” (*location information...of the location recognition tag*). Ex.1005, 11:44-47; Ex.1006, 9.

179. Second, as discussed in [1.4], Emanuel’s machine vision-system calculates the “angle XOC” of the photographed position marker using the marker’s distance and radial angle relative to the center of the field of view (*direction information of the location recognition tag*). Ex.1005, 12:24-26; Ex.1006, 10.

180. Thus, for the same reasons as discussed in association with [1.3] and [1.4], Emanuel and Ihara render obvious this limitation.

- e. **[8.4] *a location recognizing unit for recognizing a user location by using distance information measured by the distance measuring unit, and the location information and the direction information obtained by the image analyzing unit.***

181. Emanuel discloses that its machine vision system includes “machine vision software” for “determining [the] position...of an object within a predetermined area,” as discussed in [1.5] (*a location recognizing unit for recognizing a user location*). Ex.1005, Abstract, 11:19-24; Ex.1006, 1, 3, 9. “**To more accurately determine the camera’s position,**” Emanuel describes calculating the X, Y, and Z coordinate location of the camera using the distance information measured in [1.2], the location information obtained in [1.3], and the direction information obtained in [1.4]. Ex.1005, 12:11-14, 12:18-33 (“it is possible to calculate 40 a more accurate X, Y camera position”), 12:66-67 (“the Z coordinate of the object may be readily calculated”).

182. Emanuel discloses that the machine vision system can be used to determine the location of any object, including a user (*a user location*). Ex.1005, 4:44-47(“While the specific purpose is to track industrial vehicles indoors, it can be applied to track objects of almost any sort, including...people, animals, and so on.”); Ex.1006, 1, 3-4. Additionally, in the example given in Emanuel Figure 1, the

position of the camera corresponds to the location of a *user* (e.g., the person walking in the figure, or the operator of the forklift or truck). See Ex.1005, Fig. 1; Ex.1006, Fig. 1.

183. Further, described in [1.5], each of the claimed pieces of information (“*the distance information*,” “*location information*,” and “*direction information*”) are obtained and utilized within the flowchart to calculate and “expected” or “actual” position. Ex.1005, Figs. 9-11. Thus, for the same reasons as discussed in association with [1.5], Emanuel and Ihara render obvious this limitation.

6. Claim 10

- a. [10.0] *The location recognition device of claim 8, further comprising a tag location information storage unit for storing location coordinate information of a location of the location recognition tag, and logic location coordinate information corresponding to the location coordinate information.***

184. As discussed in [1.1] and [1.5], Emanuel’s system is comprised of position markers, each of “which corresponds to a particular location on the warehouse floor, and a **database of these locations is created and stored** in a computational device (digital computer) 5.” Ex.1005, 9:38-41; Ex.1006, 10. This database is the “Position Marker Look-Up Table” (“*tag location information storage unit*”) which contains “**actual X, Y, and Z coordinates and rotational orientations that have been measured and recorded for all position markers**” (“*location coordinate information*”). Ex.1005, 12:36-39; Ex.1006, 10, 13-14.

185. Each set of X, Y, and Z coordinates is associated with a marker ID (e.g., AA01) (“*logic location coordinate information*”) that is encoded within the position marker at the X, Y, Z, coordinate location. Ex.1005, 12:36-49; Ex.1006, 10. By decoding the marker IDs and referencing the look-up table, the location within the context of a warehouse or other pre-determined physical area for that position marker can be determined, as discussed in [7.0]:

Marker ID	Actual X (feet)	Actual Y (feet)	Actual Z (feet)	Actual θ (degrees)	Actual Size (inches)
AA01	1.0	1.0	22.0	0.0	8.0
AA02	1.0	4.0	22.1	+0.8	8.0
AA03	1.1	7.0	21.9	+1.2	8.0
AB01	4.0	1.0	22.0	-1.0	8.0
AB02	4.1	4.0	22.0	-0.4	8.4
AB03	4.2	7.1	22.1	0.0	8.1
AC01	7.1	1.1	22.2	0.0	8.0
AC02	7.2	4.1	22.1	-0.5	8.0
AC03	7.0	7.2	21.9	+2.2	7.8

Figure 7

Ex.1005, Fig. 7 (annotated); Ex.1006, 10, 13-14 (Description of table)

186. For example, in Emanuel’s Figure 7, the first column corresponds to encoded “Marker ID” (e.g. AA01), which as discussed in [7.0] is “*logic location coordinate information*” because it corresponds logically to the actual X, Y, and Z coordinates in the second (X=1.0 ft), third (Y=1.0 ft), and fourth (Z=22.0 ft) columns for the Marker ID (“*location coordinate information of a location of the location recognition tag*”). Ex.1005, 12:36-49; Ex.1006, 10.

187. Thus, Emanuel's marker look-up table renders obvious "*a tag location information storage unit for storing location coordinate information of a location of the location recognition tag, and logic location coordinate information corresponding to the location coordinate information.*"

X. GROUND 2: THE COMBINATION OF EMANUEL, IHARA, AND TANAKA RENDERS OBVIOUS CLAIMS 3, 4, AND 9.

A. Summary of Tanaka

188. U.S. Patent Application Publication 2004/0189856 to Tanaka ("Tanaka," Ex.1008) was filed December 24, 2003, and published on September 30, 2004.

189. Tanaka illustrates that it was well-known for cameras built into other devices to include an "automatic focusing function" or AF (Auto Focus). Ex.1018, [0007], [0072]. The AF process is carried out by employing "various kinds of active systems which measure a distance to the photographic subject," for example "by emitting infrared rays or an ultrasonic wave." Ex.1018, [0278].

B. Reasons to Combine Emanuel and Ihara with Tanaka

190. It is my opinion that a POSITA would have been motivated to combine the teachings of Tanaka with the teachings of Emanuel and Ihara. For the reasons set forth below, a POSITA would have been motivated to combine the teachings of Tanaka with the teachings of Emanuel and Ihara. It would have been obvious, beneficial, and predictable to apply Tanaka's teachings of automatic

focusing element for distance measurement (among other objectives) to the machine-vision system of Emanuel and Ihara—for example, to enhance the ability to measure the distance between a camera and an object.

191. A POSITA, when considering the teachings of Emanuel and Ihara, would have also considered the teachings of Tanaka. Tanaka relates to a camera that captures and records an image of a photographic subject. Ex.1018, Title (“Apparatus and Method for Imaging, and Computer Program”), [0159] (“[C]amera control section 210 controls each part of the camera section 22 so as to capture the still image”). As such, Tanaka is analogous art to Emanuel, Ihara, and the ’001 patent. *See, e.g.,* Ex.1001, Abstract; Ex.1005, Abstract; Ex.1006, 1-2; Ex.1007, 6:22-26.

192. A POSITA would have been motivated to combine the teachings of Tanaka with the built-in camera of Emanuel and Ihara, and doing so would have been within a POSITA’s skillset. The combination would have been obvious because it represents merely the use of Tanaka’s known technique of using camera automatic focusing (“AF process”) to “measure a distance to the photographic subject” and improve the built-in camera of Emanuel and Ihara in the same way. Ex.1018, [0278].

193. Specifically, a POSITA would have been motivated to augment Emanuel’s distance measuring method (using the ratio of the length of a line

segment in the image to the actual distance on the position marker) with Tanaka's technique (distance measurement using autofocusing) to confirm the distance measurements to enhance accuracy, which is a goal of Emanuel:

An improved method and apparatus must reduce or remove the shortcomings of current methods, provide general applicability, and **offer high accuracy**... The present invention provides a method and an apparatus for **accurately determining position** and rotational orientation within a predefined space, such as a designated area or volume inside a building.”

Ex.1005, 4:16-19, 4:23-26; Ex.1006, 1.

194. For example, as discussed in [1.2] the built-in camera of Emanuel and Ihara measures the distance to the photographic subject (e.g. position marker) based on a known distance of two points (AB) in the image. In contrast, Tanaka's technique employs an autofocus process to measure the distance to the photographic subject “by emitting infrared rays or an ultrasonic wave.” Ex.1018, [0278]. Accordingly, Tanaka provides a method of confirming or verifying the distance measured by Emanuel and Ihara using an autofocus process. Doing so would further Emanuel's objective of offering “high accuracy” in position determination. Ex.1005, 4:16-18.

195. Additionally, it would have been beneficial to use Tanaka's AF process for measuring distance so that a diverse set of position markers may be

used. For example, as discussed in [1.2], Emanuel uses “geometric position references” such as the centers of “blobs” or dark circles to calculate the length of line segment AB in the image and measure the distance to the position marker. Ex.1005, 5:52-53, 11:57-59; Ex.1006, 9. Tanaka’s AF process, however, would not rely on geometric position references imprinted on the photographic subject to calculate distance; instead, Tanaka would measure distance to the photographic “by emitting infrared rays or an ultrasonic wave.” In other words, by using Tanaka’s AF process for calculating distance, a more diverse set of position markers may be used to calculate distance to the position markers in Emanuel – position markers that do not require geometric position references imprinted upon them.

196. A POSITA would have had a reasonable expectation of success in applying Tanaka’s autofocusing technique to the built-in camera of Emanuel and Ihara. In particular, the AF process in Tanaka is specifically designed for portable devices such as “a notebook type personal computer” or a “PDA” having an “imaging function” that can “easily carry out operations for the AF frame.” Ex.1018, [0284]. Thus, a POSITA applying Tanaka’s autofocusing technique to the camera built-in to the personal computer of Emanuel and Ihara, would be using Tanaka precisely as it was intended – to measure distance to a photographic subject (e.g. position marker) using an AF process.

C. Detailed Analysis of Claims

1. Claim 3

- a. **[3.0] *The method of claim 1, wherein the distance information in b) is measured by the camera when an auto focusing operation of the camera is performed.***

197. As discussed in [1.2], Emanuel teaches determining “the distance from the camera...to the position marker” by analyzing the elements in the photographed position marker. Ex.1005, 12:64-65; Ex.1006, 10. It was well-known, however, that when using a camera to determine distance to an object, such distance may also be determined using the camera’s auto focusing system. Ex.1008, [0278]. For example, as described in Tanaka “various kinds of active [AF] systems...**measure a distance to the photographic subject by emitting infrared rays or an ultrasonic wave.**” Ex.1008, [0278]. As discussed in Section X-B, a POSITA would have been motivated to use Tanaka’s camera auto focusing operation to determine distance—for example, to confirm existing distance calculations to enhance accuracy.

198. Thus, the combination of Emanuel’s method of distance measurement with Tanaka’s AF process technique renders obvious “*wherein the distance information in b) is measured by the camera when an auto focusing operation of the camera is performed,*” as claimed.

2. Claim 4

- a. **[4.0] *The method of claim 1, wherein the distance information in b) is measured by a distance measuring sensor using infrared rays or ultrasonic waves.***

199. As discussed in [3.0], Tanaka describes an “AF process” which “measure[s] a distance to the photographic subject by **emitting infrared rays or an ultrasonic wave**” (*distance information in b) is measured...using infrared rays or ultrasonic waves*). Ex.1008, [0278]. Tanaka’s disclosure of measuring distance by “emitting infrared rays or an ultrasonic wave” renders obvious “*a distance measuring sensor.*” It was well-known and obvious to a POSITA that when Tanaka is measuring distance by emitting infrared light or an ultrasonic wave, a sensor would be used to receive “the reflected beam or wave for measuring the distance from the camera to the object by measuring elapsed time from transmission to receipt.” Ex.1018 1:29-35. Such sensors were referred to as “photosensing element[s]” for detecting the reflected light (*distance measuring sensor*). Ex.1018, 7:2-6. Accordingly, Tanaka’s teaching of measuring distance by emitting infrared light or an ultrasonic wave renders obvious “*wherein the distance information in b) is measured by a distance measuring sensor using infrared rays or ultrasonic waves.*”

3. Claim 9

- a. **[9.0] *The location recognition device of claim 8, further comprising a distance measuring sensor for measuring***

***a distance to the location recognition tag by using
infrared rays or ultrasonic waves.***

200. Limitation [9.0] is substantially similar to limitation [3.0] and [4.0], and thus for the same reasons as discussed in association with [3.0] and [4.0], Emanuel and Ihara render obvious this limitation.

XI. GROUND 3: THE COMBINATION OF EMANUEL, IHARA, AND DEVOS RENDERS OBVIOUS CLAIMS 6 AND 12.

A. Summary of deVos

201. U.S. Patent No. 5,137,354 to deVos et al (“deVos,” Ex.1011) was filed August 1, 1991, and issued on August 11, 1992.

202. DeVos relates to a “position sensing system” that “**calculates the X-Y-Z coordinates of a point in space using triangulation.**” Ex.1011, Abstract. Through triangulation, the system in deVos “determines the orientation of an object located at that point.” Ex.1011, Abstract. In deVos, the “triangulation calculation is based on the coordinates of **at least three retroreflective elements** spaced apart from each other.” Ex.1011, Abstract. Similar to Emanuel, the “retroreflective elements” used for the triangulation each “have a unique bar code in order to differentiate one element from the others.” Ex.1011, 5:24-26.

B. Reasons to Combine Emanuel with deVos

203. It is my opinion that a POSITA would have been motivated to combine the teachings of deVos with the teachings of Emanuel. It would have been obvious, beneficial, and predictable to utilize deVos’s teachings of triangulation to

Emanuel's machine vision system (as modified by Ihara). This combination would, for example, further Emanuel's goals of capturing an image of a position marker and accurately recognizing the location of the camera.

204. As an initial matter, a POSITA, when considering the teachings of Emanuel, would have considered the teachings of deVos. DeVos relates to spatial positioning through the use of an optical system. Ex.1011, 2:33-35 ("In accordance with one aspect of the present invention, a system for determining the position of a point in space"). As such, deVos is analogous to art to Emanuel and the '001 patent. *See, e.g.,* Ex.1001, Abstract.

205. As discussed *supra*, Emanuel "provides a method and an apparatus for accurately determining position and rotational orientation within a predefined space." *See* Ex.1005, 4:23-25; Ex.1006, 1. While in some embodiments a single position marker is used for the calculation of the camera's position, in alternative embodiments, Emanuel teaches that:

[M]ore than one position marker may be selected, and
the position and rotational orientation of the object **may**
be calculated for each selected position marker to
verify the calculation and improve the precision of the
position and rotational orientation determination.

Ex.1005, 5:8-12; Ex.1006, 3.

206. A well-known method of using more than one position marker to calculate the position of an object was triangulation, as confirmed by deVos. For example, deVos teaches that teaches that the position of an object in space can be calculated using a “**triangulation calculation**” using the known coordinates **of at least three “retroreflective elements”** with unique bar codes. Ex.1011, 2:22-25. **The “triangulation calculation” is used to determine “the exact location” of an object.** Ex.1011, Abstract, 4:35-38. Accordingly, a POSITA applying Emanuel’s teaching to use “more than one position marker” would have been motivated to combine Emanuel with deVos to “improve the precision of the position” determination. Ex.1005, 5:8-12, Ex.1006, 3.

207. A POSITA would have had a reasonable expectation of success applying deVos’s technique to Emanuel because Emanuel encourages the use of using multiple position markers to verify and improve precision when recognizing the location of the camera. Ex.1011, Abstract (The “triangulation calculation is based on the coordinates of at least three...elements spaced apart from each other”). Moreover, the combination would not change the intended functionality of Emanuel’s machine vision system, it would simply improve it by increasing precision when determining the location of the camera. Emanuel’s system and method would still operate to accurately determine the position of the camera, but

would do so with multiple position markers through triangulation, as taught by deVos.

208. Accordingly, a POSITA would have found it obvious to apply deVos' teachings to the system and methods taught by Emanuel because the combination merely amounts to applying a known technique to a system and methods ready for improvement.

C. Detailed Analysis of Claims

1. Claim 6

- a. ***[6.0] The method of claim 1, wherein, in e), the mobile terminal location is calculated through a triangulation measuring algorithm by using the distance information, the location information, and the direction information corresponding to the three or more location recognition tags.***

209. **First**, for a position marker in Emanuel's machine vision system, the "distance information" is obtained as described [1.2], the "location information" is obtained as described in [1.3], and the "direction information" is obtained as described in [1.4].

210. **Second**, in one embodiment within Emanuel's machine vision system, **"more than one position marker may selected"** and "each selected position marker" **may be used "to verify the calculation and improve precision of the position... determination"** of the object. Ex.1005, 5:5-12; Ex.1006, 3.

211. In view of Emanuel’s teaching of using “more than one” position marker to calculate location, a POSITA would have found it obvious to utilize triangulation, which was a well-known way to calculate the position of an object through multiple elements, as illustrated by deVos. In deVos, “**the X-Y-Z coordinates of a point in space**” can be determined using “**triangulation.**” Ex.1011, Abstract. This “**triangulation calculation is based on the coordinates of at least three...elements spaced apart from each other.**” Ex.1011, Abstract. Similar to the system in Emanuel, the system in deVos uses multiple elements for its triangulation calculation, where each element has “a unique bar code in order to differentiate one element from the others.” Ex.1011, 5:18-25.

212. Thus, Emanuel’s teaching of using multiple position markers to calculate the position of the object, in light of deVos’s teachings of triangulation, renders obvious this limitation.

2. Claim 12

- a. ***[12.0] The location recognition device of claim 8 or claim 10, wherein, when the image photographing unit photographs three or more location recognition tags from one position, the location recognition unit recognizes the user location through a triangular measuring algorithm by using the distance information of the distances to the three or more location recognition tags measured by the distance measuring unit and the location and direction information of the***

three or more locations and directions obtained by the image analyzing unit.

213. This claim [12.0] is substantially similar to limitation [6.0], except with reference to photographing “*three of more location recognition tags from one position.*” Emanuel teaches that “**one or more position markers 2 are partially or fully visible within the camera’s field of at any given time.**” Ex.1005, 11:22-25; Ex.1006, 9. Further, Emanuel teaches that, within “**an image that is captured,**” there may be “**multiple markers...present.**” Ex.1005, 11:19-21, 11:39-40; Ex.1006, 9.

214. Thus, in light of the teachings cited above with reference to limitation [6.0], Emanuel’s disclosure of photographing multiple position markers and deVos’s teachings of triangulation render obvious this limitation, as claimed.

XII. GROUND 4: THE COMBINATION OF EMANUEL, IHARA, AND SHEYNBLAT RENDERS OBVIOUS CLAIM 11.

A. Summary of Sheynblat

215. U.S. Patent No. 6,677,894 to Sheynblat et al. (“Sheynblat,” Ex.1012) was filed November 30, 1998, and issued January 13, 2004.

216. Sheynblat, like Emanuel, relates to methods and apparatuses related to a “distributed processing system...for a location-based service.” Ex.1012, 4:3-5. Within Sheynblat’s system, a “client provides information about its location and/or a location of interest to a Web server.” Ex.1012, Abstract. Thereafter, “the Web server, based on the information, provides via the Internet information relating to

the client's location." Ex.1012, Abstract. This server is based at a "remote site" and "perform[s] further processing on such data to complete or refine a position calculation." Ex.1012, 1:67-2:5. Sheynblat further describes a remote server which offloads processing that would be done by a client in order to determine the final position of the client. Ex.1012, 2:45-59 ("[A] system in which...data is sent from the trucks to the remote basestation which computes the final position").

B. Reasons to Combine Emanuel with Sheynblat

217. It is my opinion that a POSITA would have been motivated to combine the teachings of Sheynblat with the teachings of Emanuel. It would have been obvious, beneficial, and predictable to utilize Sheynblat's teachings of a remote server processing location information to Emanuel's machine vision system. This combination would, for example, further Emanuel's goals of capturing and processing an image of a position marker ("*location recognition tag*").

218. As an initial matter, a POSITA, when considering the teachings of Emanuel, would have also considered the teachings of Sheynblat. Sheynblat relates to location-based systems and information processing. Ex.1012, Abstract. As such, Sheynblat is analogous art to Emanuel and the '001 patent. *See, e.g.,* Ex.1001, Abstract; Ex.1005, Abstract; Ex.1006, 1.

219. In particular, a POSITA considering Emanuel would understand that the machine vision system in Emanuel handles extensive computation and processing:

Contemporary machine vision technology is utilized to capture and process images of the coordinate reference and position markers. **Offering sophisticated image processing capabilities such as presence or absence detection, dimensional measurement, and object shape identification**, machine vision systems are typically comprised of a video camera, a computing device, and a set of software routines.

Ex.1005, 8:27-31, Ex.1006, 8.

220. In computational systems, extensive computation and processing can lead to an increased computational burden, which plagued optical systems at the time:

Several aspects of image processing make it computationally challenging. A single image represents a data set of considerable size-typically 256K picture elements, or pixels, for a black-and-white image...**[E]normous processing time [is] required to simulate a complex image processing**.

Ex.1017, 1.

221. Given the computational constraints at that time, a POSITA would have been motivated to perform calculations requiring extensive computation and processing remotely from the camera (especially for complex tasks like image segmentation, color tracking, motion analysis, etc.). Ex.1027, 407, Fig. 1 (showing a video camera sending a video signal to a remote processing unit). A well-known way of offloading this type of processing was through the use of a remote or external server, as taught by Sheynblat. Sheynblat teaches that “**systems may benefit by communicating with the resources of a remote site, or ‘server’...** Such a server may...**perform further processing** on such data to complete or refine a position calculation, etc.” Ex.1012, 1:66-2:6. A POSITA would have been motivated to use Sheynblat’s remote server technique to offload processing to a remote or external server. Doing so would reduce the computational burden on Emanuel’s local machine vision hardware. A POSITA would have been motivated to use Sheynblat’s remote server technique to further “refine” data sent to it as well.

222. A POSITA would have had a reasonable expectation of success applying Sheynblat’s offloading technique to Emanuel. For example, Emanuel’s machine vision system contemplates embodiments which “**provide local image capture and transmission of the image information for remote processing.**” Ex.1005, 5:33-35; Ex.1006, 4. Moreover, the combination would not change the

intended functionality of Emanuel's machine vision system, it would simply improve it by reducing the computational burden of the system. Emanuel's system and method would still operate to capture an image of a position marker in order to determine the location of the camera or user, but would do so with improved efficiency and accuracy due to more availability of computational resources, as taught by Sheynblat, resulting in higher-quality image analysis and precision.

223. Accordingly, a POSITA would have found it obvious to apply Sheynblat's remote processing teachings to the system and methods taught by Emanuel because the combination merely amounts to applying a known technique to a system and methods ready for improvement.

C. Detailed Analysis of Claim

1. Claim 11

- a. *[11.0] The location recognition device of claim 8 or claim 10, wherein the location recognizing unit transmits the information obtained by the image analyzing unit to an external location managing server, receives location information calculated by the external location managing server, and recognizes a user location.*

224. **First**, Emanuel teaches that "marker positions are stored in a look-up table (FIG.7) in computer 5, and the table can be accessed to return the approximate camera position 400." Ex.1005, 10:40-42; Ex.1006, 10, 13-14. As described in [7.0], through the "decoded [marker] ID," Emanuel's machine vision system obtains "**true marker position data 170, which is obtained from a**

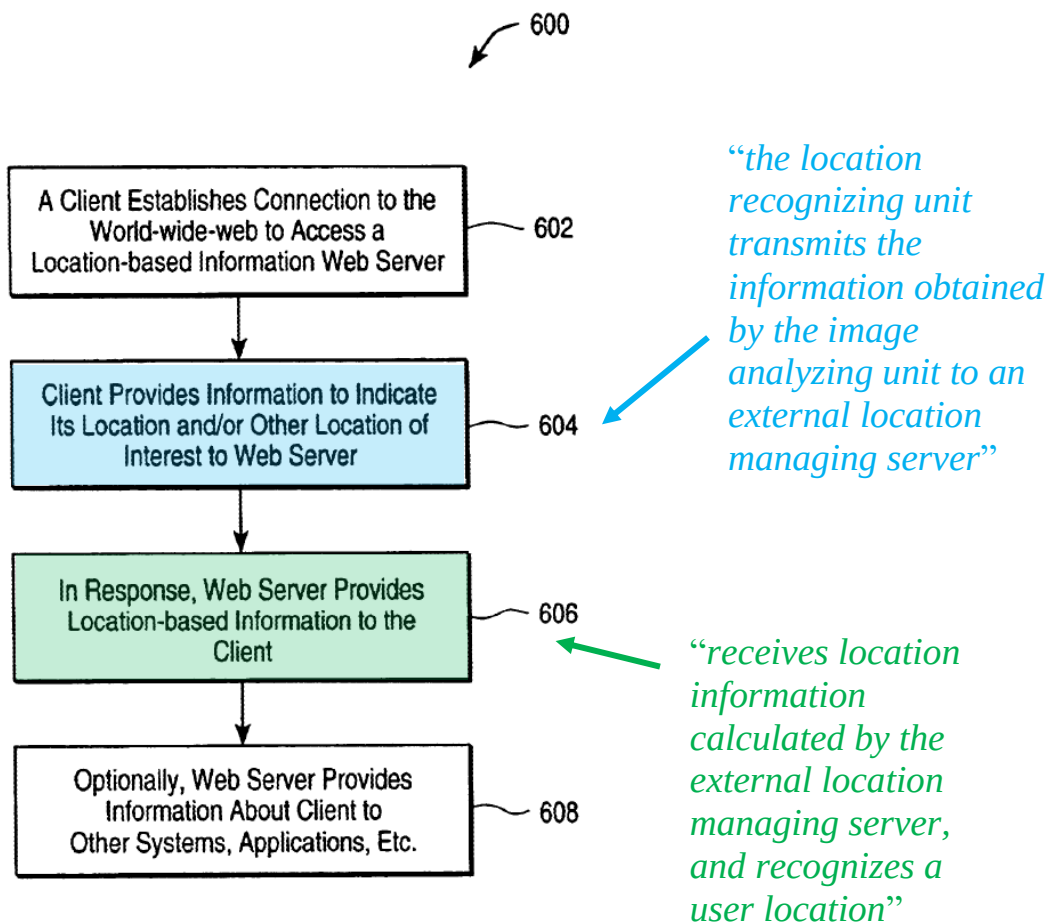
lookup table in [a] second computer.” Ex.1005, 11:3-5; Ex.1006, 10, 13-14.

This “computer 5” may “reside on-board.” Ex.1005, 9:56-57; Ex.1006, 4.

However, in the alternative, such as “vehicles not equipped with on-board computers,” this “computer 5 [may be] stationed remotely.” Ex.1005, 9:59-61; Ex.1006, 4. When Emanuel’s machine vision system (“*the location recognition device*”) **uses the decoded ID to access the look-up table in a computer that is stationed remotely, the machine vision system is “transmitting information obtained by image analyzing unit” to the remotely stationed computer.**

225. **Second**, transmitting information to “*an external location managing server*” was a well-known technique in the art, as illustrated in Sheynblat. Sheynblat teaches that “systems may benefit by communicating with the resources of a remote, or ‘**server**’ utilizing a wireless communications system.” Ex.1012, 1:66-2:6. This “**server may provide assistance data...and perform further processing on such data to complete or fine a position calculation.**” Ex.1012, 1:66-2:6. Further in Sheynblat’s system, “in response to receiving information relating to the location of the client...the Web **server provides location-based information to the client.**” Ex.1012, 20:57-21:16. After receiving information back from the remote server, “the client may, in turn, use such information to determine navigational information (e.g., its position, velocity, time, etc.).” Ex.1012, 20:57-21:16. In this way, Sheynblat demonstrates the well-known

technique of employing external or remote servers that process and return received location data. This process is demonstrated in Fig. 11 of Sheynblat:



Ex.1012, Fig. 11

226. The combination of Emanuel’s machine vision system storing a look-up table stored in a remote computer and Sheynblat’s remote server processing data sent by a client and returning information used to locate the position of a client renders obvious “location recognizing unit transmits the information obtained by the image analyzing unit to an external location managing server,

receives location information calculated by the external location managing server, and recognizes a user location,” as claimed.

XIII. GROUND 5: THE COMBINATION OF EMANUEL, IHARA, AND TANAKA RENDERS OBVIOUS CLAIMS 8-10 TO THE EXTENT CLAIM 8 IS INTERPRETED AS HAVING MEANS-PLUS-FUNCTION LIMITATIONS.

1. Claim 8

- a. [8.0] *A location recognition device for recognizing a location by using a built-in camera, the location recognition device comprising:***

227. Limitation [8.0] is substantially similar to limitation [8.0] from Ground 1, and thus for the same reasons as discussed in association with [8.0], Emanuel and Ihara render obvious this limitation.

- b. [8.1] *an image photographing unit for photographing a plurality of location recognition tags that are arranged in a predetermined physical area and respectively store location recognition information, and for performing a digital image process;***

228. In the event this limitation is construed as a means-plus-function limitation, I am adopting the following for the purposes of this declaration:

229. Function: (1) “*photographing a plurality of location recognition tags that are arranged in a predetermined physical area and respectively store location recognition information*” and (2) “*performing a digital image process.*”

230. Corresponding structure for “image photographing unit”: built-in camera. Ex.1001, 2:35-39 (“An exemplary location recognition device according

to an embodiment of the present invention recognizes a location by using a built-in camera. The exemplary location recognition device includes an image photographing unit...”), 5:35-40 (“The image photographing unit 110 performs a camera function (i.e., a photographing function). The image photographing unit 110 forms an image from lights that are reflected from a subject, converts the image into an electrical signal, processes the signal, and generates digital image data.”)

231. For the first function and corresponding structure, as described in [1.0], [1.1], and [5.0] in Ground 1, Emanuel teaches a “machine vision camera” that “captures analog and/or digital images of the positions markers” which are “arranged in a predetermined positional pattern within the coordinate space.” Ex.1005, 11:19-21, 4:56-59; Ex.1006, 9, 12. Further, as described in [1.0], it would have been obvious to implement Emanuel’s system as terminal with built-in camera, as such terminals were well known in the machine vision arts as described in Ihara. In addition, as described in [1.1], the position markers in Emanuel (“*location recognition tags*”) store “*location information*” in barcode format.

232. Accordingly, the camera in Emanuel’s machine vision system, implemented as built-in in light of Ihara, renders obvious a built-in camera “*for photographing a plurality of location recognition tags that are arranged in a*

predetermined physical area and respectively store location recognition information,” as claimed.

233. **For the second function and corresponding structure**, as discussed in [8.1] of Ground 1, Emanuel’s machine-vision system includes a “machine vision camera 4...[that] “captures...**digital** images” of “position markers 2.” Ex.1005, 11:19-21; Ex.1006, 9. In particular, Emanuel describes that “**an image is captured** 110 by the machine vision camera and **stored into its memory**” (*performing a digital image process*), Ex.1005, 10:31-32, which is much like the example of the image photographing unit in the ’001 patent that “forms an image...and generates digital image data of the subject.” Ex.1001, 5:35-40.

234. Accordingly, Emanuel and Ihara render obvious a built-in camera “*for performing a digital image process.*”

c. **[8.2] a distance measuring unit for measuring a distance to the location recognition tag;**

235. In the event this limitation is construed as a means-plus-function limitation, I am adopting the following for the purposes of this declaration:

236. Function: “*measuring a distance to the location recognition tag*”

237. Corresponding structure for “a distance measuring unit”: A camera which “uses a conventional distance measuring method” which “uses a frequency reflected after transmitting radio frequencies including high frequency signals or infrared rays to a subject, and it includes a triangulation measuring method, a

method for measuring a total amount of incident lights, and a method for measuring an incident time of radiated light.” Ex.1001, 4:17-21. This is “essentially used in a camera performing an active focusing operation.” Ex.1001, 4:25-29.

238. As discussed in [1.2] of Ground 1, Emanuel teaches that the distance between the position marker (“*location recognition tag*”) is calculated based on the ratio between known length of line segment AB in the image and focal length of the camera. Ex.1005, 12:64-67; Ex.1006, 10. As described in [3.0] and [4.0], it was well-known in the art that there were a variety of additional ways to perform this distance measurement, such as through auto-focusing operation by a camera, as provided in Tanaka. Ex.1008, [0278] (“[V]arious kinds of active [AF] systems...measure a distance to the photographic subject by emitting infrared rays or an ultrasonic wave.”)

239. Tanaka’s teaching of autofocus systems which measure distance by “emitting infrared rays” are much like the example of an autofocus system in the ’001 patent that “*measur[es] an incident time of radiated light.*” As discussed in [4.0] it was obvious that when Tanaka’s camera measures distance by emitting infrared light, a sensor would be used to receive “the reflected beam or wave for measuring the distance from the camera to the object by measuring elapsed time from transmission to receipt.” (quoting Ex.1018, 1:29-35). A POSITA would

understand this elapsed time renders obvious “*an incident time of radiated light*” because it is the time it takes for the infrared ray emitted from the camera to (radiated light) to be received back to the camera (an incident time).

240. Further, a POSITA would have been motivated to combine Tanaka with Emanuel for the reasons discussed in Section X-B.

241. Accordingly, the camera in Emanuel’s machine-vision system, implemented with auto focusing in view of Tanaka, renders obvious “*a distance measuring unit for measuring a distance to the location recognition tag,*” as claimed.

d. **[8.3] *an image analyzing unit for analyzing an image of the location recognition tag processed by the image photographing unit, and obtaining corresponding location information and direction information of the location recognition tag; and***

242. In the event this limitation is construed as a means-plus-function limitation, I am adopting the following for the purposes of this declaration:

243. Functions: Function (1) “*analyzing an image of the location recognition tag processed by the image photographing unit and obtaining corresponding location information...of the location recognition tag,*” and Function (2) “*analyzing an image of the location recognition tag processed by the image photographing unit, and obtaining corresponding...direction information of the location recognition tag.*”

244. Corresponding structure for “an image analyzing unit”: Computer-implemented algorithm.

245. Computer corresponding to Function 1: A general purpose computer such as “mobile terminals having operating functions (e.g., a personal communication system (PCS), a personal digital assistance (PDA), and a cellular phone) or a notebook computer.” Ex.1001, 3:58-65.

246. Algorithm corresponding to Function 1: The algorithm corresponding to this element includes several steps. First, the image analyzing unit “read[s] the two-dimensional barcode of the location recognition tag 30 photographed by the image photographing unit 110.” Ex.1001, 7:31-33. Although the specific bar code reading algorithm is not disclosed, Petitioner reads this as requiring the use of a standard bar code reading algorithm that existed at the time of the claimed invention or its equivalents.

247. Second, the image analyzing unit “provides the interpreted location information to the tag location information storage unit 130.” Ex.1001, 7:33-34. As shown in Figure 4, the tag location information storage unit is part of mobile terminal 100 and is not part of location information management server 200. *See also* Ex.1001, 7:44-50 (describing the difference between obtaining location information from the tag location information storage unit 130 (which the image analyzing unit does) vs. obtaining location information from the location

information management server 200, which is done by the location recognizing unit and not by the image analyzing unit).

248. Third, the image analyzing unit “receives the location coordinate of the location of the two-dimensional barcode, and provides it to the location recognizing unit 150.” Ex.1001, 8:26-27. Alternatively, if the location recognition tag “includes the absolute location coordinate,” Ex.1001, 7:39, then the second and third steps are not performed. Ex.1001, 8:29-31.

249. Computer corresponding to Function 2: The same analysis as the first function is applied here.

250. Algorithm corresponding to Function 2: The image analyzing unit “recognizes the offset information by analyzing the image of a predetermined location recognition tag 30, and generates direction angle information on the predetermined location recognition tag.” Ex.1001, 5:46-51, 7:4-9.

251. Algorithm corresponding to Function 1 in the prior art: In Emanuel, image analysis is performed on the image of a position marker (“*location recognition tag*”) as described in [1.3].

252. First, Emanuel’s machine-vision system “**Decoder 27 ‘reads’ the 45 encoded unique identification code of the position marker.**” Ex.1005, 11:44-47; Ex.1006, 9. As discussed in [1.1] and [5.1], the position markers may include “one-

dimensional or two-dimensional barcodes” that “encode[] the marker location.”

Ex.1005, 6:55-57, 10:46-55; Ex.1006, 6.

253. Second, as discussed in [10.0] Emanuel discloses providing the decoded location information to the “Position Marker Look-Up Table” (“*tag location information storage unit*”). For example, a “[d]ecoded marker ID...is used...to search [the] look-up table.” Ex.1005, 12:58-59; Ex.1006, 10, 13-14. The Position Marker Look-Up Table contains “**actual X, Y, and Z coordinates...that have been measured and recorded for all position markers.**” Ex.1005, 12:36-40; Ex.1006, 10, 13-14.

254. Third, Emanuel teaches that after providing the decoded location information to the lookup table, “the table can be accessed to **return the approximate camera position** 400. In other words, by knowing that the camera is viewing **a particular marker** we can place the camera within the approximate region **of that marker.**” Ex.1005, 10:41-45, Ex.1006, 10, 13-14. As discussed in Ground 1 of [8.4], and as further discussed below, the location coordinates of marker are then used by Emanuel’s machine vision system to calculate the position of the camera. Ex.1005, 12:11-14, 12:18-33, 12:66-67; Ex.1006, 10, 13-14.

255. Accordingly, Emanuel’s disclosure of decoding position information on a marker and obtaining the X, Y, and Z coordinates of that marker from a look-up table, renders obvious “*an image analyzing unit for analyzing an image of the*

location recognition tag processed by the image photographing unit...and obtaining corresponding location information.”

256. Computer corresponding to Function 2 in the prior art: The same analysis from the first function applies here.

257. Algorithm corresponding to Function 2 in the prior art: Emanuel discloses (1) recognizing the offset information by analyzing the image of a predetermined location recognition tag and (2) generating direction angle information by using the offset information.

258. First, as discussed in [2.0] of Ground 1, the *offset information* includes “Angle XOC” and is calculated by analyzing the image of the position marker to determine its radial angle relative to the center of the field of view of the camera. Further, as discussed in [1.5] of Ground 1, Emanuel also teaches that “angle XOC” along with “the length of line segment OC, which is the radial distance from the center of the image (center of the camera), Point O, to the center of the position marker, Point E, [sic, Point C]” can be used to calculate the position of the camera as illustrated in Figure 6:

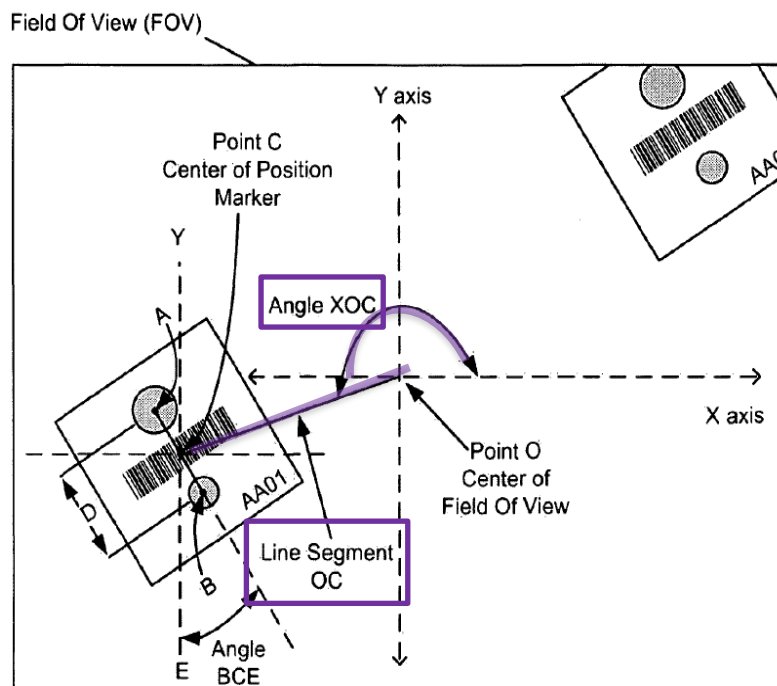
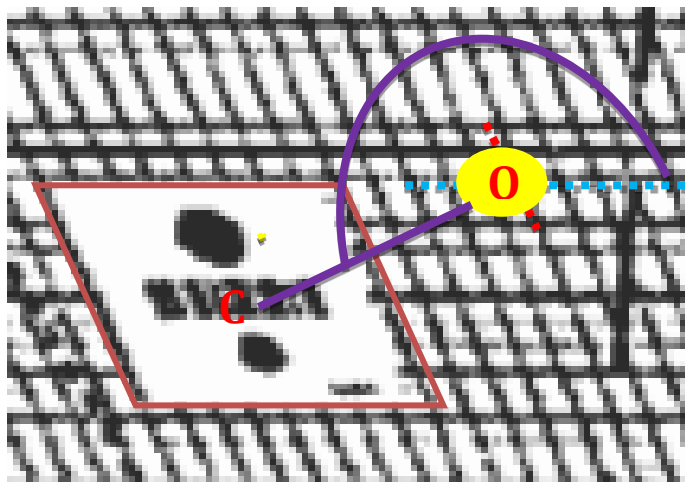


Figure 6

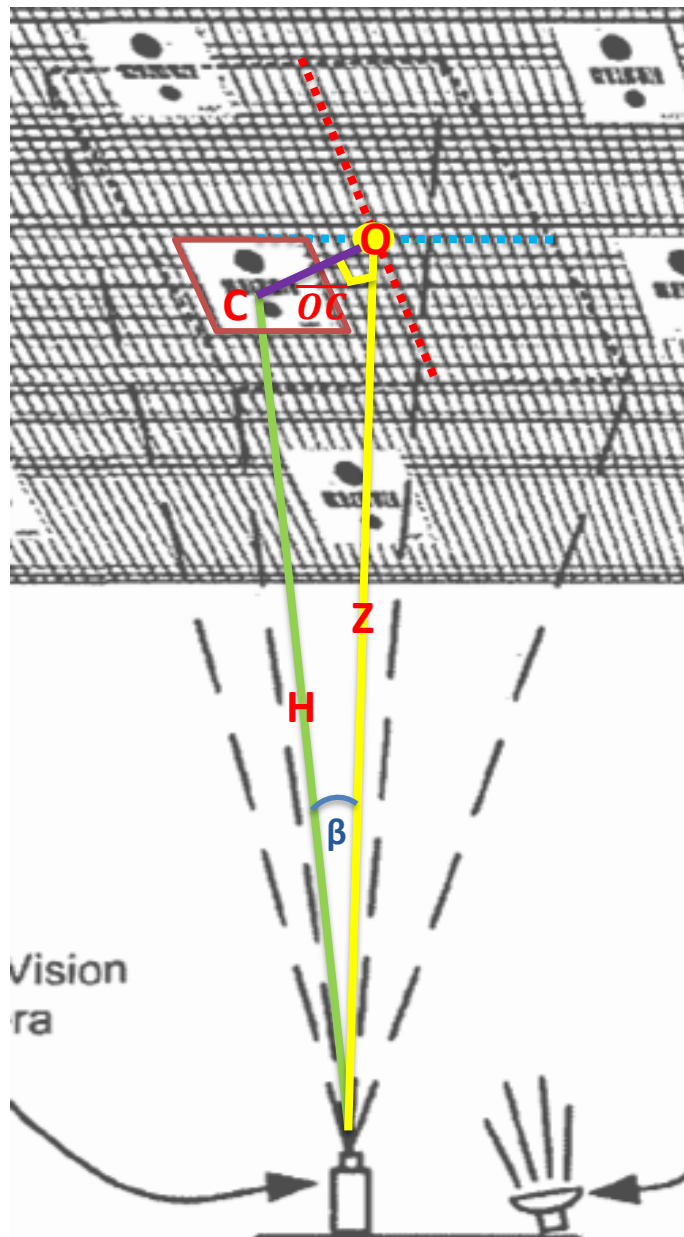
Ex.1005, Fig. 6 (annotated); Ex.1006, Fig. 11

259. “Once these two values [i.e. angle XOC and the length of line segment OC] have been established, it is possible to calculate a more accurate X, Y camera position using plane geometry.” Ex.1005, 12:24-31; Ex.1006, 10.

260. To calculate the Z camera position, it would have been obvious to a POSITA to use angle XOC and the length of line segment OC, to calculate this value for the position marker. In particular, angle XOC and the length of line segment OC define one side of a right-triangle formed by Center of Position Marker (Point C), Center of Field of View (Point O), and the camera, as shown below:



Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

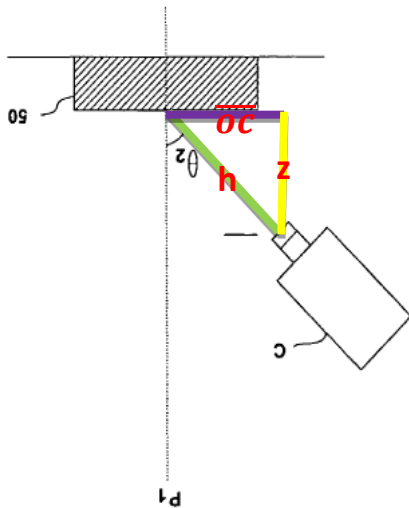


Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

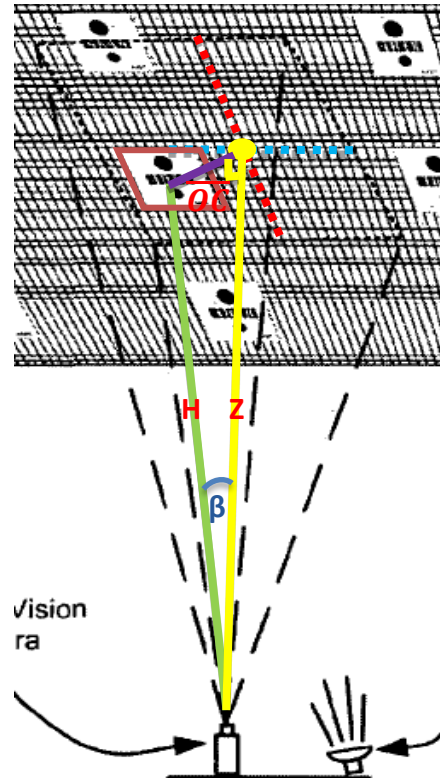
261. In the triangle $\overline{Z\bar{O}CH}$ above, Side $\overline{OC}$ corresponds to the length of line segment $\overline{OC}$, Side H corresponds to the distance between the camera and the center

of the position marker, and Side Z corresponds to the z-component of the distance between the camera and the center of the position marker.

262. The sides of triangle $\overline{Z\bar{O}CH}$ in annotated Emanuel's Figure 1 are much like the sides of a similar triangle $\overline{z\bar{o}ch}$ annotated in the '001 patent's Figure 6B:



Ex.1001, Fig. 6B (annotated and rotated)



**Ex.1005, Fig. 1 (annotated and partial);
Ex.1006, Fig. 1**

263. In the annotated triangle $\overline{z\bar{o}ch}$ of Figure 6B above, Side $\overline{oc}$ corresponds to the length of line segment $\overline{oc}$ (the distance between the center of the tag and the camera in the image plane), Side h corresponds to the distance between the camera and the center of the position marker, and Side z corresponds to the z-

component of the distance between the camera and the center of the position marker. Accordingly, the geometrical relationships among the sides of triangle $\overline{ZOCH}$ in annotated Emanuel's Figure 1, are much like the geometrical relationships among the sides of a similar triangle $\overline{zoch}$ in annotated '001 patent's Figure 6B.

264. Because the distance between the camera and the location tag is known as discussed in [8.2] (line H), and because the distance and orientation of line segment OC is known as discussed in [8.3], it would have been obvious to a POSITA to use basic math to calculate the length of line segment Z to calculate the Z coordinate of the camera. In particular, the angle beta (β) would be calculated using the well-known relationship, $\sin \beta = \overline{OC} / H$. The angle beta would then be used to calculate the length of the Z coordinate (line Z).

265. It would be obvious to a POSITA to calculate the length of line Z (the solid yellow line in the annotated figure above) using basic trigonometry as follows.

266. As shown in annotated Figure 1, a POSITA would understand that line Z (solid yellow) and line segment OC (purple) are perpendicular to each other because line Z in the z-plane forms a 90-degree angle to line segment OC in the xy-plane. Thus, the $\overline{ZOC}$ vertex of the triangle $\overline{ZOCH}$ is a 90-degree angle, and triangle $\overline{ZOCH}$ is a right-angle triangle.

267. A POSITA would calculate angle β of the right-triangle $Z\overline{O}CH$, using the trigonometric ratio:

$$\beta = \arcsin\left(\frac{\overline{OC}}{H}\right)$$

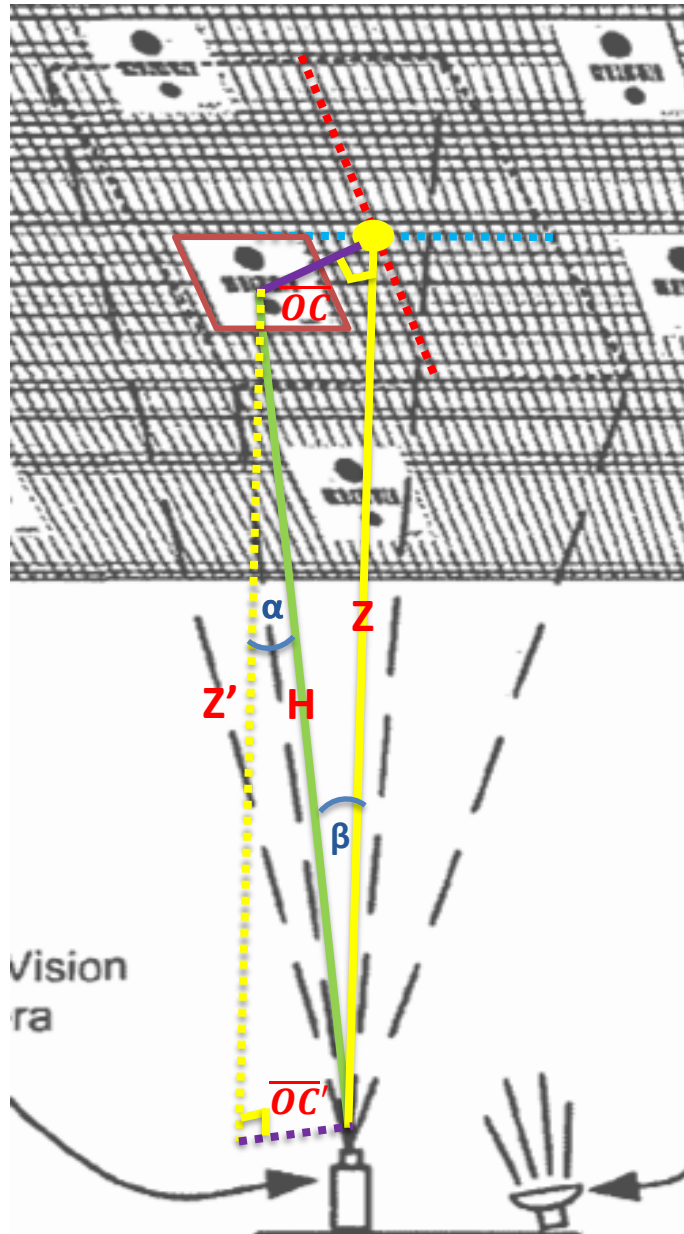
268. Knowing angle β , the length of line Z would be calculated using the trigonometric formula:

$$\cos \beta = \frac{Z}{H}$$

269. Thus, solving for the length of line Z:

$$H \cos \beta = Z$$

270. Second, it would have also been obvious to a POSITA that calculating the value of angle beta by using angle XOC and the length of line segment OC that define one side of a right-triangle, renders obvious “generating direction angle information by using the offset information.” In particular, angle beta is equivalent to angle alpha annotated in the congruent triangle formed by the line segments Z’ (dotted yellow), OC’ (dotted purple), and H below (solid green), as shown in Figure 1 below:



Ex.1005, Fig. 1 (annotated and partial); Ex.1006, Fig. 1

271. A POSITA would understand that angle beta is equivalent to angle alpha as proven using basic geometry below:

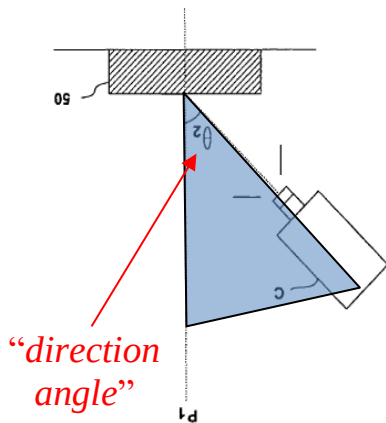
272. Line Z (solid yellow) may be positioned parallel to itself at the opposite end of Line $\overline{OC}$, denoted as Line Z' (dotted yellow).

273. Line $\overline{OC}$ (solid purple) may be positioned parallel to itself at the opposite end of Line Z, denoted as Line $\overline{OC'}$ (dotted purple).

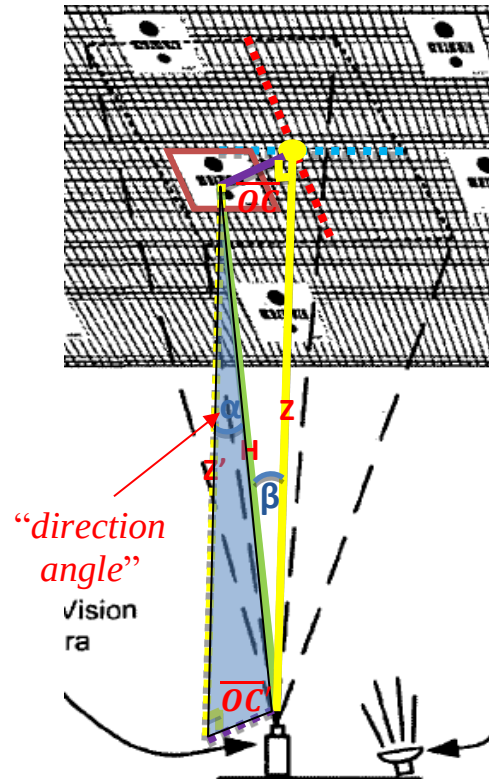
274. Accordingly, right-triangle $Z'\overline{OC'}H$ is congruent to right-triangle $Z\overline{OCH}$.

275. Because all corresponding sides and angles are the same in congruent triangles, and because angle β corresponds to angle α , it must be true that angle β = angle α .

276. Angle alpha is much like the example of a “*direction angle*” in the '001 patent where the user location is calculated “by applying the distance information following the direction angle,” as illustrated in Figure 6B of the '001 patent as angle θ_2 :



Ex.1001, Fig. 6B (annotated and rotated)



**Ex.1005, Fig. 1 (annotated and partial);
Ex.1006, Fig. 1**

277. Just like the distance between the camera C and location recognition tag 50 is “appl[ied]...following the direction angle” θ_2 “to the coordinate information of the first location recognition tag” in the '001 patent, Ex.1001, 6:11-15, the distance Z between the camera the position would be applied following direction angle alpha (which is equivalent to angle beta) to calculate the location of the camera.

278. Thus, Emanuel’s disclosure of calculating the value of angle beta, by using angle XOC and the length of line segment that define one side of the right-

triangle $\overline{ZOCH}$, renders obvious “*generating direction angle information by using the offset information.*”

- e. **[8.4] *a location recognizing unit for recognizing a user location by using distance information measured by the distance measuring unit, and the location information and the direction information obtained by the image analyzing unit.***

279. In the event this limitation is construed as a means-plus-function limitation, I am adopting the following for the purposes of this declaration:

280. Function: “*recognizing a user location by using distance information measured by the distance measuring unit, and the location information and the direction information obtained by the image analyzing unit*”

281. Corresponding structure for “a location recognizing unit”: Computer-implemented algorithm.

282. Computer corresponding to the function: The computer element in the ’001 patent for the “location recognizing unit” is the same as the computer element in [8.3].

283. First algorithm corresponding to the function: The “*location recognizing unit*” (1) “receives the absolute location coordinate, the photographing angle, and the information on the distance to the location recognition tag 30” Ex.1001, 7:54-56 and (2) “calculates the current user location by applying the

distance information following the direction angle to the coordinate information of the first location recognition tag 30.” Ex.1001, 6:12-15.

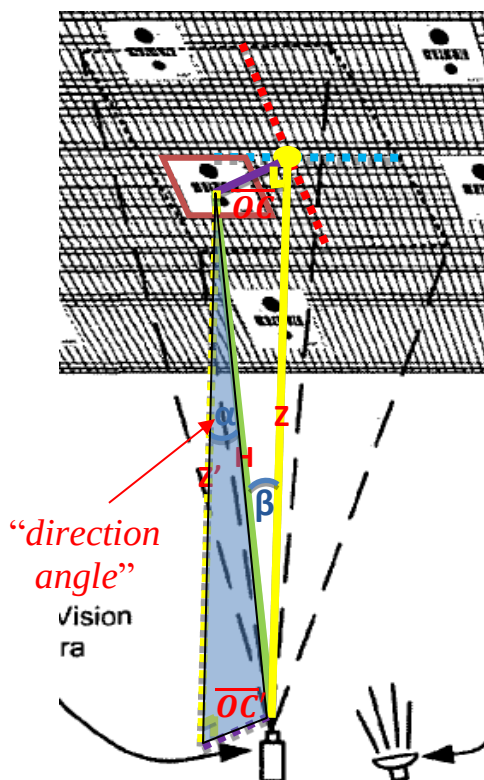
284. Computer corresponding to the function in the prior art: Emanuel teaches the computer element through Emanuel’s “machine vision system computational device 5.” Ex.1005, 10:1-6.

285. Algorithm corresponding to the function in the prior art: Emanuel discloses receiving a location coordinate, photographing angle, and information on the distance to the position marker (“*location recognition tag*”).

286. For the first step of the function, as discussed in [1.3] Emanuel discloses obtaining X, Y, and Z coordinates of the position markers by decoding “the position markers encoded information.” Ex.1005, 10:20-24; Ex.1006, 8. As discussed in [7.0], the encoded information may be absolute location coordinate or logic location coordinate information. Ex.1005, 10:48-49, 53-55; Ex.1006, 3-4, 6-8, 12-13. As discussed in [2.1] Emanuel discloses obtaining a photographing angle, which is the angle XOC. As discussed in [1.2], Emanuel describes determining “the distance from the camera 4 to the position marker.” Ex.1005, 12:64-65; Ex.1006, 10.

287. For the second step of the function, Emanuel discloses applying the distance information following the direction angle to the coordinate information of the location recognition tag. As discussed in [8.2], the distance between the camera

and the location tag is represented by line H, and as discussed in [8.3] the direction angle to the location recognition tag is angle alpha (which is equivalent to angle beta):



Ex.1005, Fig. 1
(annotated and partial);
Ex.1006, Fig. 1

288. Because both the distance between the camera and the location tag is known as discussed in [8.2] (line H), and because the length and orientation of line segment OC is known as discussed in [8.3], it would have been obvious to a POSITA to use basic math to calculate the length of line segment Z. In particular,

the length of line Z would be calculated using the well-known relationship, $\cos \beta = Z / H$, as discussed below:

289. Because angle β is known, and because angle α is equivalent to angle β , the length of line Z would be calculated using the trigonometric ratio:

$$\cos \alpha = \cos \beta = \frac{Z}{H}$$

290. Solving for the length of line Z:

$$H \cos \alpha = H \cos \beta = Z$$

291. Therefore, a POSITA would have found that calculating the length of line Z using the mathematical relationship between angle beta (which is equivalent to angle alpha) (“the direction angle”) and line H (“*the distance information*”), renders obvious “applying the distance information following the direction angle to the coordinate information of the location recognition tag.”

292. Finally, as discussed in [1.5], Emanuel teaches that with the Z coordinate of the position marker already known, “the Z coordinate of the object may be readily calculated,” along with the X and Y coordinates of the object (“calculate user location”). Ex.1005, 12:66-67; Ex.1006, 10. Accordingly, Emanuel’s disclosure of a machine vision system that obtains the X, Y, and Z coordinates of the positions markers, obtains a photographing angle, determines a distance from the camera to the position marker, applies the distance information following the direction angle to the coordinate information of the location

recognition tag, and calculates the location of the camera, render obvious “a location recognizing unit for recognizing a user location by using distance information measured by the distance measuring unit, and the location information and the direction information obtained by the image analyzing unit.”

2. Claim 9

- a. **[9.0] The location recognition device of claim 8, further comprising a distance measuring sensor for measuring a distance to the location recognition tag by using infrared rays or ultrasonic waves.**

293. Limitation [9.0] is substantially similar to limitation [9.0] from Ground 1, and thus for the same reasons as discussed in association with [9.0], Emanuel and Tanaka render obvious this limitation.

3. Claim 10

- a. **[10.0] The location recognition device of claim 8, further comprising a tag location information storage unit for storing location coordinate information of a location of the location recognition tag, and logic location coordinate information corresponding to the location coordinate information.**

294. Limitation [10.0] is substantially similar to limitation [10.0] from Ground 1, and thus for the same reasons as discussed in association with [10.0], Emanuel renders obvious this limitation.

XIV. GROUND 6: THE COMBINATION OF EMANUEL, IHARA, AND SHEYNBLAT RENDERS OBVIOUS CLAIM 11 TO THE EXTENT CLAIM 8 IS INTERPRETED AS HAVING MEANS-PLUS-FUNCTION LIMITATIONS.

1. Claim 11

- a. *[11.0] The location recognition device of claim 8 or claim 10, wherein the location recognizing unit transmits the information obtained by the image analyzing unit to an external location managing server, receives location information calculated by the external location managing server, and recognizes a user location.*

295. Limitation [11.0] is substantially similar to limitation [11.0] from Ground 4, and thus for the same reasons as discussed in association with [11.0], Emanuel and Sheynblat render obvious this limitation.

XV. GROUND 7: THE COMBINATION OF EMANUEL, IHARA, AND DEVOS RENDERS OBVIOUS CLAIM 12 TO THE EXTENT CLAIM 8 IS INTERPRETED AS HAVING MEANS-PLUS-FUNCTION LIMITATIONS.

1. Claim 12

- a. *[12.0] The location recognition device of claim 8 or claim 10, wherein, when the image photographing unit photographs three or more location recognition tags from one position, the location recognition unit recognizes the user location through a triangular measuring algorithm by using the distance information of the distances to the three or more location recognition tags measured by the distance measuring unit and the location and direction information of the*

three or more locations and directions obtained by the image analyzing unit.

296. Limitation [12.0] is substantially similar to limitation [12.0] from Ground 3, and thus for the same reasons as discussed in association with [12.0], Emanuel and deVos render obvious this limitation.

XVI. CONCLUSION

297. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code.

Dated: February 27, 2025



Nikos Papanikolopoulos, Ph.D.