

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Amazon Inc.

Petitioner

v.

LightGuide, Inc.

Patent Owner

Case IPR2023-01423

Patent No. 10,528,036

**EXPERT DECLARATION OF WILLIAM SINGHOSE IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW**

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PETITIONER’S EXHIBIT LIST

Petitioner Ex. No.	Description
1001	U.S. Patent No. 10,528,036 (cited as '036 patent)
1002	Prosecution history to '036 patent
1003	Declaration of William Singhose (technical expert) re: '036 patent (cited as “Singhose”)
1004	<i>Curriculum Vitae</i> of Dr. William Singhose
1005	Rick Kjeldsen et al., <i>Interacting with Steerable Projected Displays</i> (in Proc. of 5 th Int’l Conf. on Automatic Face and Gesture Recognition (May 20-21, 2002)) (downloaded from https://web.archive.org/web/20050410205612/http://www.research.ibm.com/ed/publications/fg02.pdf) (cited as “Kjeldsen”)
1006	Claudio Pinhanez et al., <i>Ubiquitous Interactive Graphics</i> (dated May 17, 2002, downloaded from https://web.archive.org/web/20060208095408/http://www.research.ibm.com/ed/publications/rc22495.pdf) (cited as Pinhanez-I)
1007	Declaration of Nathaniel E. Frank-White of the Internet Archive
1008	Declaration of James Mullins (library practices and public availability expert) re: availability of prior art.
1009	Declaration of Rick Kjeldsen
1010	U.S. Patent No. 6,833,863
1011	RESERVED
1012	Docket Control Order Granting Joint Motion for Entry of Proposed Docket Control Order, D.I. 62 in <i>LightGuide, Inc. v. Amazon.com, Inc., et al.</i> , Case No. 2:22-CV-00433-RWS-RSP (E.D. Texas)
1013	Case Docket for <i>Amazon.com, Inc., et al. v. LightGuide, Inc.</i> , Case No. 2:23-cv-00053-JHC (W.D. Wa.)

1014	Claudio Pinhanez et al., <i>Applications of Steerable Projector-Camera Systems</i> (in Proc. Of ICCV Workshop on Projector-Camera Systems (PROCAMS'03)) (cited as Pinhanez-II)
1015	Claudio Pinhanez and Gopal Pingali, <i>Projector-camera Systems for Telepresence</i> (in Proc. of the 2004 ACM SIGMM Workshop on Effective Telepresence) (cited as Pinhanez-III)
1016	Tamotsu Machino et al., <i>Robot-Augmented Communication: A Remote-collaboration System based on a Shared Field of View in Real Space</i> (in Proc. of 2005 IEEE Int'l Conference on Robotics & Automation) (cited as Machino-I)
1017	Tamotsu Machino et al., <i>Remote-Collaboration System using Mobile Robot with Camera and Projector</i> (in Proc. of the 2006 IEEE Int'l Conf. on Robotics and Automation) (cited as Machino-II)
1018	Tetsuo Iyoda et al., <i>LightCollabo: Distant Collaboration Support System for Manufacturers</i> (in Proc. of 14th Int'l Multimedia Modeling Conference (2008)) (cited as Iyoda)

I. INTRODUCTION

1. I, William Singhose, have been retained as an independent expert by Amazon Inc. (“Petitioner” or “Amazon”) in connection with an *inter partes* review of U.S. Patent No. 10,528,036 (the “’036 patent”). I have prepared this declaration in connection with Amazon’s Petition for *Inter Partes* Review.
2. Specifically, this document contains my opinions about the technology at issue in claims 1-12 of the ‘036 patent (the “Challenged Claims”) and the grounds against these claims that have been asserted by Amazon. I was not asked to provide any opinions that are not expressed herein.

II. SUMMARY OF OPINIONS

3. Below, I set forth the opinions I have formed, the conclusions I have reached, and the bases for my opinions and conclusions. I believe the statements contained in this declaration to be true and correct to the best of my knowledge.
4. Based on my experience, knowledge of the art at the time of the applicable priority date, analysis of Petitioner’s asserted grounds and references, and the understanding a person of ordinary skill in the art (POSITA) would have had of the claims, in light of the specification, as of the applicable priority

date, it is my opinion that the Challenged Claims of the '036 patent would have been anticipated and/or obvious over the asserted grounds.

5. I am being compensated for my time at the rate of \$800 per hour. This compensation is in no way contingent upon the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding.

III. BACKGROUND AND QUALIFICATIONS

6. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational and work experience. A copy of my curriculum vitae is attached as Exhibit 1004.
7. I am a Professor of Mechanical Engineering at the Georgia Institute of Technology ("Georgia Tech"). I received a B.S. in Mechanical Engineering from the Massachusetts Institute of Technology ("MIT") in 1990. I then received an M.S. in Mechanical Engineering from Stanford University in 1992. Finally, I received a Ph.D. in Mechanical Engineering from MIT in 1997. After receiving my Ph.D., I was a postdoctoral researcher at MIT before becoming a professor at Georgia Tech in 1998.
8. Based on my work experience, described in my curriculum vitae and in more detail below, I am knowledgeable about the subject matter of the '036 patent, and the related prior art. Key elements of the subject matter and prior art include projectors, cameras, image processing, remote control, remote

displays, and operational aids. I have experience working with each of these key elements, and combinations of these elements.

9. My qualifications as an expert in this subject matter stem from my industry work experience, as well as my experience as a Professor in the Woodruff School of Mechanical Engineering at Georgia Tech performing research, teaching, and consulting. I have several patents and hundreds of publications that are directed toward understanding and improving automation, control systems, and operator aids. Many of these publications include the use of smart cameras to achieve the desired outcomes.
10. In my current position at Georgia Tech, I teach courses in mechanical design, system dynamics, and controls. I also lead teams of professors, post-docs, graduate students, and undergraduate students that conduct research in mechanical design, dynamics, controls, automation, robotics, spacecraft, and human-machine interfaces. During my 25 years at Georgia Tech, I have also had visiting academic appointments at MIT, Stanford, the Polytechnic University of Madrid, and the Tokyo Institute of Technology.
11. Throughout my engineering career, I have worked with automated systems. Before starting my teaching career at Georgia Tech, I worked as a full-time mechanical engineer for several companies, including Walt Disney World, Apple Computers, Inc., and Convolv, Inc. During my tenure at Georgia

Tech I have continued to actively work for companies as either a part-time consultant or as a full-time engineer. For example, from 2017-2020 I took a leave of absence from Georgia Tech to work at Google.

12. In my role at Walt Disney World, I designed and developed a number of structures and components for the parks' rides, including operational control procedures for the Body Wars simulators. These simulators were rooms that held about 40 people at a time. The entire rooms, and the guests seated within, were automatically moved up, down, side-to-side, and through a range of inclinations via a series of preprogrammed motions. At the front of the room was a large screen that displayed a projection of a video that was coordinated with the motion of the room. The net result was a ride that simulated traveling through the human body.
13. For Apple Computers, I designed and developed computer monitors with built-in speakers and microphones. Part of my job responsibilities required me to use complex sensors and computer controllers to conduct performance testing on numerous design prototypes that were directed at measuring the effectiveness of the human-machine interaction. I also tested the quality of the displayed images under a variety of conditions.
14. For Convolve, Inc., I analyzed the dynamics of automated robots, satellites, and NASA high-altitude balloons. I also developed automated control

systems for laser interferometers. These sensors emit laser beams using two different frequencies of coherent light. The beams both travel through, and reflect off, specialized mirrors that control the beam pathways such that nanometer-level measurements of a moving object can be obtained.

15. While working for Google, I designed several consumer electronic products and a shopping assistant that scanned clothing barcodes using the camera of a smartphone. The goal of the project was to guide users to select the most appropriate-sized article for purchase. During my years at Google I worked in both the Advanced Technology and Projects lab (ATAP), as well as the Google augmented reality division.
16. One of the primary focusses of my career at Georgia Tech has been developing technology to aid humans during the operation of machines. The operator-aiding technologies that I have developed decrease the required effort and skill, as well as help reduce operator errors. For example, I have developed technologies that help crane operators move payloads without inducing sway. This makes transferring payloads from one location to another much easier and with less chance of accidents.
17. An important aspect of the subject matter of this case is focused on sensors that detect user gestures. The summary of the invention of the '036 patent indicates that the invention can utilize a camera "...to image at least one of

the actions of an individual guided by the visual indicator...” [‘036, 2:20-21.] I have published numerous papers covering the use of computer vision, such as [1-11]. I have also published papers describing research using visual guides to aid workers [12-14]. Furthermore, I have extensive experience using sensor systems that can accurately locate objects within large workspaces, such as VICON motion capture systems.¹

18. One of my research projects that is closely related to the technology described in the ‘036 patent involved mounting a laser on the top of a small-scale tower crane. The laser was directed toward the ground and was controlled such that its illumination spot indicated to the operator where the crane payload would be about 3 seconds in the future. The laser effectively helped guide the operator to move the crane payload through cluttered environments and arrive at the intended target location. Additionally, starting in 2006, I used a webcam in conjunction with the crane so that remote users could both observe the actions of a local operator and perform remote control of the crane as well. The webcam allowed users at both Stanford University and MIT to perform extensive tests on the crane while it was physically located at Georgia Tech in Atlanta. Additionally, users in

¹ www.vicon.com

Japan and Spain also operated the crane to complete control experiments for their coursework. The webcam video stream allowed these remote users to better understand and control the motions that the crane was performing.

19. I have commercialized operator-aiding technologies by founding two companies: CAMotion Cranes and InVekTek. CAMotion Cranes designed and installed crane control systems that decrease payload sway, automatically avoid obstacles, and improve crane safety. These improvements were achieved through sensor systems and control methods that my research group at Georgia Tech developed, patented, and deployed. CAMotion Cranes was acquired by PAR Systems in 2013. InVekTek develops and commercializes control systems for large robotic and industrial material-handling systems. InVekTek products include control systems that read sensor signals and accurately control machine actuators.
20. Most of the installations of my crane-operator aids that include an overhead camera for monitoring the crane payload and workspace use a DVT, or Cognex, smart camera. These cameras first became available in the early 1990's. They are essentially the combination of a digital camera, a processor, and specialize image processing software all in the same small package.

21. Finally, I have previously worked as a technical expert on cases involving warehouse automation equipment. I worked on two investigations at the International Trade Commission (ITC-1293 and ITC-1333), both of which involved warehouse automation equipment that helped store and retrieve items in warehouses.

IV. MATERIALS CONSIDERED

22. My opinions are based on my experience, knowledge of the relevant art, the patents and prosecution histories of the '036 patent, the '614 patent, and the '981 patent, the documents identified as References at the end of my declaration, and the documents discussed in this declaration.

V. LEGAL STANDARDS

23. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents related to this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the Challenged Claims.

A. Claim Construction

24. I have been instructed that the terms appearing in the '036 patent should be interpreted in view of the claim language itself, the specification, the

prosecution history of the patent, and any relevant extrinsic evidence. I understand that the words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention. While claim limitations cannot be “read in” from the specification, the specification is the single best guide to the meaning of claim terms. I have followed these principles in reviewing the claims of the ’036 patent and forming the opinions set forth in this declaration. However, I have also been instructed that a claim term may be indefinite if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.

B. Level of Ordinary Skill

25. I understand a person of ordinary skill in the art is determined by considering issues such as (i) the type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) rapidity with which innovations are made; (iv) sophistication of the technology; and (v) educational level of active workers in the field. I understand that these factors are not the only criteria that can be applied while determining a level of ordinary skill. For example, the claimed subject matter can be compared to subject matter that

is typically taught in the relevant engineering curricula to provide guidance of what would constitute appropriate educational requirements for a person of ordinary skill in the art.

C. Anticipation

26. I have been told that under 35 U.S.C. § 102, a patent claim is invalid if its subject matter was patented or described in a printed publication before the effective filing date of the claimed invention. I have been told that this is referred to as invalidity by anticipation. I have been told that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

D. Obviousness

27. I have been told that under 35 U.S.C. § 103, a patent claim may be obvious if the differences between the subject matter sought to be patented 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 to which the subject matter pertains.
28. I have been told that a proper obviousness analysis involves:
- a. Determining the scope and content of the prior art;
 - b. Ascertaining the differences between the prior art and the claims at issue;

- c. Resolving the level of ordinary skill in the pertinent art; and
- d. Considering evidence of secondary indicia of non-obviousness (if available).

- 29. I have been told that the relevant time for considering whether a claim would have been obvious to a POSITA is the time of invention.
- 30. I have been told that a reference may be modified or combined with other references, or with a POSITA's own knowledge, if the person would have found the modification or combination obvious. I have also been told that a POSITA is presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a POSITA would employ.
- 31. I have been told that whether a prior art reference renders a patent claim obvious is determined from the perspective of a POSITA. I have also been told that there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention. However, suggestions to combine known elements to achieve the claimed invention may come from the prior art as a whole, or individually, and may consider the inferences and creative steps that a POSITA would employ. I understand that obviousness grounds cannot be sustained by mere

conclusory statements and must include some articulated reasoning, with some rational underpinning, to support the legal conclusion of obviousness.

32. I have been told that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also have been told that the “teaching, suggestion, or motivation” test can be used in establishing a rationale for combining elements of the prior art. I have also been told to be aware of distortions caused by hindsight bias, and that reading into the prior art the teachings of the patent at issue is improper.

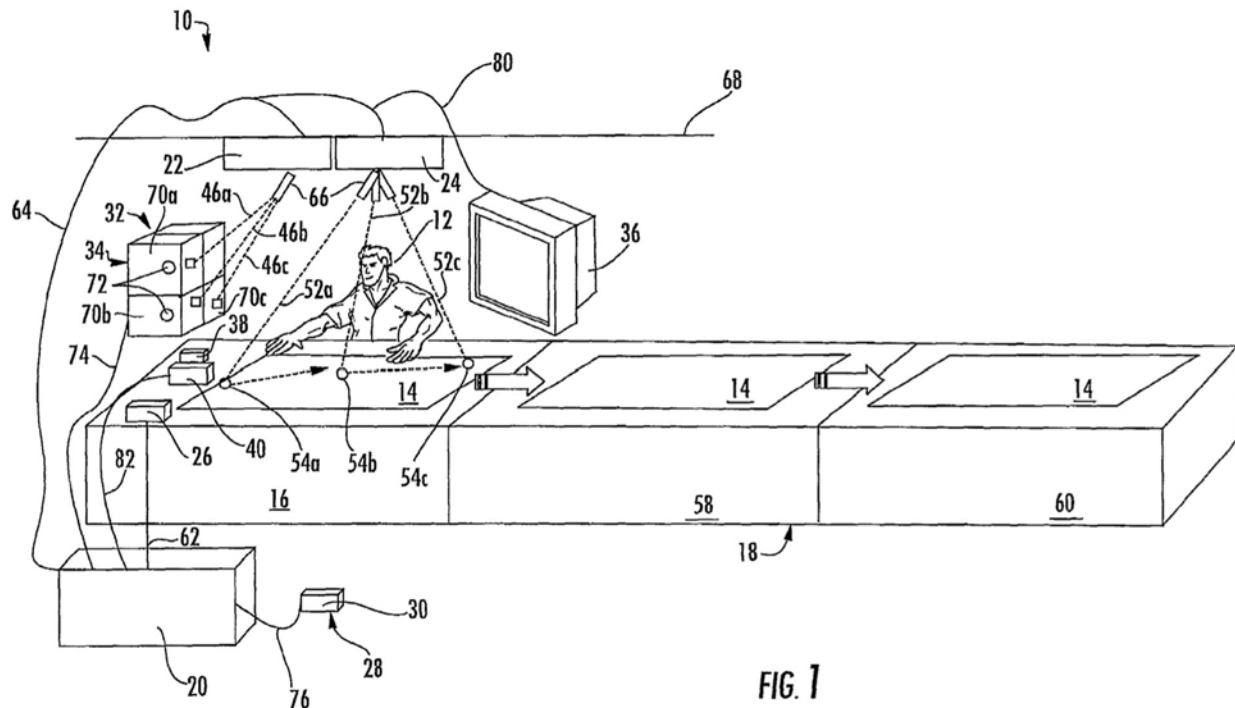
VI. THE '036 PATENT

A. Specification

33. U.S. Patent No. 10,528,036 (“the '036 patent”) was issued to Paul Ryznar and James Ryznar on January 7, 2020. The patent claims priority to a U.S. provisional application No. 61/441,897, that was filed on February 11, 2011. The patent owner further contended that the '036 Patent is entitled to a priority date no later than October 1, 2010, which is the priority date that I used in my analysis.
34. The '036 patent describes technology that generally utilizes two main components. First, it describes a guide system that projects visual indicators onto an object in a workspace to guide the actions of an individual. Then,

the '036 patent describes how a camera is used to capture images of the individual, an object, and the projected light and display the captured images on a remote monitor.

35. A schematic representation of the guide system is provided in Figure 1 of the '036 patent, which has been reproduced below for convenience.



'036 Patent, Fig. 1.

36. The guide system is described as having overhead directional light devices 22 and 24 that project light downward onto the workspace of the operator 12. The light devices provide indicating lights 46 and 52 to guide an operator in the selection and assembly of parts.

37. The location and positioning of the projected indicating lights are directed by a “guide system controller.” The guide system controller can include a plurality of “addressed display features” that are used to project images “at a location corresponding to the selected positional identifiers.” [’036, 1:46-60.] The actions of the guide system controller are described as being directed by “input signals” that determine which images are selected for projection, and at what locations those images are directed. For example, “...guide system controller 220 may receive input signals directly from a sensor apparatus and/or via manual inputs from an operator.” [’036, 19:8-10.]
38. The sensor apparatus that can provide inputs to the guide system controller can be a component of the guide system, or can be an external component. For example, “sensor apparatus 226 may be a sensor apparatus component of guide system 200. Alternatively, sensor apparatus 226 may be a separate component, such as a device that detects the presence and/or type of product at guide system 200, or may be a device such as a computer for allowing manual inputs.” [’036, 18:37-42.]
39. The ’036 patent describes its technology as using a camera to monitor the guide system and the individual working within the workspace. For example, it states “integrated camera device 313 that may be used to record

and/or review activities by an individual being guided by guide system 300, as well as the object that is the subject of activities by the individual. ['036, 20:24-27.]

40. The '036 patent has two independent claims – claims 1 and 7. Claim 1 is representative of the claimed technology. It is reproduced here for convenience.

1.0	A method of projecting visual indicators to guide actions of an individual for a particular guided operation, said method comprising:
1.1	projecting a visual indicator using a directional light device onto a physical object associated with the particular guided operation;
1.2	imaging the projected visual indicator with a camera located proximate to the directional light device;
1.3	transmitting images from the camera to a monitor located remotely from the directional light device; and
1.4	displaying images from the camera on the monitor;
1.5	wherein said imaging, by the camera, captures images of at least the individual being guided, the physical object and the projected visual indicator.

41. The preamble and limitation 1.1 simply require projecting light onto objects to guide individuals. This method was well-known at the priority date of the '036 patent. State-of-the art references such as *LightCollabo: Distant Collaboration Support System for Manufacturers* by Iyoda (“Iyoda”) and *Cooperative Augmentation of Smart Objects with Projector-Camera Systems* by Molyneaux (“Molyneaux”) predate the '036 patent and teach the use of

directional light devices to guide operations. For example, Molyneaux teaches that its system projects information onto objects and then “The employee sees the projected message and picks up the object.” [Molyneaux, Sec. 6.4, ¶2.] Iyoda teaches a system that uses projectors to allow remote collaborations. For example, Iyoda teaches that remote users can “draw annotation on the video image and the annotations are projected back onto the original object so that the local users can see.” [Iyoda, Sec. 1, ¶2.]

42. Limitations 1.2-1.5 of the '036 patent then go on to claim the use of a camera while imaging, transmitting, and displaying activities of the individual on a remote monitor. Note that the sum total of limitations 1.2-1.5 would be practiced by the use of a conventional webcam.

B. Prosecution History

43. I understand that during prosecution, the Examiner rejected claims 1-3 originally as filed as unpatentable over U.S. Patent Publication No. 2005/0225753 (“Engelbart”) and Engelbart in view of U.S. Patent Publication No. 2011/0178627 (“Wechter”). [Ex. 1002 ('036 File History), 120-129 (pdf pagination).]
44. Despite patentee’s objections that Engelbart does not disclose imaging visual indicators, the Examiner maintained the rejection. [Ex. 1002, 356-58 (pdf pagination).] The Examiner also rejected patentee’s newly added dependent

claims 5-9 over Engelbart in view of Wechter and U.S. Patent Publication No. 2008/0121168 (“Ryznar”) [Ex. 1002, 366-374 (pdf pagination)] and objected to claim 4 on the grounds that it is “dependent upon a rejected base claim.” [Ex. 1002, 355 (pdf pagination).]

45. The Examiner did allow the newly added claims 10-15 [Ex. 1002, 355 (pdf pagination)], which introduced the additional claim limitation that the camera is “configured to capture an image of ***at least the individual, the physical object*** and said visual indicator when said visual indicator is projected onto the physical object.” [Ex. 1002, 347 (pdf pagination).] The final allowable claims all require that the camera capture an image of at least the individual, the physical object, and the visual indicator. [Ex. 1002, 427-429 (pdf pagination).]

VII. LEVEL OF ORDINARY SKILL IN THE ART

46. In my opinion, a person of ordinary skill in the art (“POSITA”) pertinent to the ’036 patent would have had at least a four-year degree in electrical engineering, mechanical engineering, computer science, or a closely related field, and a year of experience working in interactive computer applications with integrated cameras. Additional education could substitute for professional experience, and significant work experience — such as designing or implementing interactive computer applications with integrated

cameras — could substitute for formal education. Specific experience with projected light is not required since, by 2011, projecting light was a routine step that used essentially the same tools as any other display output.

However, experience with laser projection would be a plus, as many prior art light-guided assembly tools used laser projection.

47. I arrived at this definition by considering the various factors listed above in Section V.B, as well as the claims themselves. For example, the types of problems encountered in developing a guide system controller would be similar to problems encountered while developing the controller for many other types of automated systems. Practitioners would need to solve the problem of controlling the position of the projected light. The field of controls is interdisciplinary; however, the fundamentals of the field are taught in electrical engineering, mechanical engineering, and computer science curriculums. Therefore, people educated in these fields and who worked to integrate light projection in automated or semi-automated environments would be prepared to understand and address the control challenges.
48. Problems that would arise in using a camera to monitor the guiding system and the individual include selecting the appropriate field of view. Engineers trained in the above list of disciplines and with experience in camera

applications would know how to select, implement, and test cameras to ensure they could perform the required actions.

49. An additional problem encountered in this technology field includes performing the computations required to both control the projector, as well as acquire and analyze the video stream from the camera. Once again, engineers trained in the above list of disciplines would know performing this computation quickly could be achieved by using one computer to control the projector and using a separate controller for the vision system.
50. Prior art solutions to problems addressed by the '036 patent include the use of webcams to remotely monitor individuals. Again, this subject matter would be understandable to a variety of engineering disciplines. As mentioned above, I utilized webcams to remotely monitor individuals that operated the small-scale cranes in my laboratory at Georgia Tech. Master's-level graduate students in my research group selected and installed the webcams used for this aspect of our work.
51. Although the main components claimed by the '036 patent are straightforward technologies, the specific arrangement of components claimed in the '036 patent would obviously not be taught in undergraduate curriculums. Therefore, some amount of practical work experience in

automation and/or camera equipment would be beneficial for understanding the full scope of the claimed invention.

52. The educational requirements of my definition of a POSITA are also tied closely to the claimed subject matter. The operating principles of projectors and cameras are relatively straightforward concepts that would be covered in introductory college-level physics classes and in a variety of engineering disciplines. A central feature of the claims include control actions that project visual indicators. Such controllers are common within the field of automation. In order to function, they must receive information, such as from sensor apparatuses or manual inputs, and then provide command signals in response to the inputs they receive. The command signals effectively drive the directional light device that guides operator actions. Such control systems (controller, sensors, controlled objects, and the code executing on the controller processor) are interdisciplinary technology, but they are generally taught at the undergraduate level in electrical engineering, mechanical engineering, and computer science.
53. I was at least a POSITA as of the priority date of the '036 patent because I received an undergraduate degree in mechanical engineering in 1990 and I had worked for more than ten years on automation-related applications,

many of which included the use of cameras. I also had experience using lasers to guide individuals in performing operations.

VIII. CLAIM CONSTRUCTION

54. I have been instructed that the terms appearing in the '036 patent should be interpreted in view of the claim language itself, the specification, the prosecution history of the patent, and any relevant extrinsic evidence. I understand that the words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention. While claim limitations cannot be “read in” from the specification, the specification is the single best guide to the meaning of claim terms. I have followed these principles in reviewing the claims of the '036 patent and forming the opinions set forth in this declaration.
55. For purposes of forming my opinions, I have not found it necessary to construe any of the claim language, because the prior art so clearly falls within the scope of the claim language that the core meaning of the claim terms is sufficient for my analysis.
56. However, I note that many of the claims appear to have ambiguities that may render them indefinite. For example, the terms “located remotely” and “proximate to” are terms of degree whose boundaries cannot be ascertained

from the terms themselves or the specification. Furthermore, the phrase “a sequence of one or more input signals” is indefinite because there cannot be a “sequence of one” input signal. Similarly, the phrase “a combination of the sequence of the input signals” in claim 11 is likely indefinite for the same reasons. Nevertheless, for these terms, my analysis focuses on the core meaning of the claim terms, as that meaning was sufficient to determine that the prior art discloses these elements and resolving the boundaries of the claim terms was unnecessary for me to complete my analysis.

IX. SUMMARY OF THE PRIOR ART

A. Summary of the Everywhere Displays Projector and the M&M Exhibition

57. The prior art in this IPR Petition primarily concerns a system developed by researchers at IBM called the “Everywhere Displays” projector. This device combined a projector and a camera to allow for both displaying and capturing images at various locations. Two prototypes of the Everywhere Displays (ED) projector are shown below:

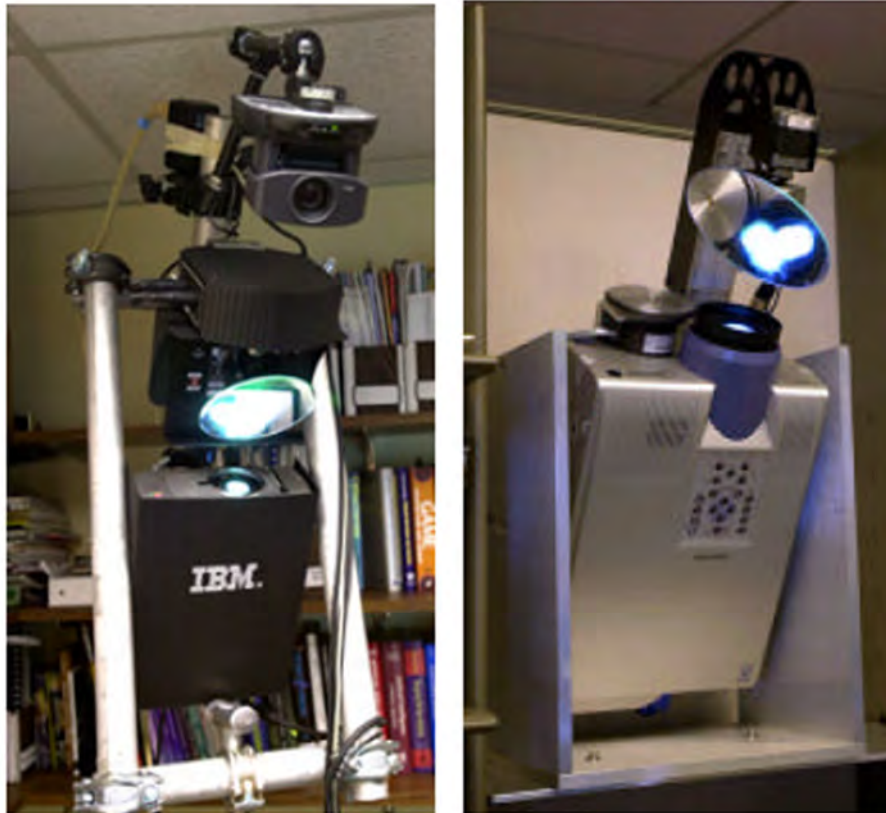


Fig. 1: Two prototypes of the Everywhere Displays projector.

Kjeldsen, Fig. 2.

58. The developers of the Everywhere Displays projector demonstrated their system at several conferences and wrote over a dozen articles² describing its components and functions. They also maintained a website regarding the Everywhere Displays projector at www.research.ibm.com/ed/. Many of the

² See *Everywhere Displays: Publications*, IBM RESEARCH, http://www.research.ibm.com/ed/ed_publications.htm [available at http://web.archive.org/web/20090502141124/www.research.ibm.com/ed/ed_publications.htm].

Everywhere Display articles were also published on that website. [See Ex. 1009 (“Kjeldsen Decl.”) ¶¶ 4; Ex. 1007 (“Archive.org Decl.”) at 6, 16, 19, 23.]

59. Several of the Everywhere Displays publications concern a public demonstration of the system that occurred at the 2001 conference of the “Special Interest Group on Computer Graphics and Interactive Techniques.” This conference is called “SIGGRAPH’01.”
60. During SIGGRAPH’01, the Everywhere Displays projector was presented as part of an interactive demonstration in which over 650 people participated. [Kjeldsen at 5.] The exhibit concerned “an augmented reality assembly task” where, . . . [a]s in any assembly task, each individual contributes to the assembly of an object by executing specific parts of the assembly process.” [Kjeldsen at 2.] The specific assembly task involved assembling “a 60x50 picture made of M&M’s . . . where each M&M is regarded as a “pixel” of the picture.” [Kjeldsen at 2.]
61. As part of this interactive experiment, the Everywhere Displays projector was placed in an exhibition workspace having various unmarked buckets of M&M’s on shelves, as shown below, as shown below.

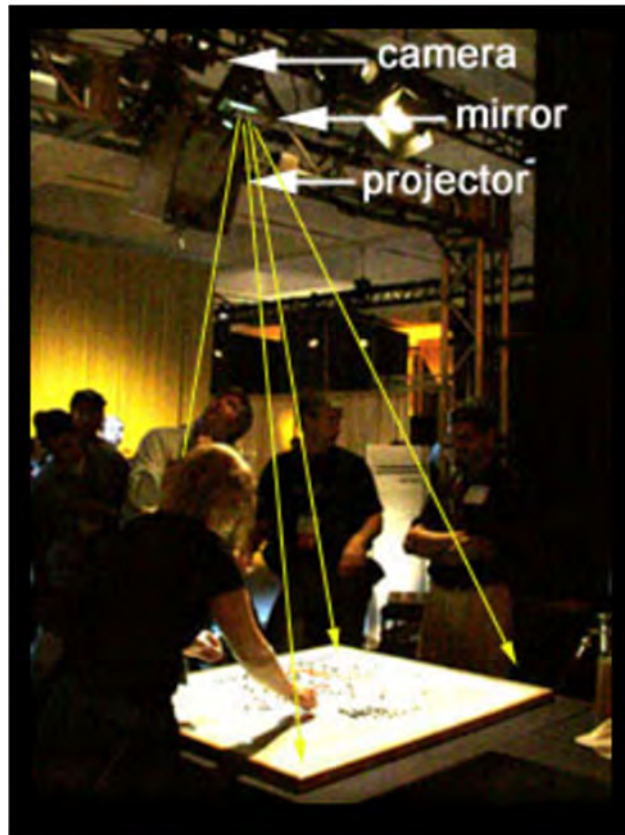


Ex. 1007 at 6 (IBM webpage on ED projector demo at SIGGRAPH'01)

This exhibition space is described as follows:

In the front of our experimental space is a table; on the table lies a flat transparent Plexiglas board coated with double-sided transparent stick tape. This board is used as a mounting “canvas” for the M&M’s and after assembly, as the hanging support for the pictures. On the back walls of the space are shelves with unlabeled buckets, each containing one of the 18 different colors of M&M’s used. Each bucket is covered with paper of different color and texture. Two other surfaces are also used for projection: a painter’s palette mounted on an easel and a wood board first covered with one inch thick foam and then topped with white fabric. On the surrounding walls are completed M&M pictures, giving users a notion of the final goal of the assembly task.

[Kjeldsen at 2.] The Everywhere Displays projector/camera itself is located above the center of the space, as shown below.



Ex. 1007 at 6 (IBM webpage on ED projector demo at SIGGRAPH'01)

62. The assembly task exhibited at SIGGRAPH'01 and reported in many publications involved the following steps:
63. *First*, “[a]s the visitor arrives in the space, she sees the image of an M&M projected on the painter’s palette with the instruction “Touch to begin”, as shown in Fig. 2a. When the visitor touches the M&M “button,” the system responds by projecting an arrow onto the palette and a message inviting the visitor to “Come in.” [Kjeldsen at 2.] The initial projection onto the painter’s palette is illustrated below:



Kjeldsen, Fig. 2(a).

64. *Second*, “[t]he ED -projector is then steered towards the foam-covered-board where images of different colored M&Ms are projected along with the invitation “Pick a color” (see fig. 2b). Here, the user can select which color to place in this iteration by simply touching the M&M of the desired color.” [Kjeldsen at 2.] This “pick a color” operation is illustrated below:



Kjeldsen, Fig. 2(b).

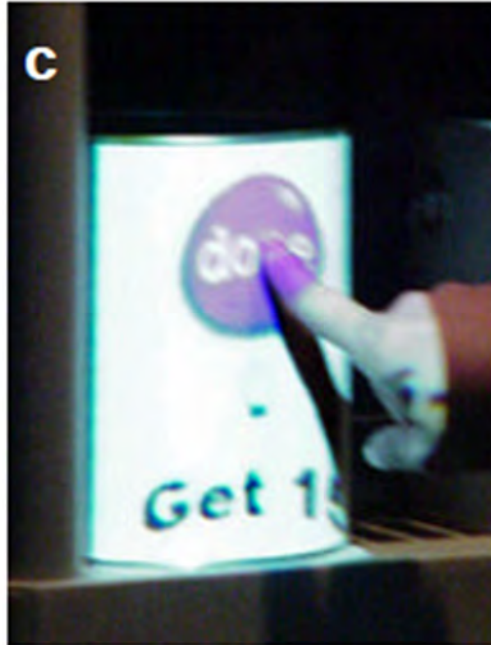
Additional description of this step includes, “As soon as the system detects the user selecting the color she wants to place, it projects a message on the foam covered-board, asking the user to get a certain number of M&M’s from a highlighted can.” [Kjeldsen at 2.] This is illustrated below:



Ex. 1007, Exhibit B-1 (SIGGRAPH’01 video) at 0:19.

65. *Third*, “[t]he ED-projector then rotates the mirror so it highlights the bucket that contains the M&Ms of that color.” [Kjeldsen at 2.] “It displays the message “Get n”, (where n is the number of M&Ms to be picked up from the bucket) on the bucket’s frontal face. In addition, a button with the word “done” on it, i.e., an image of an M&M underlined by a pointing finger (see Fig. 2c), is also displayed on the can. After retrieving the appropriate number of M&M’s from inside the bucket, the visitor has to touch this

“done” button to communicate that the picking has been completed (Fig. 2c).” [Kjeldsen at 2-3.] This task of retrieving items from the bucket is illustrated below:



Kjeldsen, Fig. 2(c).

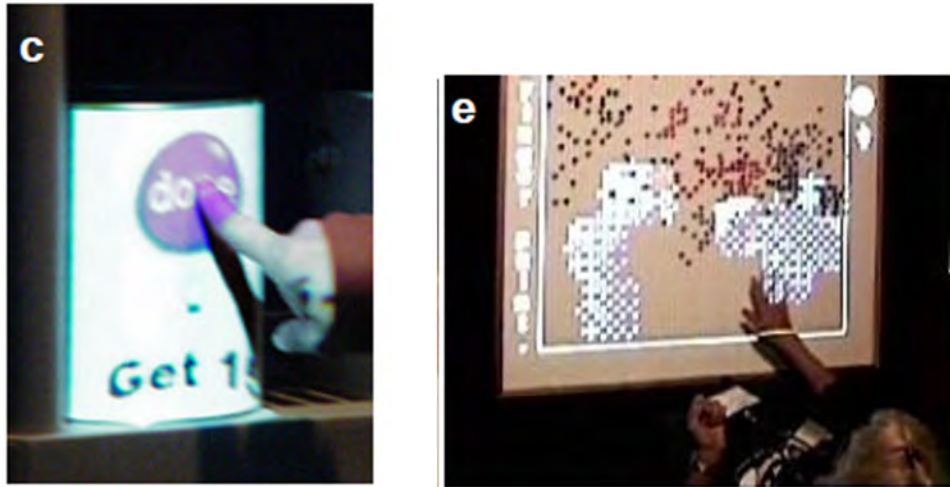
66. *Fourth*, “[i]mmediately afterward an instruction of “Go to the table” is projected on the bucket and the ED-projector is redirected to the Plexiglass board. [Kjeldsen at 3.] The ED-projector then indicates the precise location where the M&M’s should be placed . . . by projecting an image of the target locations on the canvas.” [Kjeldsen at 3.] This target projection is illustrated below in a figure from Pinhanez I.



Pinhanez I, Fig. 9(c); *see also* Kjeldsen, Fig. 2(d) for similar image.

67. During this step, the ED-projector “also displays the instructions ‘Place the M&M’s’, and ‘Done ?’ and an M&M button labeled ‘yes’. After the user places the M&M’s, she communicates the end of her action by touching this button.” [Kjeldsen at 3.]
68. Relevant to this case, the camera on the ED-projector takes images during the operation of the system. These images include the individual being guided by the Everywhere Displays projector, physical objects, and

projected light indicators. For example, the Kjeldsen reference includes the following images taken by the camera of the ED-projector device, both of where were taken by the “system camera.” [Kjeldsen at 2.]



Kjeldsen, Fig. 2(c), (e).

Additional images taken by the system camera appear in Kjeldsen and other references. Most notably, a 2-minute video taken by the ED-projector system camera at SIGGRAPH'01 was posted online by IBM where it was intended to be transmitted to other monitors over the internet. [Ex. 1007, Exhibit B-1; Ex. 1009 (Kjeldsen Decl.); Ex. 1007 (Internet Archive Decl.); *see also* Pinhanez II at 3 (“[a] video, from the [ED-projector] system’s camera point of view [is available] at <http://www.research.ibm.com/people/p/pinhanez/download/video1.avi>”).] This video is discussed in further detail below.

69. The specific references that I rely on for my claim-by-claim analysis are discussed below.

B. Summary of Kjeldsen

70. *Interacting with Steerable Projected Displays* (“Kjeldsen”) is an article published in 2002 in the proceedings of the 5th International Conference on Automatic Face and Gesture Recognition (FG’02). I have been informed that it is considered prior art to the ’036 patent.
71. Kjeldsen describes the ED-projector and the demonstration that occurred at SIGGRAPH’01. It focuses primarily on reporting the results of the experiment conducted at SIGGRAPH’01, and in particular, the success of the camera component of the ED-projector at detecting user actions. [See, e.g. Kjeldsen at 5-6.]

C. Summary of Pinhanez I

72. *Ubiquitous Interactive Graphics* (“Pinhanez I”) is IBM Research Report RC22495 that was published May 17, 2002. I have been informed that it is considered prior art to the ’036 patent.
73. Pinhanez I also describes the Everywhere Displays system, including many of the technical components. The main components of the ED-Projector are schematically shown in Figure 2 of Pinhanez I, which has been reproduced below for convenience. Figure 3b of Pinhanez I shows a photograph of the

actual hardware components. That photograph has been reproduced below in annotated form with the main components labeled.

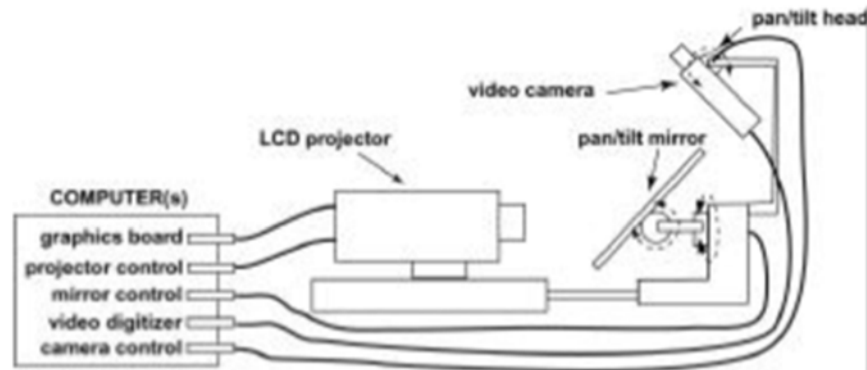
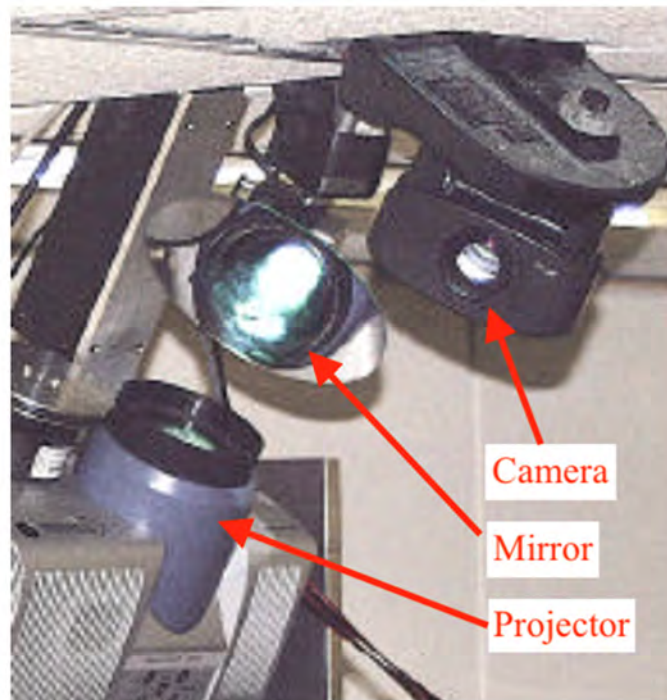


Figure 2. Diagram of the components of the ED-projector.

Pinhanez I Figure 2.



Pinhanez I Figure 3b – Annotated.

74. Both Figures 2 and 3b indicate that the camera is located proximate to the directional light device. Furthermore, Figure 2 indicates that multiple “computer(s)” can be used to perform the required computations.
75. Pinhanez I explains that in order to “capture user interaction with the projected graphics, the images gathered by the camera are processed using computer vision techniques.” [Pinhanez I, Sec. 1, ¶3.] Using its system, Pinhanez I is able to “determine the user’s hand position in reference to a surface and to detect simple, touch-like gestures, effectively mapping the user’s hand gestures into mouse-like events.” [Pinhanez I, Sec. 1, ¶3.]
76. Pinhanez I describes the use of the Everywhere Displays projector in various scenarios. Section 4.1, entitled *An Office Application*, describes using the ED projector in an office environment. Section 4.2 of Pinhanez I entitled, *Augmenting an Assembly Task*, describes the SIGGRAPH’01 experiment discussed above. Section 4.3 describes a computer game in which a frog is displayed somewhere in the room and, when someone tries to touch it, the ED projector moves the frog to another location.
77. Relative to the SIGGRAPH’01 experiment, Figure 9 in Pinhanez I illustrates the same process that was shown in Figure 2(b) – 2I in Kjeldsen discussed herein. [See analysis in Challenge 1 at [1.1].]

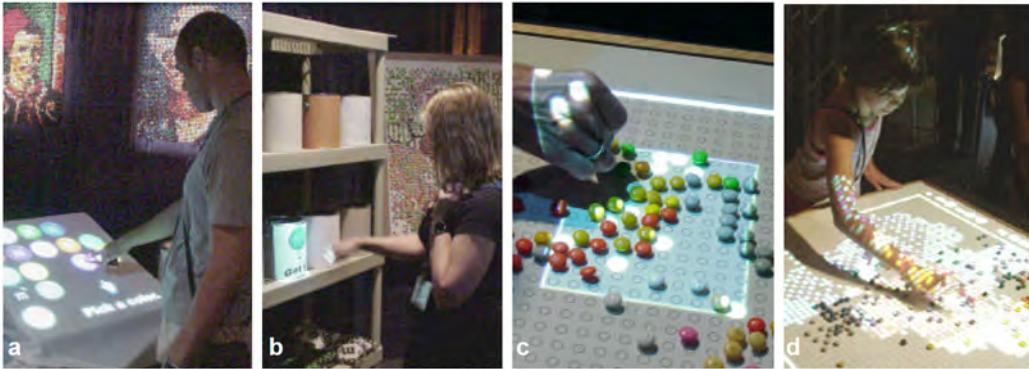


Figure 9. The M&M picture assembly task: a) choosing a color; b) “clicking” a bucket after getting the M&Ms; c) placing the M&Ms on the highlighted areas; and d) “finger painting” to reveal the complete picture.

Pinhanez I, Fig. 9.

78. Specifically, Figure 9a in Pinhanez I shows a user selecting a color to begin the assembly process. “The user simply touches the color of his choice to select it.” [Pinhanez I, Sec. 4.2, ¶ 3.] “Figure 9.b shows a ‘clickable’ button appearing on a paint bucket that contains the M&M’s of the selected color.” [Pinhanez I, Sec. 4.2, ¶ 3.] “In Figure 9.b the system [also] highlights the bucket that contains the M&M’s of the selected color, and also provides additional information on how many M&M’s to pick.” [Pinhanez I, Sec. 4.2, ¶ 3.] These disclosures show that in response to an input signal (*i.e.*, the signal generated by the button widget in Figure 9a), the Pinhanez I graphics board, projector control, and mirror control (*i.e.*, components of *the guide system controller*) *prompt[s] the directional light device* (projector/mirror) *to project the visual indicator* (the bucket highlight, the number of M&Ms to pick up, and button on Figure 9b) *for the particular guided operation* (selecting the appropriate M&Ms from the supply buckets).

79. The sequence of steps is similar for Figure 9c: after the user selects the button on Figure 9b, “the system points the exact places on the picture board where the M&M’s should be placed.” [Pinhanez I, Sec. 4.2, ¶ 3.] This is another example of *the assembly guidance system ... prompting the directional light device* (projector/mirror) to *project the visual indicator* (proper M&M locations) *for the particular guided operation* (placing the M&Ms at the proper location).

D. Summary of Pinhanez II

80. *Applications of Steerable Projector-Camera Systems* (Ex. 1014, “Pinhanez II”) is a paper published by Pinhanez et al. at the ICCV Workshop on Projector-Camera Systems (PROCAMS’03) in 2003. I have been informed that it qualifies as prior art to the ‘036 patent.
81. Pinhanez II describes the same ED-projector discussed above. However, Pinhanez II provides additional details of the computational structure that are not included elsewhere. Specifically, Pinhanez II teaches how the system is implemented using two different computers when it states in Section 3 “The system is currently run on two different computers, one responsible for the application software and the projector software; the other controlling the positioning of the camera and runs the computer-vision system responsible for detecting user interaction.” [Pinhanez II, Sec. 3, ¶2.]

E. Summary of Pinhanez III

82. Projector-camera Systems for Telepresence” (Ex. 1015, “Pinhanez III”) is IBM Research Report RC23308 that was published August 23, 2004. I have been informed that it is considered prior art to the ’036 patent.
83. Pinhanez III describes the same ED-projector that was presented in Pinhanez I and Pinhanez II. However, Pinhanez III provides details of the remote monitors. Specifically, Pinhanez III teaches that the camera images are displayed on a monitor that is remote from the directional light device.
84. Figure 1 of Pinhanez III, reproduced below for convenience, illustrates a use of its ED-Projector for telepresence applications. Pinhanez III discloses implementing a projector-camera device at a local site, while a “user in a remote space can access/view and control both the projector and the camera through a [remote] display and writing device.” [Pinhanez III, Sec. 1, ¶3.]

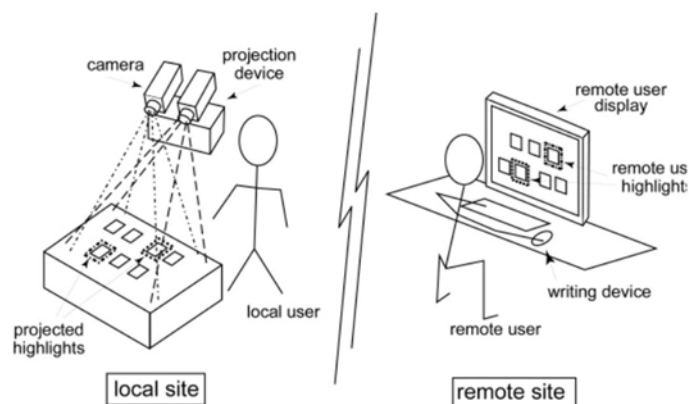


Figure 1. Overview of using a projector-camera system in a telepresence application.

Pinhanez III Figure 1.

85. Pinhanez III describes an example application of the ED-Projector for use in a conference workshop that includes remote attendees. Figure 2 of Pinhanez III, reproduced below for convenience, “shows a screenshot of the control interface available to the session chair. The upper window in this figure shows the interface to camera views. This window displays video from (one of) the remote camera(s) and enables the chair to manipulate the remote camera(s) through the pan, tilt, and zoom controls and also define camera views.” [Pinhanez III, Sec. 2, ¶2.] While the upper window is used for the camera, “The lower window in Figure 2 shows the interface for the chair to control the remote Everywhere Display projector.” [Pinhanez III, Sec. 2, ¶2.]



Pinhanez III Figure 2.

86. Figures 4 and 5 of Pinhanez III, reproduced below for convenience, show images from the illustrative conference workshop application using the ED-projector. “In Figure 4, the session chair has selected the same camera view and projection surface. In this case, however, he has used the ‘draw’ option to transmit the drawing in the lower window, where he is showing the time left for the speaker. As seen in the live camera view, this information is projected on the wall next to the speaker in the conference.” [Pinhanez III, Sec. 2, ¶8.]



Pinhanez III, Figs. 4-5.

87. Figure 5 shows a different use case wherein “the chair has selected the camera view that shows the audience in the conference. In the lower window, he has chosen the highlight as the drawing option and moved this highlight onto the face of one of the audience members who has raised her hand...” [Pinhanez III, Sec. 2, ¶9.]
88. Pinhanez III discloses that such uses of the ED-projector allow “the real effect on the local environment [to] be monitored through the live video in the upper window” on the remote monitor. [Pinhanez III, Sec. 2, ¶4.]

F. Additional Everywhere Displays References

89. In addition to the technical papers describing the Everywhere Displays projector, this same project was described on a series of web pages and other resources located at www.research.ibm.com/ed/. This website included the Kjeldsen, Pinhanez I, and Pinhanez II articles discussed above. Additionally, it contains web pages describing the Everywhere Displays project overall (Ex. 1007 at 19) and the SIGGRAPH’01 experiment specifically (Ex. 1007 at 6). The Everywhere Displays website includes two videos that show the Everywhere Displays projector in action. [See Ex. 1007 at Exhibit B-1 and B-2.]
90. The video attached to Exhibit 1007 as Exhibit B-1 shows the SIGGRAPH’01 experiment in progress and is particularly significant to my

analysis. This video was taken by the Everywhere Displays projector and posted online at URL: <https://education.siggraph.org/conferences/annual-conference/siggraph2001>. The video includes a full run through of a person participating in the M&M picture assembly project. The video illustrates the ED camera capturing various images of the operator, physical objects, and indicating lights, including the screen grab images shown below:



[Ex. 1007, Exhibit B-1 at 0:17, 0:35, 1:01.] Notably, the video was posted online so that remote users would watch it (on remote monitors). [See Ex. 1007 at 8 (containing link to video).]

G. Combination of Everywhere Displays References

91. As discussed in further detail below, it would have been obvious to a POSITA to combine any of the Everywhere Displays references together for purposes of obviousness. All of the references (Kjeldsen, Pinhanez I, Pinhanez II, Pinhanez III, and the Everywhere Displays web pages and videos (Ex. 1007 at 6, 19, Exhibit B-1 and Exhibit B-2)) concern the same system (the ED-projector) and were published by the same set of authors

around the same time. Therefore, it would have been obvious to a POSITA to combine the teachings of the references. The references all describe the same invention, but each publication focuses on different details of the system. Therefore, a POSITA would view a combination of the Everywhere Displays publications as a unified teaching of the same invention. In addition, the references are reasonably pertinent to the problem to which the claims of the '036 patent are directed, namely integrating the use of cameras with projected light guidance systems.

H. Summary of Machino I

92. *Remote-Augmented Communication: A Remote-collaboration System based on a Shared Field of View in Real Space* (“Machino I”) is one of a series of technical papers authored by Tamotsu Machino and other researchers at NTT Cyber Solutions Laboratories on a remote communications system for performing remotely assisted maintenance operations. I have been informed that it is prior art to the '036 patent.
93. Specifically, Machino I describes implementing a projector-camera system called SCOPE (which stands for “sight collaboration by projection effect”) that allows “an on-site worker human worker [to be] assisted by another skilled human operator at a remote support center.” [Machino I at Abstract.] To do so, “[SCOPE] has three key functions: creating a shared field of view

between a remote supporter and an on-site worker, keeping meta-information related to the objects in real-space, and projecting meta-information onto the objects.” [Machino I at Abstract.]

94. Figure 2 of Machino I, which is reproduced below for convenience, provides an illustrated view of how information about target objects relevant to a maintenance operation is “indexed” by the remote supporter and “superimposed” (or projected) onto the actual objects at the on-site location.

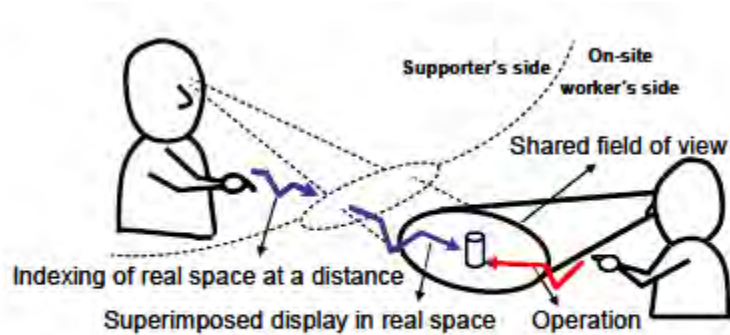


Fig. 2 Image of remote support to provide a shared field of view in real space.

Machino I, Fig. 2.

The Machino papers describe a system that implements this functionality. For example, Machino I includes a figure showing the various components of the SCOPE system:



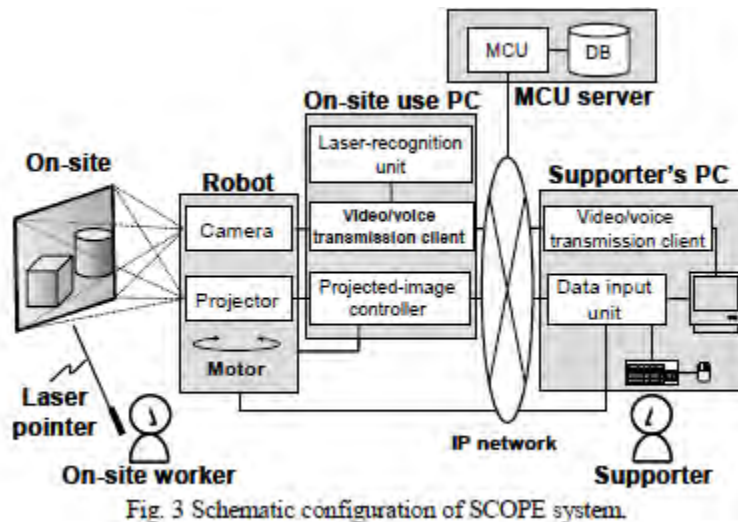
Fig. 5 Scenes of verification experiments.

Machino-I at 4.

As shown, SCOPE has a projector and a camera (top right, “Projector With Camera”), and a remote monitor (bottom left, “Support”). The figure in the top-left (“Shared View”) shows the image that is captured by the SCOPE camera and sent back to the remote display, including both a person and the object he or she is working on. The bottom right figure (“Field”) shows a different camera angle.

95. SCOPE accomplishes this by allowing “the camera and projector on the on-site worker’s side [to] be manipulated from the supporter’s side, and the domains of the viewing field and the information presentation can be changed” [Machino I at 4] based on inputs by the remote supporter. A

schematic diagram of the SCOPE system documenting its functions is shown in Figure 3, which is reproduced below for convenience.



Machino I, Fig. 3.

96. Figure 4 in Machino I further shows a view of the remote supporter's monitor screen, including a list and dialog box for adding/editing objects to be projected (and their associated attribute information), and a camera feed "displaying images transmitted from the on-site worker's side" including projected objects. [Machino I at 4.]

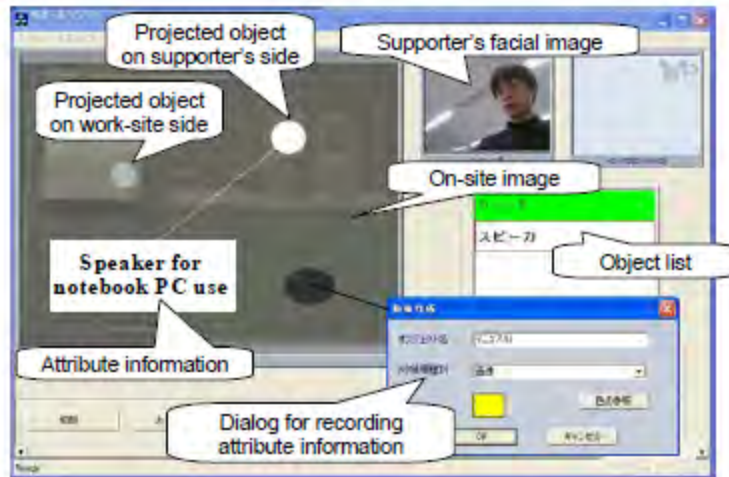


Fig. 4 View of a support screen.

Machino I, Fig. 4.

97. In addition to the use case above, Machino I also discusses verification experiments conducted to evaluate the effectiveness of SCOPE in improving remote-collaboration efficiency and their results. [Machino at 4-6.]

I. Summary of Machino II

98. *Remote-Collaboration System Using Mobile Robot with Camera and Projector* (“Machino II”) is another paper describing the SCOPE system with the same primary author. It was presented at the IEEE International Conference on Robotics and Automation in May 2006. I have been informed that it is prior art to the '036 patent.
99. Iterating on the stationary design of the original SCOPE system, Machino II proposes “a mobile SCOPE” [Machino II at Abstract] where the on-site camera and projector are mounted onto a planar mobile robot. [Machino II

at 3.] This mobile version of the SCOPE system is illustrated in Figure 1 of Machino II, which is reproduced below for convenience.

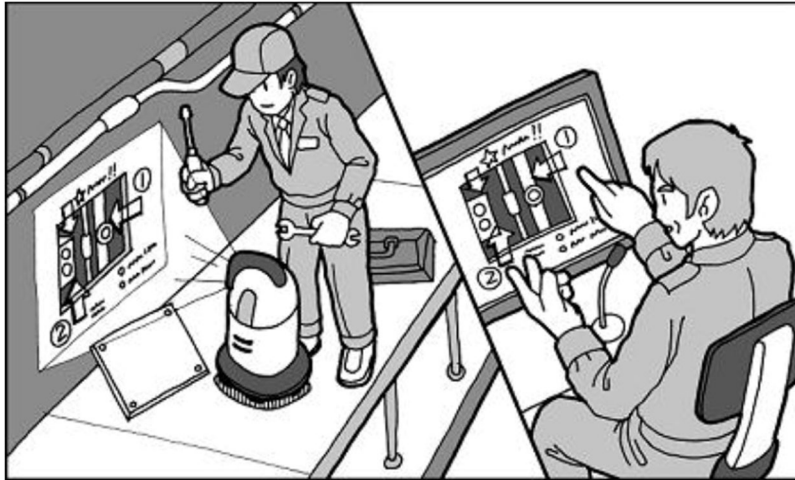


Figure 1 of Machino II.

100. Figure 11 of Machino II, which is reproduced below for convenience, shows “a scene of remote support using the mobile SCOPE.” [Machino II at 5.] The photograph shows the mobile robot carrying the projector and camera on the lower right side. The projected light is shown on the wall behind the kneeling worker located on site. The projection also shows a boundary that indicates the region of space that the camera is capturing and transmitting back for display on the monitor of the remote support person.

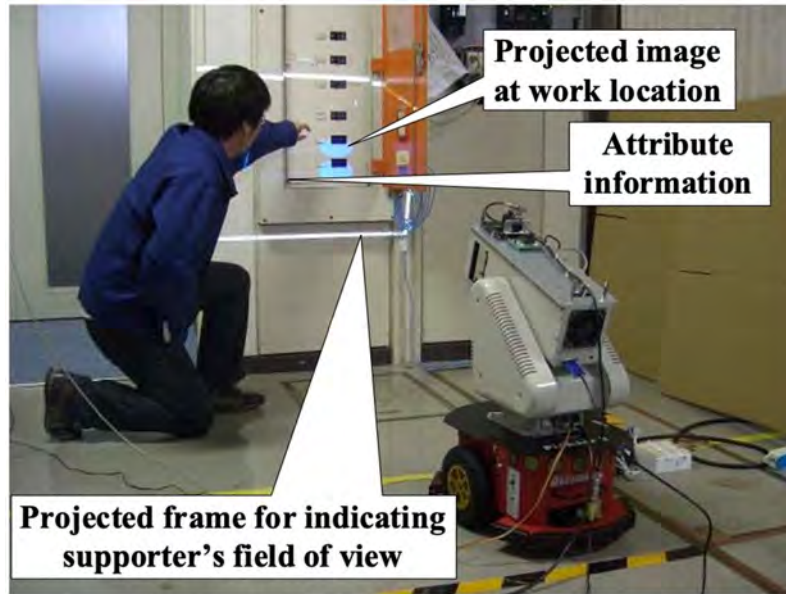


Fig. 11 Mobile SCOPE (on-site location).

Machino II, Fig. 11.

101. Figure 12 of Machino II, which is reproduced below for convenience, shows a screen shot of the monitor that is located remotely with the remote support

person. The remote monitor displays the camera feed of the “on-site image” on the left side.

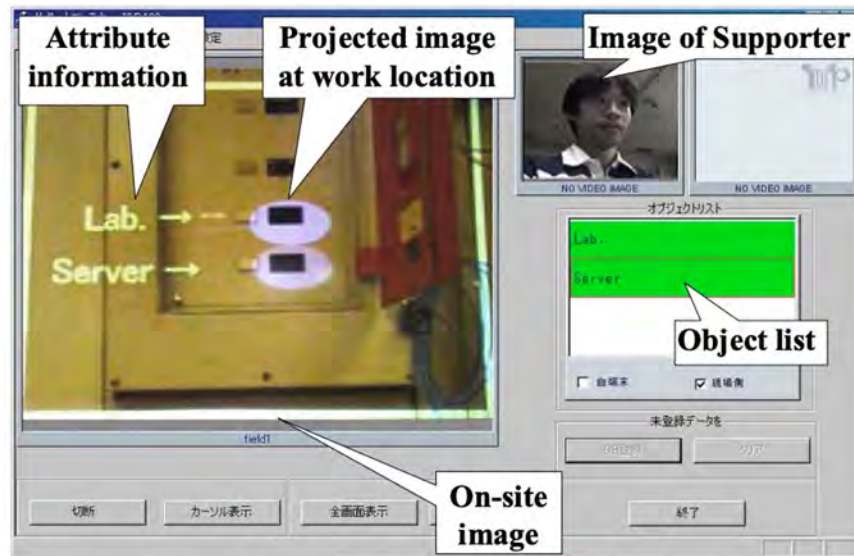


Fig. 12 Screen shot (supporter's location).

Machino II, Fig. 12.

J. Motivation to Combine Machino I and II

102. As discussed in further detail below, it would have been obvious to a POSITA to combine the teachings from Machino I and Machino II. Both references concern the same system (the SCOPE system) and were published by the same set of authors around the same time. Therefore, it would have been obvious to a POSITA to combine the teachings of the references. While both references describe the same system, Machino II introduces a mobile configuration (mobile SCOPE) for the same system. Therefore, a POSITA would view a combination of Machino I and II as a unified teaching of the same invention. In addition, the references are

reasonably pertinent to the problem to which the claims of the '036 patent are directed, namely integrating the use of cameras with projected light guidance systems.

103. In addition, given that Machino I and II describe the same system with similar components, combining the unique disclosures in Machino I (e.g. system schematics including separate on-site use PC) with those in Machino II would simply be the use of known components, in a known way, to achieve an obvious result – that of creating a remote-collaboration system for remotely assisted maintenance operations. Accordingly, a POSITA would have a reasonable expectation of success in combining the teachings from Machino I and II.
104. Lastly, both Machino I and II are analogous to the '036 patent. Both references are directed to a system for projecting instructions and taking images of the person being guided, similar to the guide system described in the '036 patent. Machino I and II are reasonably pertinent to the '036 patent, which is directed to a projector-camera system used to (1) project information to an individual; and (2) take and remotely display images of the projection and the individual's response to that projection.

X. ANALYSIS OF PETITION GROUNDS

A. CHALLENGE 1: Claims 1-12 Are Obvious over Kjeldsen (Ex. 1005) in view of Pinhanez III

1. Rationale for combining Kjeldsen and Pinhanez III

105. It would have been obvious for a POSITA to use the remote monitor concept from Pinhanez III in the system described in Kjeldsen. As discussed above in Section IX, at [G], both references concern the same basic system—the ED-projector. [See, e.g. Pinhanez III at 3 (“This demonstration uses a steerable projector-camera system – the Everywhere Display – in a local environment and provides a control interface to a user in a remote environment.”).] The references also share two authors in common, Pinhanez and Pingali.
106. Further, the example given in Pinhanez III Figure 1—of a camera and remote monitor working together to remotely display visual indicators from a tabletop surface—is directly applicable to the tabletop display used in Kjeldsen to hold the M&M artwork and to receive images of where the M&M’s should be placed.

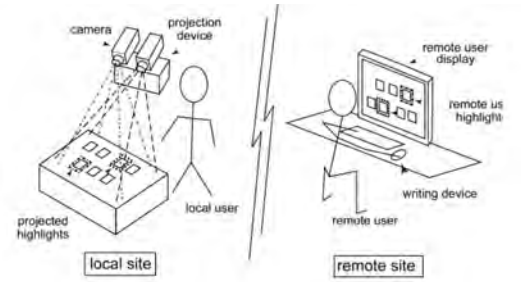
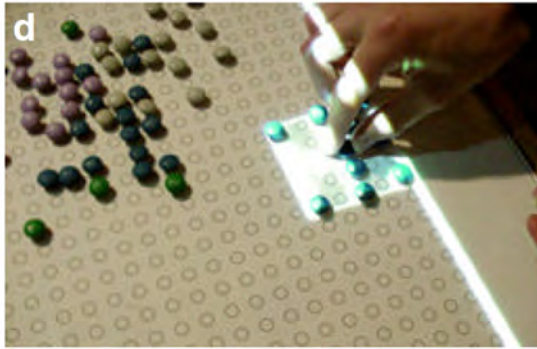


Figure 1. Overview of using a projector-camera system in a telepresence application.

Kjeldsen, Fig. 2(e); Pinhanez III, Fig. 1

A POSITA would thus readily understand how to combine the teachings from Kjeldsen and Pinhanez III, and would have a reasonable expectation of success in doing so.

107. Specifically, Pinhanez III is directed to extending the ED-projector to include remote capabilities. [Pinhanez III at 2-3 (“While previous work on the camera-projector systems and steerable interfaces has been primarily focused on local augmentation, we begin to explore its potential in telepresence or remote augmentation here.”).] To do so, the “[p]rojection and lighting [of the ED-projector] ... allows overlaying and embedding information and visualization on real objects,” [Pinhanez III at 2-3], while “a user in a remote space can access/view and control both the projector and the camera through a display and writing device.” [Pinhanez III at 3]. Moreover, Pinhanez-III provides a motivation for using the ED-projector

disclosed in Kjeldsen with a remote display, explaining that “[p]rojector-camera systems have the potential not only to allow remote individuals to view each other's environments but also to communicate in new ways by overlaying and embedding information and visualizations on real objects and surfaces in the remote environment.” [Pinhanez-III at 1.]

108. As an example application, Pinhanez III describes a remote operator using a drawing feature to “paint” information onto the projected surface. Using a remote display and writing device, “the real effect on the local environment can now be monitored through the live video in the upper window.”

[Pinhanez III at 4]. A POSITA reading this disclosure would, therefore, understand that including a remote display device and transmitting camera images to said device would assist a remote observer in monitoring the local assembly operations in real-time. Particularly, Kjeldsen explains that the researchers conducting the demonstration of the ED-projector system at SIGGRAPH’01 recognized that “most of our users were confronting a novel interaction paradigm,” and were therefore “not shy of giving [users] instructions as needed.” [Kjeldsen at 5]. The technology shown in Pinhanez-III allowing for the remote user to draw images for projection, such as the hand-drawn circle below, would be of particular use in giving instructions in real time:



See Pinhanez-III Fig. 4.

109. The idea of remotely displaying information from the camera in Kjeldsen is also strongly supported by Kjeldsen itself. Kjeldsen states that its “camera video stream was recorded onto tape,” and a POSITA would understand that the taped video would be available for playback on computer monitor(s) and indeed were intended to be played back on a remote monitor. [Kjeldsen at 5.] Exhibit 1007 at 6 and the corresponding video at Exhibit B-1 further show that the recorded camera video from the Everywhere Display demonstration at SIGGRAPH’01 was made available for download and

display over the internet, including on computers located remotely from the demonstration site. [See also Pinhanez II at 3 (offering a video from the system's camera point of view at URL).] The online videos are additional proof that combining a remote display with a projector camera, such as that in Pinhanez III, would have had a strong chance of success. Saving the videos on tape also shows that the images taken by the ED-projector camera were *intended* to be displayed on a remote monitor later on. Notably, Kjeldsen itself includes screenshots taken by the system camera, as discussed below for [1.2].

110. Moreover, one of the primary applications taught by Kjeldsen is the assembly task augmented with projected light that guides individuals through a sequence of tasks. A key component of this application is detecting the touching gestures performed by the individuals. For example, the individual must “touch” the color selection menu that is projected onto a table surface. The camera system monitors user gestures and attempts to automatically identify a “touch” performed by the individual. Only after detecting a color-selecting touch, can the system then guide the individual to the correct supply bucket.
111. Kjeldsen teaches that gestures are not always correctly identified by the camera and its associated software. Kjeldsen reports on the success rate by

stating, “[a] sample with 130 consecutive users with 621 button touch events (touching gestures or false detections) yielded correct detection of touching gestures in 81% of the events, with 12% false negatives and 7% false positives. [Kjeldsen at 5.] A POSITA would recognize that this gesture-detection data was acquired by humans that viewed the camera images on a display. For example, “false positives” of a touch gesture are generated when the automated camera system indicates that a touch has been performed, but a human viewing the camera images realizes that a touch gesture was actually *not* performed. A false positive can only be identified when a remote human monitor views the images of the individual and determines the images do not show a touch gesture.

112. A POSITA would certainly recognize that the displaying and analyzing of camera images would best be performed on a monitor that was remote from directional light device. First, the directional light device is mounted overhead. Therefore, to the extent the monitor is not “remotely located” means placing a monitor next to the overhead directional light device would make it extremely awkward for the camera images to be viewed. Second, placing the observation monitor close to the directional light device would likely cause interference with the individuals performing the assembly task. Third, even if individuals performing the assembly could be physically

separated from the viewing monitor and the people viewing the images, they would likely be distracted by the close proximity of the monitor and the humans viewing the camera images on the monitor. Finally, it would be useful to record the camera images and then display them at a later time on a monitor in a research lab so that they could be studied in detail to accurately assess the incident rate of “false positives.” [See Ex. 1007 at 6, 19, Exhibit B-1, Exhibit B-2; *see also* Pinhanez II at 3 (offering download of “video, from the system’s camera point of view.”).]

113. For the reasons provided above, a POSITA would want the camera images to be displayed on a monitor that is remote from the directional light device. To the extent that Kjeldsen does not explicitly teach the use of a remote monitor, a POSITA would want to use a remote monitor and would thus find it obvious to use the explicit teaching of a remote monitor that appears in Pinhanez III. Given that Pinhanez III describes the same system as Kjeldsen, a POSITA would know that they would be successful in using a remote monitor.
114. Thus, it would have been obvious to combine Kjeldsen with Pinhanez III. Both references concern the same specific device (the IBM Everywhere Displays projector). Pinhanez III contains an express suggestion that work on the Everywhere Displays projector should be extended to include remote

capabilities. [Pinhanez III at 2-3. (“While previous work on the camera-projector systems and steerable interfaces has been primarily focused on local augmentation, we begin to explore its potential in telepresence or remote augmentation here.”).] Additionally, a POSITA would recognize that the remote display of a tabletop (including visual indicators) was directly applicable to the M&M tabletop assembly task disclosed in Kjeldsen. Thus, there is an express suggestion to combine the two references in the manner discussed below.

115. In addition, adding the remote monitor capabilities from Pinhanez III to the M&M assembly system of Kjeldsen would be nothing more than combining prior art elements (Kjeldsen with the remote monitor of Pinhanez III) according to known methods (i.e., as disclosed in Pinhanez III) to yield predictable results (e.g. providing remote viewing, like with a webcam). The combination is also obvious as the use of a known technique (Pinhanez III’s remote monitor) to improve similar devices (the Everywhere Projector in both cases) in the same way. Similarly, the combination is nothing more than applying a known technique (Pinhanez III’s remote monitor) to a known device ready for improvement (the Everywhere Displays projector M&M artwork environment as disclosed in Kjeldsen I) to yield predictable results such as allowing remote researchers to analyze the assembly task.

116. Lastly, both Kjeldsen and Pinhanez III are analogous to the '036 patent.

Both Kjeldsen and Pinhanez III are within the same field of invention as the '036 patent because they concern projector-camera systems. Both are reasonably pertinent to the same problem inventors of the '036 patent were trying to solve, namely projecting instructions to an individual and monitoring the individual's reaction using a camera.

2. Claim 1 Analysis

[1.0]: “A method of projecting visual indicators to guide actions of an individual for a particular guided operation, said method comprising:”

117. If the preamble is limiting, then Kjeldsen discloses it. Kjeldsen describes *a method of projecting visual indicators to guide actions of an individual for a particular guided operation*. Specifically, Kjeldsen discloses “[combining] computer vision ... with a steerable projector” [Kjeldsen at Abstract] to transform “any surface in an environment” into “an interactive surface” using “real-time techniques for recognizing ‘touch’ and ‘point’ gestures on steerable projected displays produced by a new device called the Everywhere Displays projector (ED-projector).” [Kjeldsen at Abstract.]
118. Kjeldsen further describes an experiment using the ED-projector to “guid[e] several hundred first-time users through an assembly task.” [Kjeldsen at 6; *see also* Kjeldsen at Abstract (“We demonstrated the validity of our

approach through an experiment involving hundreds of users interacting with projected interfaces.”).] Specifically, this experiment concerned using the ED-projector to guide a task of assembling a picture made of M&Ms. [Kjeldsen at 2-3.] This assembly task is a *guided operation*. [See Kjeldsen at 2 (“As in any assembly task, each individual contributes to the assembly of an object by executing specific parts of the assembly process.”).]

119. The ED-projector also projects *visual indicators* by “projecting an interactive display onto arbitrary surfaces in the environment,” as shown below in an annotated version of Kjeldsen Figure 2. [Kjeldsen at 6; *see also* Kjeldsen at 1 (“ED-projector ... *steer* a projected display on to any surface in an environment”) (emphasis in original).]

Projected instructions (*visual indicators to guide actions of an individual for a particular guided operation*)

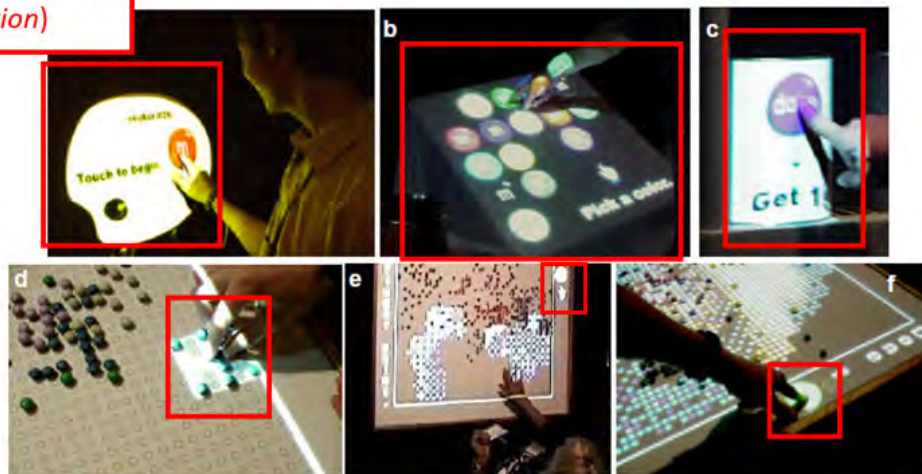


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the “done” button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a “yes” button is touched after all interaction is done. (c&e from system camera)

Kjeldsen, Fig. 2 – Annotated.

120. As shown above, the ED-projector projects the interactive graphics to convey instructions such as “Touch to begin,” “Come in,” “Pick a color,” “Get n” (where n is the number of M&Ms to be picked up from the bucket) and “Go to the table.” [See Kjeldsen at 2-3.] Figure 2(d) further shows the ED-projector using a spotlight or highlight to “indicate[] the precise location where the M&M’s should be placed (Figs. 2d) by projecting an image of the target locations on the canvas.” [Kjeldsen at 3.] Thus, the ED-projector projects interactive displays to *guide actions of an individual for a particular guided operation.*

121. Accordingly, Kjeldsen discloses claim element 1.0.

[1.1]: “projecting a visual indicator using a directional light device onto a physical object associated with the particular guided operation;”

122. Kjeldsen discloses the ED-projector *projecting a visual indicator using a directional light device onto a physical object associated with the particular guided operation.* This is shown by Kjeldsen Figure 2, which is reproduced below in annotated form, and the accompanying text, which is also provided and discussed below.

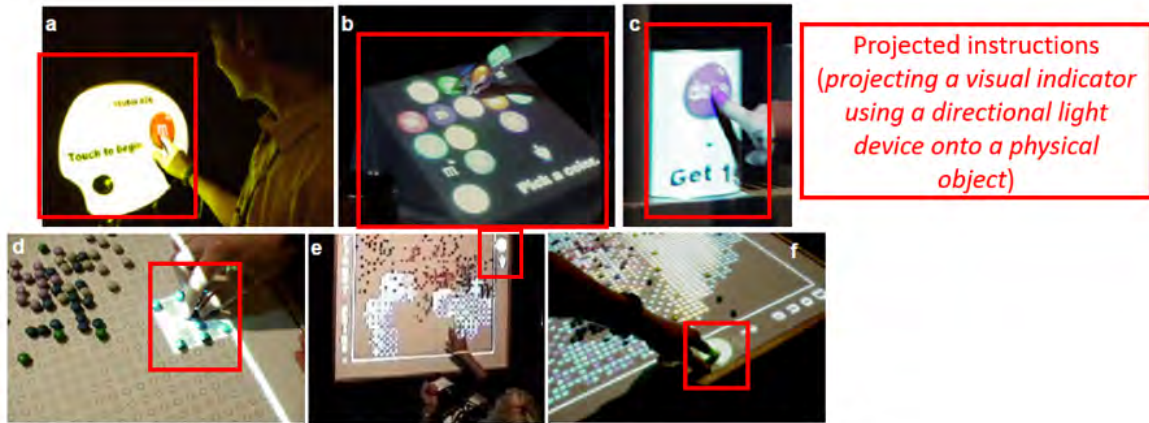


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the "done" button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a "yes" button is touched after all interaction is done. (c&e from system camera)

Kjeldsen, Fig. 2 – Annotated.

- Figure 2(a) shows *projecting a visual indicator* of “the image of an M&M projected on the painter’s palette with the instruction ‘Touch to begin.’” [Kjeldsen at 2.] The physical painter’s palette is the *physical object* and is associated with the *particular guided action* of touching the M&M projection to “start the process.” [Kjeldsen at Fig. 2.]
- Figure 2(b) shows *projecting a visual indicator* on a “foam-covered-board where images of different colored M&Ms are projected along with the invitation ‘Pick a color.’” [Kjeldsen at 2.] At this stage, the “foam-covered-board” is a *physical object associated with the particular guided operation* of selecting a color to add to the existing M&M artwork.
- Figure 2(c) shows *projecting a visual indicator* when the ED projector “highlights the bucket that contains the M&Ms of that color.” [Id.] The

visual indicator includes the “message ‘Get n’, (where n is the number of M&Ms to be picked up from the bucket).” [Kjeldsen at 2-3.] A further *visual indicator* is a “button with the word ‘done’ on it, i.e., an image of an M&M underlined by a pointing finger.” [Kjeldsen at 3.] In all of these examples, the buckets containing the M&Ms are *physical objects* that are *associated with the guided operation* of building the M&M artwork relative to both retrieving the M&M’s and pressing the word “done” when the retrieval step is complete.

- Figure 2(d) shows *projecting a visual indicator* that “indicates the precise location where the M&M’s should be placed by projecting an image of the target locations on the canvas.” [Kjeldsen at 3.] In addition, during this step, the ED-projector “also displays the instructions ‘Place the M&M’s’, and ‘Done ?’ and an M&M button labeled ‘yes’.” [Kjeldsen at 3.] In this step, the canvas and the already-placed M&Ms are each the claimed *physical object* and are *associated with the guided operation* of building the M&M artwork. The *guided operation* includes the steps of putting the M&Ms on the canvas in the positions indicated by the projected light and selecting the “done” button to indicate that the placement task has been completed.

- Figures 2(e) and 2(f) shows additional steps of *projecting a visual indicator* when “the user is invited to ‘Finger paint’” to reveal the rest of the image. [Kjeldsen at 3.] “The vision system tracks the position of the user’s hand and fills in circles of the appropriate color in the vicinity of the fingertip, interactively completing the picture.” [Kjeldsen at 3.] The *physical object* includes the canvas and any already-placed M&Ms, both of which are *associated with the guided operation* of building the M&M artwork. When finished, “the user can stop this activity by touching the ‘yes’ button to the right of the image.” [Kjeldsen at 3.] In this last step, the “yes” button is a *visual indicator* and the canvas is a physical object associated with the guided operation of building the M&M artwork.
123. The projector and pan/tilt mirror used to display these images is a *directional light device*. “The ED-projector is composed of ***an LCD projector, a computer-controlled pan/tilt mirror***, and a pan/tilt/zoom camera.” [Kjeldsen at 1 (emphasis added).] Kjeldsen further discloses that the ED-projector “uses a computer-controlled mirror to steer a projected display on to any surface in an environment, while correcting for distortion caused by oblique projection. With the ED-projector, any surface can become a display and everyday objects can be enriched with information without having to wire them.” [Kjeldsen at 1.] Pictures of ED-projector

directional light device systems, including both the projector and the pan/tilt mirror, are shown below:



Fig. 1: Two prototypes of the Everywhere Displays projector.

Kjeldsen, Fig. 1 – Annotated.

124. Accordingly, Kjeldsen discloses claim element 1.1.

[1.2]: “imaging the projected visual indicator with a camera located proximate to the directional light device;”

125. Kjeldsen discloses *imaging the projected visual indicator with a camera located proximate to the directional light device* in the following text:

A user’s interactions with the Everywhere Display are detected with a single pan/tilt/zoom camera that is steered to follow the projected image. A vision system examines the video stream for user actions and generates events for the application software. The camera is located adjacent to the mirror assembly so that the

camera's view of the user's hand interacting with the display is generally occluded only if she occludes the projected image itself ...

[Kjeldsen at 3.] As noted above in my analysis of element 1.1, the *mirror* is part of the *directional light device*, and thus the camera is adjacent (*i.e.* next or nearest in space) to the directional light device. Additionally, Kjeldsen's Figure 1, reproduced below in annotated form, illustrates how the projector, mirror, and camera in the ED-projector are part of the same device and are close in space to each other. Thus, the *camera* in Kjeldsen is *located proximate*³ to the *directional light device*.

³ The term "proximate" is a term whose outer limits are undefined. I understand that there may be disputes regarding the scope or definiteness of this term. I did not need to resolve those disputes here because Kjeldsen describes the camera as "adjacent" to the mirror assembly (which is part of the *directional light device*). [Kjeldsen at 3.] Kjeldsen explains that the

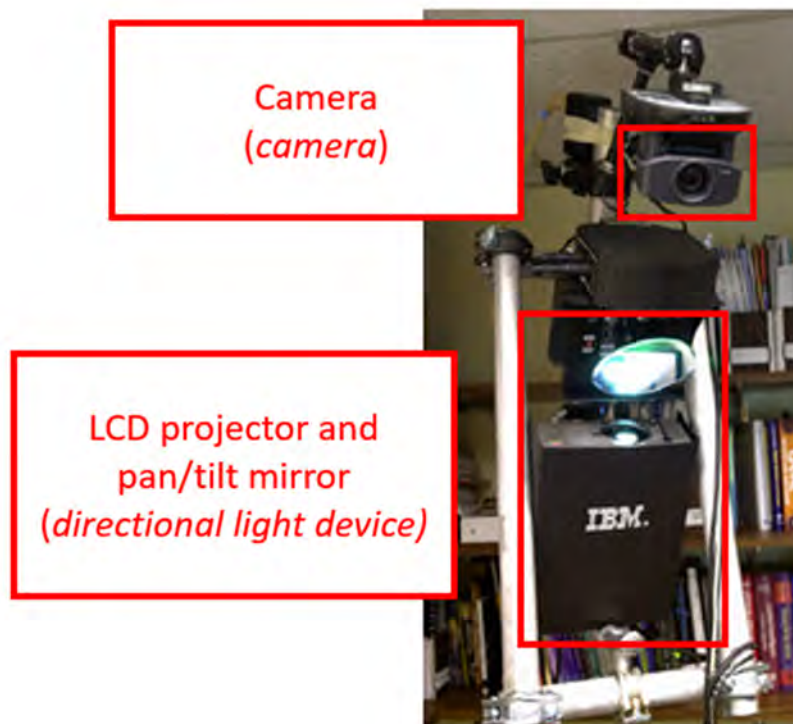


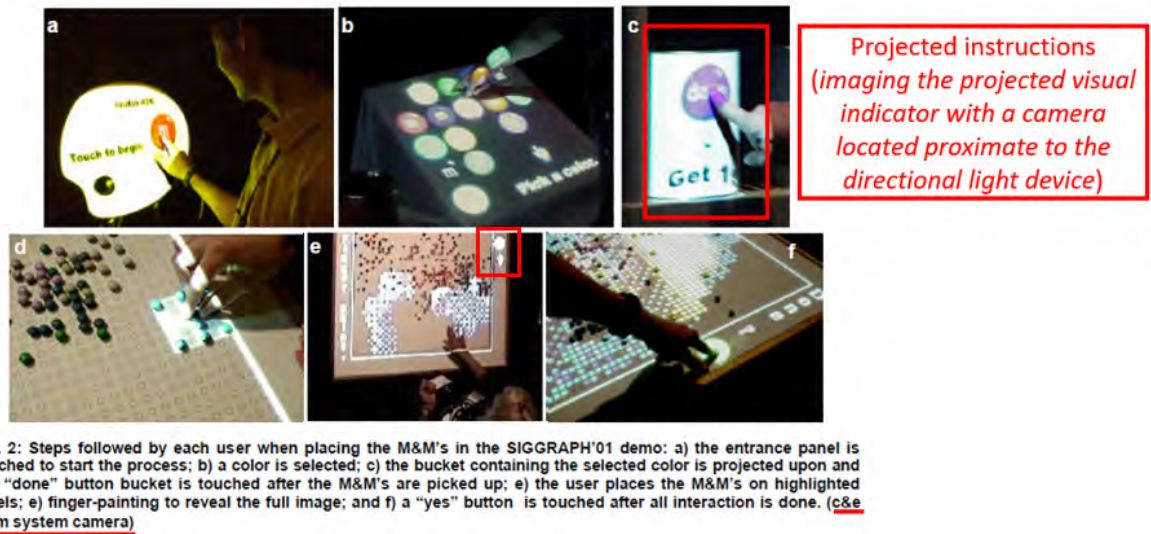
Fig. 1: Two prototypes of projector.

Kjeldsen, Fig. 1 – Annotated.

126. Kjeldsen teaches that, at least for the SIGGRAPH’01 experiment, “[t]he camera video stream was recorded onto tape and the users’ selections were logged.” [Kjeldsen at 5.] This is a teaching of *imaging the projected visual indicator*.⁴

⁴ A 2-minute capture of the camera video stream from SIGGRAPH’01 is attached as Ex. to the Internet Archive Declaration (Ex. 1007) as Exhibit B-1. Further examples of captures from the camera video stream are found in the Internet Archive Declaration as Exhibit B-2 and in Pinhanez I.

127. Examples of the images taken by the ED-projector camera include Figures 2(c) and 2(e), which are images taken “from the system camera.” [Kjeldsen at Fig. 2.] These teachings provided by Kjeldsen Figure 2 are provided below with clarifying annotations.



Kjeldsen, Fig. 2 – Annotated.

These figures show images of various *projected visual indicator[s]* as discussed above for element 1.1. Additionally, Kjeldsen Figure 4, provided below in annotated form, shows another example of the ED-projector *imaging the projected visual indicator*. Note that the figure caption specifically states that the images are from the “camera view.”

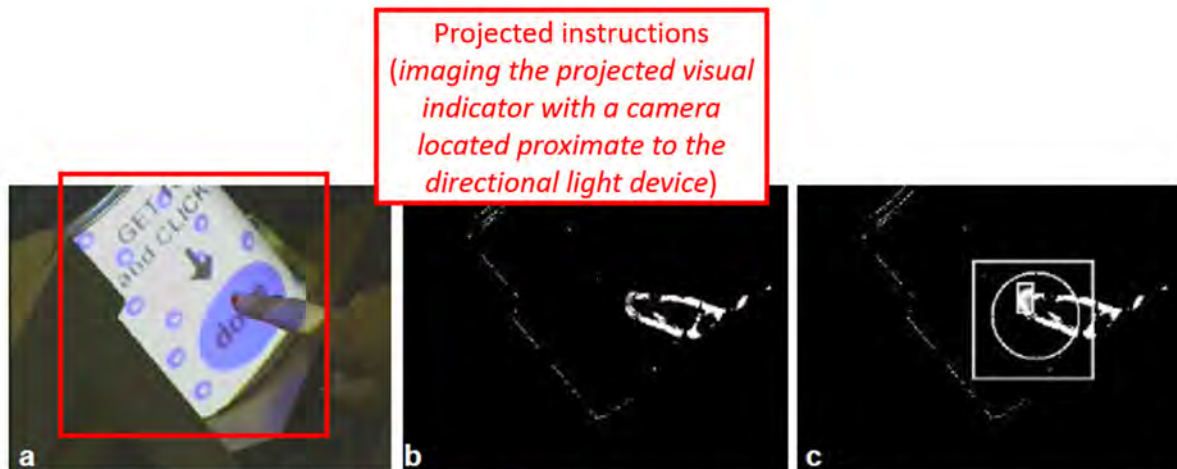


Fig. 4. a) Camera view of an interaction with a bucket; b) image difference data; c) overlay of search region (square), button active area (circle), and the fingertip template shown at the pointing location.

Kjeldsen, Fig. 4 – Annotated.

128. Accordingly, Kjeldsen discloses claim element 1.2.

[1.3]: “transmitting images from the camera to a monitor located remotely from the directional light device; and displaying images from the camera on the monitor;”

129. It would have been obvious to combine the teachings of Kjeldsen and Pinhanez III (Ex. 1015) so as to render obvious the limitation of *transmitting images from the camera to a monitor located remotely from the directional light device; and displaying images from the camera on the monitor*. The reasons/rationale for this combination are discussed above in Section X.A.1.

130. As discussed above, Pinhanez III is an article entitled *Projector-Camera Systems for Telepresence* that was published in 2004. Pinhanez III was written by Claudio Pinhanez and Gopal Pingali, two of the original developers of the Everywhere Displays projector (and co-authors on the

Kjeldsen paper). Pinhanez III describes how the Everywhere Displays projector system presented in Kjeldsen can be used for remote communications, including “to allow remote individuals to view each other’s environments.” [Pinhanez III at Abstract; *see also* Pinhanez III at 3 (“This demonstration uses a steerable projector-camera system – the Everywhere Display – in a local environment and provides a control interface to a user in a remote environment.”).]

131. Pinhanez III specifically discloses *transmitting images from the camera to a monitor located remotely⁵ from the directional light device; and displaying images from the camera on the monitor*, as shown below in the annotated version of Figure 1.

⁵ The phrase “*monitor located remotely*” does not specify how close the monitor may be to the camera while still falling within the scope of the claims. Thus, there may be a dispute as to the definiteness of this claim. However, I do not need to resolve the issue for purposes of this opinion because the monitor in Pinhanez III is clearly taught as being remote from the camera.

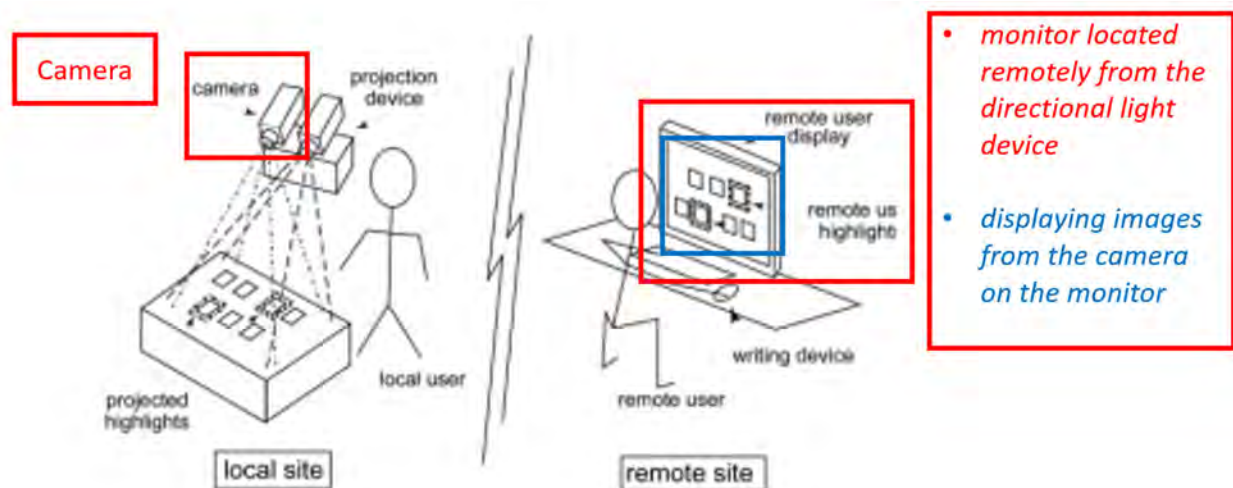


Figure 1. Overview of using a projector-camera system in a telepresence application.

Pinhanez III, Fig. 1 – Annotated.

132. Pinhanez III explains that this figure shows “an environment is equipped with steerable camera(s) and steerable projector(s).” [Pinhanez III at 3.] As a result, “[a] user at a remote site can view the local environment through video from the remote camera.” [Pinhanez III at 3; *see also* Pinhanez III at Abstract (“Projector-camera systems have the potential . . . to allow remote individuals to view each other’s environments.”).] Thus, Pinhanez III discloses *transmitting images from the camera* (at the local site) *to a monitor located remotely from the directional light device* (at the remote site); and *displaying images from the camera on the monitor* (as shown in the remote user display).

133. The reasons/rationale for this combination are discussed above in Section X.A.1 and include the fact that both Kjeldsen and Pinhanez concern the same basic system. Therefore, the combination of Kjeldsen and Pinhanez III render element 1.3 obvious.

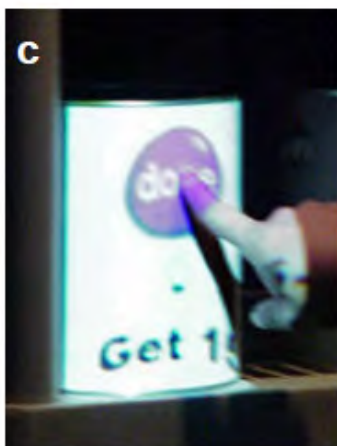
[1.4]: “wherein said imaging, by the camera, captures images of at least the individual being guided, the physical object and the projected visual indicator.”

134. The '036 patent describes “captur[ing] images of ... the individual” as capturing at least part of the individual (such as the individual’s hand), instead of the entire individual. Specifically, the '036 patent describes an embodiment where “sensor 423 [] monitor[s] activities of an operators [sic] body, **hand**, etc.” and “sensor 423 may include a camera that is additionally utilized to record and/or review activities by an individual being guided by guide system.” [’036 patent, 21:54-59, 22:26-29.]

135. The camera in Kjeldsen *captures images of [] the individual being guided, the physical object, and the projected visual indicator*. As discussed above in my analysis of element 1.2, the camera in Kjeldsen captures videos (i.e. a series of images) of the user’s hand (*the individual being guided*) and the projected interactive graphics (*the projected visual indicator*) on the painter’s palette, a bucket containing M&Ms, and the tabletop where the art was assembled (*the physical object*). [See analysis above for element 1.2.]

Additionally, Kjeldsen discloses that “[a] **user’s interactions** with the Everywhere Display are detected with a single pan/tilt/zoom camera that is steered to **follow the projected image.**” [Kjeldsen at 3 (emphasis added); see also Kjeldsen at 3 (“The camera is located adjacent to the mirror assembly so that **the camera’s view of the user’s hand interacting with the display** is generally occluded only if she occludes the **projected image itself.**”) (emphasis added).] These passages also teach element 1.4 because they show that the ED-projector camera captures the “user’s hands” (i.e., *the individual being guided*), user “interactions” (which would include the claimed *physical object* they are interacting with); and the “projected image” (i.e., *the projected visual indicator*).

136. Kjeldsen Figures 2(c), 2(e), and 4 show examples of the claimed imaging. For example, the following copies of Figure 2(c) show images, taken by the Everywhere Display system camera, that includes (1) the *individual being guided*, (2) the *physical object*, and (3) the *projected physical indicator*).



Kjeldsen Figure 2(c)



- Individual (hand)
- Physical Object (bucket)
- Projected Visual Indicator (highlight, "done" M&M button, and "Get 15")

Kjeldsen Figure 2(c) - Repeated and Annotated.



Kjeldsen, Fig. 2(e).

Figure 2(e) (which shows a user following the direction “finger-paint” over the table) likewise shows the *individual being guided*, the *physical object*, and the *projected visual indicator*.



Fig. 4. a) Camera view of an interaction with a bucket; b) image difference data; c) overlay of search region (square), button active area (circle), and the fingertip template shown at the pointing location.

Kjeldsen, Fig. 4.

The same is true for Kjeldsen Figure 4, which also shows *the individual being guided* (i.e., their hand), the *physical object* (the bucket of M&Ms), and *the projected visual indicator* (that is projected on the bucket).

137. Thus, Kjeldsen discloses claim element 1.4 and the combination of Kjeldsen and Pinhanez III renders obvious claim 1.

3. Claim 2 Analysis

[2.0]: “The method of claim 1,”

138. As shown above, the combination of Kjeldsen and Pinhanez III renders obvious Claim 1. [See my analysis above for claim 1.]

[2.1]: “further comprising receiving, by the guide system controller, a sequence of one or more input signals and prompting the directional light device to project the visual indicator for the particular guided operation.”

139. This claim appears to be indefinite (1) due to the lack of antecedent basis for “the guide system controller,” as there is no “guide system controller” in claim 1; and (2) because a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” would entail. Assuming, (1) “the guide system controller” has sufficient antecedent basis and (2) that “a sequence of one or more input signals” refers to one input signal or a sequence of input signals (two or more input signals), the limitation is disclosed by Kjeldsen.
140. Kjeldsen discloses *a guide system controller* that “causes the projector to project the visual indicator(s).” [’036, 3:8-9; *see also* 24:18-22 (Claim 7).] Specifically, Kjeldsen explains that its “projector is connected to the display output of a host computer.” [Kjeldsen at 1.] Thus, the host computer

includes a *guide system controller* within the meaning of the '036 patent because it controls the projector through its display output.

141. Further, the host computer includes the *guide system controller* because it includes application software that determines what the projector displays. Specifically, Kjeldsen discloses “application software” that responds to user actions [*see, e.g.* Kjeldsen at 3 (“[a] vision system examines the video stream for user actions and generates events for the application software”)] and changes projected images in response. [*See, e.g.* Kjeldsen at 2-3.] It would have been obvious to a POSITA that the application software is part of the host computer, because the host computer is one of a limited number of hardware components (if not the only hardware component) capable of hosting the application software. [*See* Kjeldsen at 1 (listing components of ED-projector including an LCD projector, a mirror, a camera, and a host computer.).]
142. Kjeldsen also discloses *receiving, by the guide system controller, a sequence of one or more input signals*. Kjeldsen discloses this claim element in two ways. First, Kjeldsen discloses that the host computer (including the *guide system controller*) receives, from the Everywhere Displays camera, *a sequence of one or more input signals* in the form of a “video stream.” [Kjeldsen at 3.]

143. The “video stream” is then examined to create a second *sequence of one or more input signals*. Specifically, the “video stream” is sent to the ED-projector “vision system.” [Kjeldsen at 3 (“A vision system,” which “examines the video stream for user actions and generates events for the application software.”)] [*Id.*] The Everywhere Display software includes “interactive components (widgets)” that “provides a basic type of interaction, such as triggering an event or controlling the value of a parameter.” [Kjeldsen at 3.] The ED-projector vision system “examines portions of the video stream for image events that indicate a user has interacted with a widget, and generates an application event in response.” [Kjeldsen at 3.] Thus, Kjeldsen discloses at least two types of *a sequence of one or more input signals*: (1) the video stream from the camera; and (2) the events generated by the widgets / vision system examining the video stream.
144. Lastly, Kjeldsen also discloses *prompting the directional light device to project the visual indicator for the particular guided operation*. As discussed above for element 1.1, when the Everywhere Displays system detects events such as touching a button, it causes new visual indicators to be projected. Several of these transitions between the projections of visual indicators are shown in Figure 2, which has been reproduced below for convenience.

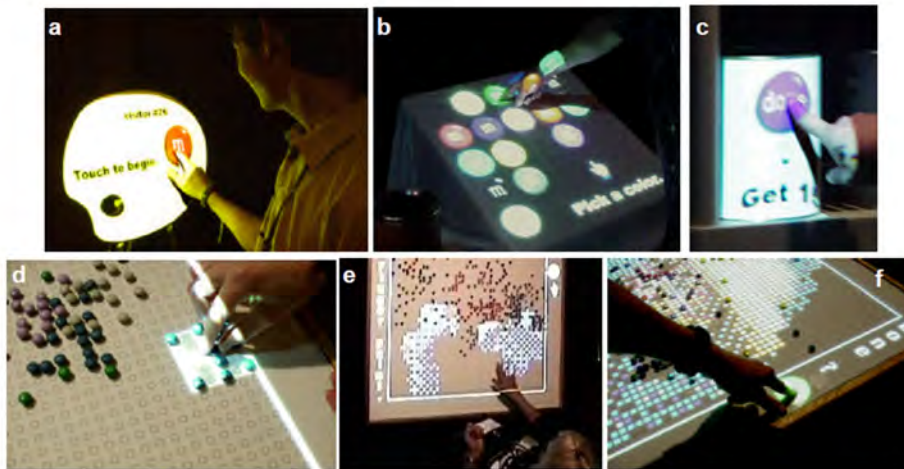


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the "done" button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a "yes" button is touched after all interaction is done. (c&e from system camera)

145. For example, pressing the M&M button in Figure 2(a) causes the projected image (*visual indicator*) in Figure 2(b) to appear. [Kjeldsen at 2 (“When the visitor touches the M&M ‘button,’ the system responds by projecting an arrow onto the palette and a message inviting the visitor to “Come in.” The ED - projector is then steered towards the foam-covered-board where images of different colored M&Ms are projected along with the invitation “Pick a color” (see fig. 2b).”).] Similarly, when the user picks a color in Fig. 2(b), the projector is prompted to highlight a supply bucket, as shown in Fig. 2(c), and so forth.
146. Thus, Kjeldsen discloses element 2.1 and the combination of Kjeldsen and Pinhanez III renders obvious claim 2.

4. Claim 3 Analysis

[3.0]: “The method of claim 2,”

147. As shown above, the combination of Kjeldsen and Pinhanez III discloses and renders obvious claim 2. [See my analysis above for claim 2.]

[3.1]: “wherein the sequence of one or more input signals are provided by a separate computer system or controller to the guide system controller.”

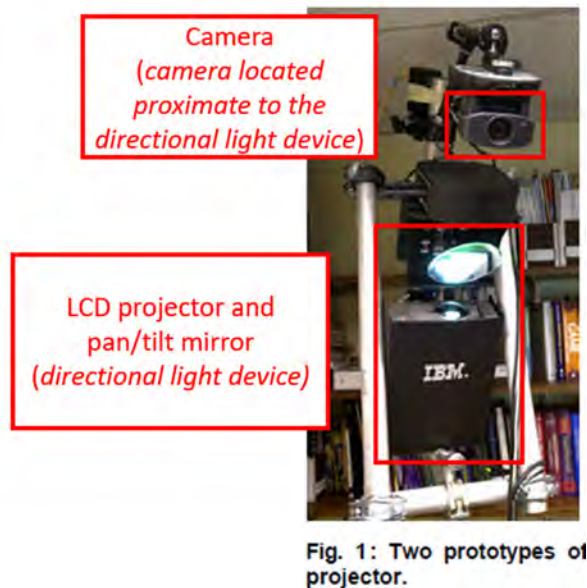
148. This claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” would entail. Assuming that “a sequence of one or more input signals” refers to one input signal or a sequence of input signals (two or more input signals), the limitation is disclosed by Kjeldsen.

149. As discussed for claim 2 above, Kjeldsen discloses two types of information that qualify as a *sequence of one or more input signals*. One of these is the video stream provided by the Everywhere Displays camera.⁶ [Kjeldsen at 3 (“A user’s interactions with the Everywhere Display are detected with a

⁶ I note that in supporting my opinions for my claim 2 analysis, I identified several sequences of input signals that satisfied the claim 2 limitations. My opinions for this ground relative to claim 3 rely solely on the video stream input signals.

single pan/tilt/zoom camera that is steered to follow the projected image. A vision system examines the video stream for user actions”).]

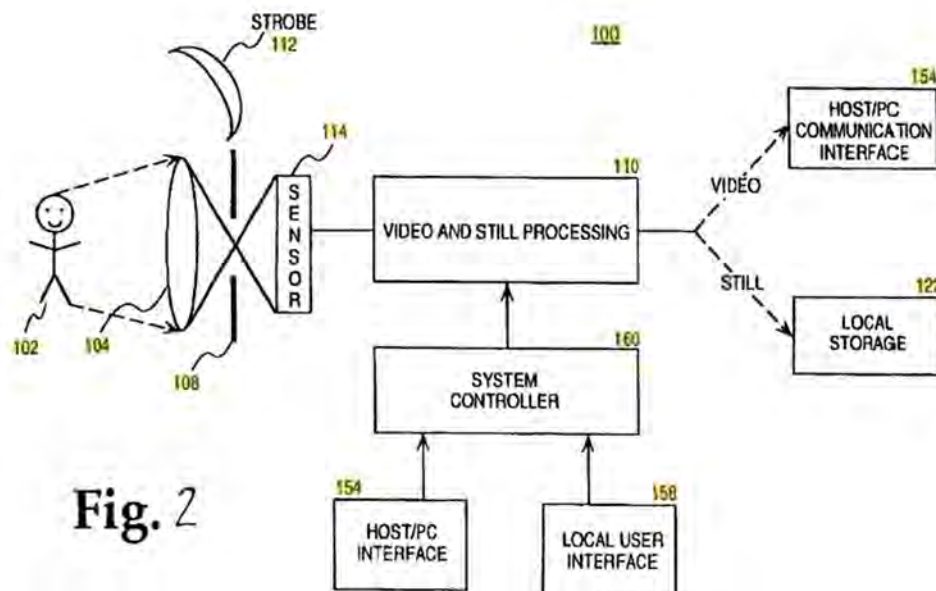
150. The Everywhere Displays camera that provides this video stream constitutes *a separate computer system or controller to the guide system controller* (part of the host computer). As shown in annotated Kjeldsen Figure 1 below, the Everywhere Displays camera is a discrete component that is separate from any computer, including the “host computer” that includes the claimed *guide system controller*.



Kjeldsen, Fig. 1 – Annotated.

151. Moreover, a POSITA would understand that the Everywhere Displays camera is a digital camera capable of generating and outputting a video stream to the host computer. A POSITA would also understand that a digital

camera refers to any of a known class of structures having their own controller / computer functionality that acquire video data from an image sensor and converts that data into a video stream. That conversion process requires the computational and control abilities of a computer/controller. This is illustrated, for example, by U.S. Patent No. 6,833,863 (Ex. 1033), which was issued in 2004. I have been informed that it is considered prior art to the '036 patent. The '863 patent illustrates what, in my experience, is a typical architecture of a digital camera, in which a separate computer and/or controller resides on the digital camera, such as illustrated below:



[’863 patent, Fig. 2; *see also id.* at 3:45-46 (“FIG. 2 is a logical block diagram of a digital image capture apparatus such as a digital camera.”)] In Ex. 1009, “The digital camera 100 includes a video and still processing

block 110, an optical interface having a lens system 104 and an aperture 108 for being exposed to incident light reflected from an object 102 whose image is to be captured.” [’863 patent at 3:60-64.] Additionally, “[t]he system controller 160 orchestrates the capture of video and still images.” This is a typical arrangement for a digital camera (and indeed is what is meant by the term “digital camera”—a camera with an image sensor and a computer or controller for conveying data from the image sensor to another location. Thus, the term “digital” in “digital camera” conveys to a POSITA the structure shown in the ’863 patent including both the image sensor and the separate computer/controller (shown in the ’863 patent as the video and still processing 110 and the system controller 160).

152. To the extent LightGuide argues that Kjeldsen does not adequately disclose a *separate computer system or controller*, that argument is incorrect. Digital cameras are structures that include their own *separate computer system or controller*, as illustrated above for the ’863 patent. Moreover, to the extent that it is argued that a digital camera potentially refers to a different structure, then the claims are still obvious because it would have been obvious to combine Kjeldsen with the teachings of the digital camera of the ’863 patent, as that would be nothing more than a simple substitution of the digital camera teachings from Kjeldsen for the more detailed digital camera

teachings of Ex. 1009. The '863 patent is analogous art because a digital camera is reasonably pertinent to the '036 patent (which requires the use of a digital camera to capture images and transmit them to a remote monitor).

153. Thus, Kjeldsen discloses claim element 3.1 and Kjeldsen and Pinhanez III render obvious claim 3.

5. Claim 4 Analysis

[4.0]: “The method of claim 1,”

154. As shown above, Kjeldsen and Pinhanez III disclose and render obvious claim 1. [See my analysis above for claim 1.]

[4.1]: “further comprising receiving, by the guide system controller, a sequence of input signals and prompting the directional light device to dynamically project a sequence of visual indicators onto the physical object for the particular guided operation based on the sequence of the input signals.”

155. As with claim 2, there is an apparent lack of antecedent basis for “the guide system controller,” as there is no “guide system controller” in claim 1. Additionally, a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” would entail. Assuming “the guide system controller” has sufficient antecedent basis the limitation is disclosed by Kjeldsen. The limitation is disclosed regardless of whether it requires multiple input signals (two or more input signals) or whether it can be satisfied by a single input signal (one or more input signals).

156. As discussed above for claim 2, Kjeldsen discloses a *guide system controller* being part of the host computer. [Kjeldsen at 1 (“[t]he projector is connected to the display output of a host computer.”).] As also discussed above for [1.1] and [2.1], Kjeldsen discloses *a sequence of input signals and prompting the directional light device to . . . project a . . . visual indicator[] onto the physical object for the particular guided operation*. Specifically, the *input signals* (e.g., the video stream or computer vision events) cause the projector to display an image associated with the various steps in the assembly process, as shown relative to Figure 2 provided below.

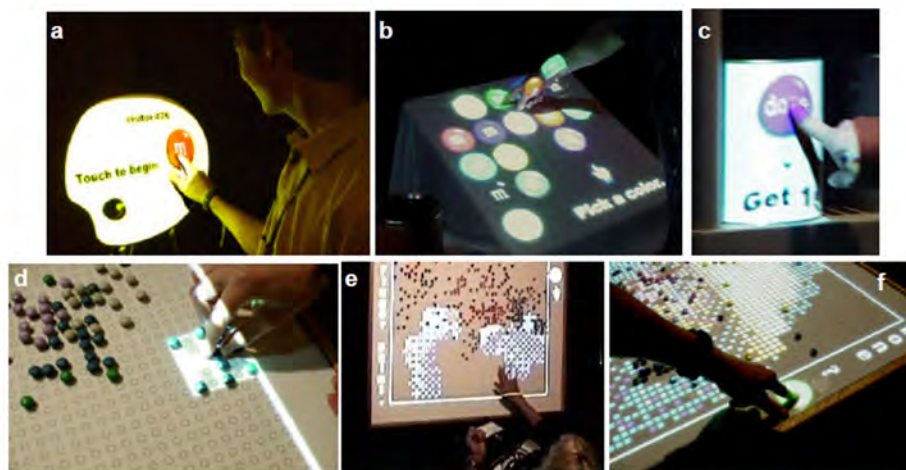


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the "done" button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a "yes" button is touched after all interaction is done. (c&e from system camera)

157. This same process satisfies the requirement *to dynamically project a sequence of visual indicators . . . based on the sequence of the input signals*. For example, pressing the M&M button in Figure 2(a) causes the system to

dynamically project the set of remaining M&M colors in Figure 2(b).

[Kjeldsen at 2 (“When the visitor touches the M&M “button,” the system responds by projecting an arrow onto the palette and a message inviting the visitor to “Come in.” The ED - projector is then steered towards the foam-covered-board where images of different colored M&Ms are projected along with the invitation “Pick a color” (see fig. 2b).”.)] Similarly, when the user picks a color in Fig. 2(b), the projector is prompted to highlight a supply bucket, as shown in Fig. 2(c), which is an example of *dynamically project[ing] a visual indicator* at the corresponding bucket in Figure 2(c).

The system also *dynamically project[s]* instructions on where to put the M&Ms at different locations on the artwork board, as shown in Figure 2(d). [Kjeldsen at 3 “[t]he ED-projector [] indicates the precise location where the M&M’s should be placed (Figs. 2d) by projecting an image of the target location on the canvas.”]

158. These projections are based on both (1) the selected M&Ms’ color, (2) whether the user has touched the projected “done” button on the bucket that contains the M&M’s of the selected color; and (3) previously placed M&Ms. Because the sequence, appearance, and timing of what is projected depends upon the input signals, Kjeldsen satisfies the *dynamically project a sequence of visual indicators onto the physical object for the particular guided*

operation based on the sequence of the input signals. This is true regardless of whether “sequence” refers to “one or more” or “two or more” of an ordered set.

159. The guide system controller also *prompt[s] the directional light device* (the projector and mirror) *to ... project a sequence of visual indicator[s] onto the physical object for the particular guided operation*, as shown above in the discussions of the projected interactive graphics in Figure 2. [See analysis above for [1.1] and [2.1].]
160. Thus, Kjeldsen discloses claim element 4.1 and the combination of Kjeldsen and Pinhanez III renders obvious claim 4.

6. Claim 5 Analysis

[5.0]: “The method of claim 4,”

161. As shown above, Kjeldsen and Pinhanez III disclose and render obvious claim 4. [See my analysis above for claim 4.]

[5.1]: “further comprising receiving, by the guide system controller, a combination of the sequence of the input signals and generation of a dynamic, real-time projection, via the directional light device, of the sequence of said visual indicators.”

162. This claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a combination of the sequence of the input signals and generation of a dynamic, real-time projection” entails.

Alternatively, a POSITA would not understand with reasonable certainty what “a combination of the sequence of the input signals” would entail. Claim 5 is also indefinite because it contradicts the claims from which it depends from, claim 1 and 4, by requiring that the guide system controller “receiv[es] ... generation of a dynamic, real-time projection, via the directional light device.” However, to the extent the meaning of this claim limitation can be interpreted as meaning the guide system controller receiving the sequence of input signals results in a generation of a dynamic, real-time projection of the sequence of said visual indicators via the directional light device, Kjeldsen discloses it.

163. Kjeldsen discloses *a combination of the sequence of the input signals (i.e. detected user interactions) results in a generation of a dynamic, real-time projection of the sequence of said visual indicators (i.e. interactive graphics)*. As discussed above, a combination of detected user interactions including at least (1) touching a color, and (2) touching or “clicking” the button on a bucket containing the selected M&Ms results in the generation of interactive graphics, as illustrated in Figure 2 provided below.

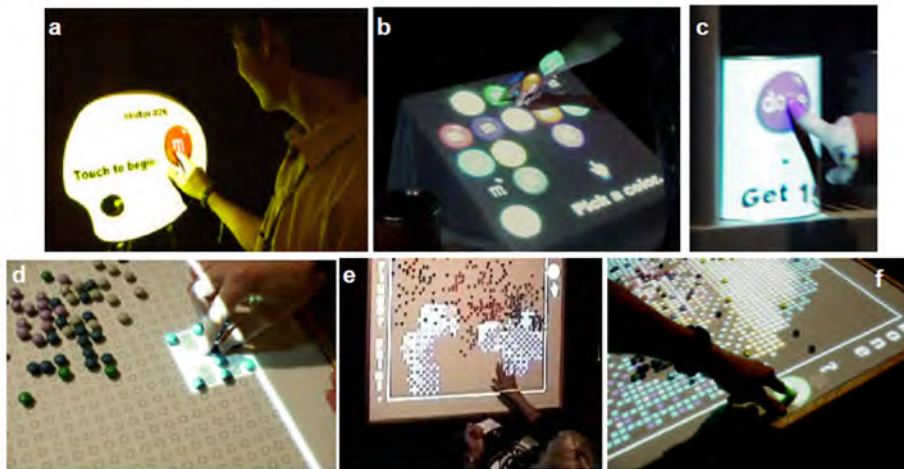


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the "done" button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a "yes" button is touched after all interaction is done. (c&e from system camera)

Kjeldsen, Fig. 2.

164. Furthermore, this projection is *dynamic* because said projection changes in response to *the sequence of input signals*. [See my analysis above for claim 4.] In addition, Kjeldsen teaches projecting in *real-time* in response to detecting the user's interactions with the projected graphics. Here, real-time refers to "real time or dynamic creation of visual indicators or display images . . . for guiding the activities of an individual." ['036 patent, 18:8-10.] As discussed above in my analysis of element 4.1, Kjeldsen discloses determining projected interactive graphics (i.e. projected highlights representing proper location of M&M's) based on *the sequence of input signals* such as the event associated with detecting a user's choice of a color.

165. Accordingly, Kjeldsen discloses claim element 5.1 and the combination of Kjeldsen and Pinhanez III renders obvious claim 5.

7. Claim 6 Analysis

[6.0]: “The method of claim 5,”

166. This claim appears to be indefinite because it depends from invalid claim 5. Nevertheless, Kjeldsen and Pinhanez III disclose and render obvious claim 5. [See my analysis above for claim 5.]

[6.1]: “wherein the sequence of input signals are provided by a separate computer system or controller to the guide system controller.”

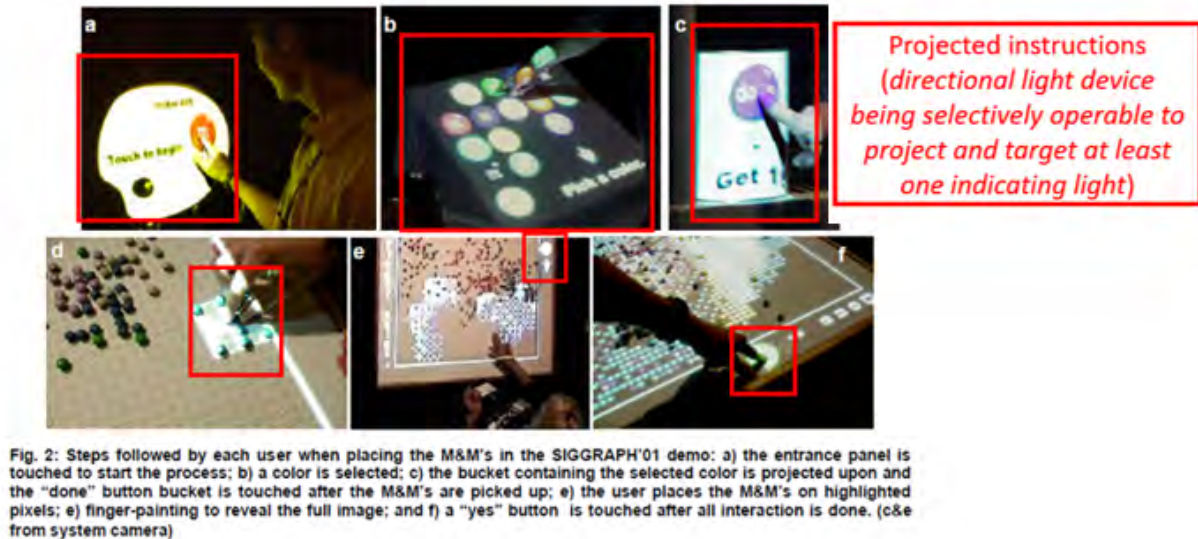
167. Kjeldsen discloses this claim limitation. [See my analysis above for element 3.1.]
168. Accordingly, Kjeldsen and Pinhanez III disclose claim element 6.1 and render obvious claim 6.

8. Claim 7 Analysis

[7.0]: “A guide system adapted to provide visual indicators to an individual to guide actions of the individual for a particular guided operation, said guide system comprising:”

169. If the preamble is limiting, then Kjeldsen discloses it. As shown above, Kjeldsen discloses *[a] guide system (ED-projector) adapted to provide visual indicators (interactive graphics) to an individual to guide actions of the individual for a particular guided operation (assembling a picture made*

of M&M's). [See my analysis above for elements 1.0 and 2.0.] Specifically, the ED-projector selectively projects the following instructions, as illustrated in annotated Kjeldsen Figure 2 below:



Kjeldsen, Fig. 2—Annotated.

170. Accordingly, Kjeldsen discloses claim element 7.0.

[7.1]: “a directional light device, said directional light device being selectively operable to project and target at least one indicating light;”

171. As discussed above, Kjeldsen discloses *a directional light device* including an LCD projector and a pan-tilt mirror. [See my analysis above for element 1.1.]

172. Kjeldsen further teaches *said directional light device being selectively operable to project and target at least one indicating light* because, as discussed above for [1.1], the LCD projector and pan/tilt mirror projects

interactive graphics by directing the projector's light (*indicating light*) onto surfaces of objects [Kjeldsen, Sec. 3, ¶ 2 (“***The projector’s light can be directed*** anywhere within a cone defined by approximately 60 degrees”) (emphasis added); *see also* Kjeldsen, Sec. 3.1, ¶ 1.] Given that Kjeldsen projects interactive graphics, the system is selectively operable because it selects which graphics to project, and where to target them, based on the actions and selections of the user. For example, as shown in Kjeldsen Figure 2, the ED-projector can selectively target where its images are displayed:

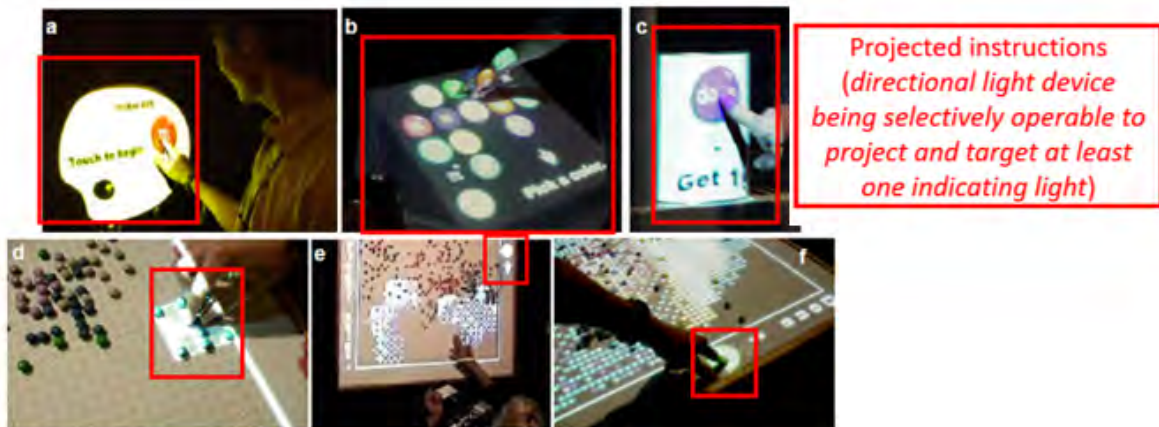


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the "done" button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a "yes" button is touched after all interaction is done. (c&e from system camera)

Kjeldsen, Fig. 2 (annotated)

173. Accordingly, Kjeldsen discloses claim element 7.1.

[7.2]: “a guide system controller, said guide system controller being operable to control said directional light device to project a visual indicator with said indicating light onto a physical object associated with the particular guided operation;”

174. As discussed above, Kjeldsen discloses a *guide system controller* (computer(s) that controls the projector and mirror) *operable to control said directional light device*. [See analysis above for element 2.1.]
175. Kjeldsen further teaches the *directional light device project[s] a visual indicator* (interactive graphics) *with said indicating light*. [See my analysis above for element 7.a.] Said *visual indicator* is further projected *onto a physical object associated with the particular guided operation*. [See analysis above [1.1].]
176. Accordingly, Kjeldsen discloses claim element 7.2.

[7.3]: “a camera located proximate to said directional light device and configured to capture an image of at least the individual, the physical object and said visual indicator when said visual indicator is projected onto the physical object;”

177. This claim appears to be indefinite for failure to identify the invention, particularly with regards to the lack of definition for the word “proximate.” However, regardless of possible definitions, Kjeldsen discloses a *camera located proximate to said directional light device*. [See analysis above [1.2].]

178. Kjeldsen further teaches said camera is *configured to capture an image of at least the individual, the physical object and said visual indicator when said visual indicator is projected onto the physical object*. [See analysis above [1.4].]

179. Accordingly, Kjeldsen discloses claim element 7.3.

[7.4]: “a monitor, said monitor being remote from said directional light device and said guide system controller, with said monitor being operably interfaced with said camera to display the image captured by said camera.”

180. As discussed above, Pinhanez III discloses a *monitor being remote from said directional light device and operably interfaces with said camera to display the image captured by said camera*. [See analysis above for [1.3].]

181. Pinhanez III also discloses that the same monitor is *remote from ... said guide system controller*. As discussed above in [2.1], the *guide system controller* is part of the host computer connected to the local projector. [See Kjeldsen at 1 (“[t]he projector is connected to the display output of a host computer.”).] Because the projector is located in the local environment away from the remote monitor, [see Pinhanez III at 3 (“[t]his demonstration uses a steerable projector-camera system – the Everywhere Display – in a local environment and provides a control interface to a user in a remote environment”); see also Pinhanez III, Fig. 1], the host computer is also located locally and *remote from* said monitor.

182. In addition, Pinhanez III discloses a *monitor being remote from said directional light device and said guide system controller*, where said monitor is further *operably interfaced with said camera to display the image captured by said camera*. The annotated version of Pinhanez III FIG. 1 below illustrates that the camera at the local site captures an image and displays it (including the projected highlights) at the remote site, showing that the remote monitor is *operably interfaced* with the camera.

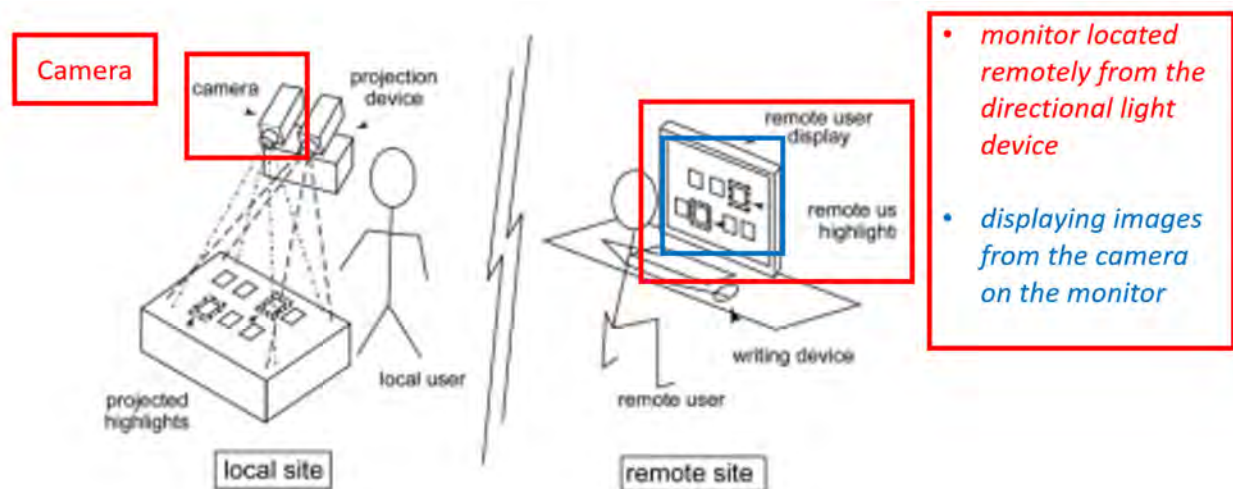


Figure 1. Overview of using a projector-camera system in a telepresence application.

Pinhanez III, Fig. 1.

183. Accordingly, the combination of Kjeldsen and Pinhanez III discloses claim element 7.4 and renders obvious claim 7.

9. Claim 8 Analysis

[8.0]: “The system of claim 7,”

184. As shown above, Kjeldsen and Pinhanez III disclose claim 7. [See analysis above [7.0]- [7.4].]

[8.1]: “wherein said guide system controller is configured to receive a sequence of one or more input signals causing said directional light device to project said visual indicator for the particular guided operation.”

185. As discussed above, this claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” may entail. [See analysis above [2.1].] Nevertheless, assuming this claim limitation is not indefinite, it is also disclosed by Kjeldsen. [See analysis above [2.1].]
186. Accordingly, Kjeldsen and Pinhanez III disclose claim element 8.1 and renders obvious claim 8.

10. Claim 9 Analysis

[9.0]: “The system of claim 8,”

187. This claim appears to be indefinite because it depends from invalid claim 8. Nevertheless, Kjeldsen and Pinhanez III disclose claim 8. See analysis above [8.0] - [8.1].

[9.1]: “further including a separate computer system or controller and wherein said separate computer system of controller is configured to provide the sequence of one or more input signals to said guide system controller.”

188. Kjeldsen discloses this claim limitation. [See analysis above [3.1].]
189. Accordingly, Kjeldsen and Pinhanez III disclose claim element 9.1 and render obvious claim 9.

11. Claim 10 Analysis

[10.0]: “The system of claim 7,”

190. As shown above, Kjeldsen and Pinhanez III disclose claim 7. [See analysis above [7.0] - [7.4].]

[10.1]: “wherein said guide system controller is configured to receive a sequence of input signals and to cause said directional light device to dynamically project a sequence of visual indicators onto the physical object for the particular guided operation based on the sequence of the input signals.”

191. Kjeldsen discloses this claim limitation. [See analysis above [4.1].] The only difference from [4.1] is that this element uses the word “cause” instead of “prompt[.]” Both words are used similarly in the '036 patent in describing the projection of visual indicators based on input signals. [See, e.g. '036 patent, 2:9-12, 2:34-36, 2:66-3:1, 19:21-23.]
192. Accordingly, Kjeldsen and Pinhanez III disclose claim element 10.1 and render obvious claim 10.

12. Claim 11 Analysis

[11.0]: “The system of claim 10,”

193. As shown above, Kjeldsen and Pinhanez III disclose claim 10. [See analysis above [10.0] - [10.1].]

[11.1]: “wherein a combination of the sequence of the input signals results in a generation of a dynamic, real-time projection of the sequence of said visual indicators.”

194. This claim appears to be indefinite because a POSITA would not understand with reasonable certainty what “a combination of the sequence of the input signals” would entail. [See analysis above [5.1].] To the extent the claim is not indefinite, it is disclosed by Kjeldsen.
195. As discussed above in my analysis of element 4.1 and element 10.1, Kjeldsen discloses the ED-projector *receiv[ing] a sequence of input signals and [] prompting / caus[ing] ... dynamic projection of a sequence of visual indicators onto the physical object.*
196. Kjeldsen discloses *a combination of the sequence of the input signals (i.e. detected user interactions) results in a generation of a dynamic, real-time projection of the sequence of said visual indicators (i.e. interactive graphics).* As discussed above, a combination of detected user interactions including at least (1) touching a color, and (2) touching or “clicking” the

button on a bucket containing the selected M&Ms results in the generation of interactive graphics, as illustrated in Figure 2 provided below.

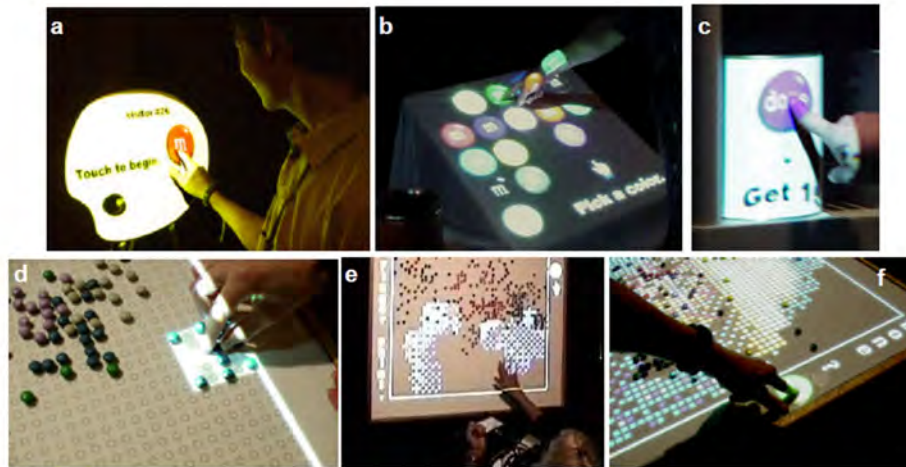


Fig. 2: Steps followed by each user when placing the M&M's in the SIGGRAPH'01 demo: a) the entrance panel is touched to start the process; b) a color is selected; c) the bucket containing the selected color is projected upon and the "done" button bucket is touched after the M&M's are picked up; e) the user places the M&M's on highlighted pixels; e) finger-painting to reveal the full image; and f) a "yes" button is touched after all interaction is done. (c&e from system camera)

Kjeldsen, Fig. 2.

197. Furthermore, this projection is *dynamic* because said projection changes in response to *the sequence of input signals*. [See my analysis above for claim 4.] In addition, Kjeldsen teaches projecting in *real-time* in response to detecting the user's interactions with the projected graphics. Here, real-time refers to "real time or dynamic creation of visual indicators or display images . . . for guiding the activities of an individual." ['036 patent, 18:8-10.] As discussed above in my analysis of element 4.1, Kjeldsen discloses determining projected interactive graphics (i.e. projected highlights

representing proper location of M&M's) based on *the sequence of input signals* such as the event associated with detecting a user's choice of a color.

198. Accordingly, Kjeldsen and Pinhanez III disclose claim element 11.1 and Kjeldsen and Pinhanez III render obvious claim 11.

13. Claim 12 Analysis

[12.0]: “The system of claim 11,”

199. This claim appears to be indefinite because it depends from invalid claim 11. Nevertheless, Kjeldsen and Pinhanez III disclose and render obvious claim 11. [See analysis above [11.0]-[11.1].]

[12.1]: “further including a separate computer system or controller and wherein said separate computer system or controller is configured to provide the sequence of input signals to said guide system controller.”

200. Kjeldsen discloses this claim limitation. [See analysis above [3.1], [6.1].]
201. Accordingly, Kjeldsen and Pinhanez III disclose claim element 12.1 and renders obvious claim 12.

B. CHALLENGE 2: Claims 1-12 Are Obvious over Kjeldsen and Pinhanez III in view of Pinhanez I

202. If LightGuide argues that the combination of Kjeldsen and Pinhanez III fails to disclose the claimed *guide system controller*, then the further combination of those references with Pinhanez I would render the claims obvious. The details of how the combination of Kjeldsen, Pinhanez III, and Pinhanez I –

three of the Everywhere Display publications – disclose claim limitations relating to the guide system controller is described in detail below.

203. Additionally, to the extent that LightGuide argues that Kjeldsen does not disclose a camera that is *proximate to* the directional light device, it would have been obvious to supplement Kjeldsen’s teachings with Figure 3 of Pinhanez I, which discloses a prototype with a camera located mere centimeters from the pan/tilt mirror of the *directional light device*. Pinhanez I is another publication that describes the ED-projector and the M&M experience disclosed in Kjeldsen. The only difference is that the ED-projector in Pinhanez I shows the camera located even closer to the projector than in Kjeldsen. Notably, Kjeldsen expressly discloses that it is desirable to put the camera and the directional light device close together. See Kjeldsen at 3 (“The camera is located adjacent to the mirror assembly so that the camera’s view of the user’s hand interacting with the display is generally occluded only if she occludes the projected image itself....”).
204. Aside from the elements of Pinhanez I discussed herein, the analysis of the rest of the challenged claims for Challenge 2 is otherwise the same as discussed in Challenge 1 above.

1. Rationale for combining Kjeldsen, Pinhanez III, and Pinhanez I

205. As discussed above in Section IX, at [G], it would have been obvious to combine teachings from Kjeldsen, Pinhanez III, and Pinhanez I because all three references are authored by the same group of authors and discuss the same ED-projector. Further, Pinhanez I explicitly cites Kjeldsen to describe “[ED-projector’s] ability to interact on any surface [] us[ing] pan/tilt camera feeding custom image processing and gesture recognition engines.” [Pinhanez I at 6 (citing reference [31] (i.e., Kjeldsen) for additional details).]
206. In addition, Pinhanez I discloses additional details regarding the hardware components and internal workings of the ED-projector (e.g. host computer). Thus, it would have been obvious for a POSITA to look to Pinhanez I for more teachings on the ED-projector, and the combination would have been nothing more than using a known technique (ED-projector in Pinhanez I) to improve similar devices (ED-projector in Kjeldsen) in the same way. For example, Kjeldsen discloses that “the camera is located adjacent to the mirror assembly” (i.e. part of the *directional light device*), whereas Pinhanez I illustrates the relative position of the camera and the *directional light device* (including pan-tilt mirror and projector) in detail. [Kjeldsen at 3; Pinhanez I at 4, Fig. 3b]. Thus, a POSITA would have a reasonable expectation of success in combining the teachings from these references.

207. Lastly, Pinhanez I is also analogous to the '036 patent. Like Kjeldsen and Pinhanez III, Pinhanez I also discloses projector-camera systems and is reasonably pertinent to the problem the '036 patent is meant to solve, namely improvements to existing systems that use projectors to guide individuals. Thus, all three references are within the same field of invention as the '036 patent.

2. Claims 2-12 Analysis Relative to *Guide System Controller*

208. The combination of Kjeldsen, Pinhanez III, and Pinhanez I renders claims 2-12 obvious relative to the *guide system controller* limitation (which is required, directly or indirectly by each of those claims). To the extent it is argued that Kjeldsen does not sufficiently disclose a *guide system controller*, Pinhanez I describes it in greater detail and thus discloses this claim limitation.

209. Specifically, Pinhanez I discloses a *guide system controller* being part of one or more (host) computers. Specifically, Pinhanez I explains that its “projector is connected to the display output of a host computer that also controls the mirror and the camera (see Figure 2).” [Pinhanez I, Sec. 3, ¶ 1; see '036 Patent, 3:8-9 (stating *guide system controller* “causes the projector to project the visual indicator(s)”); see also 24:18-22 (Claim 7).] As shown below, Figure 2 in Pinhanez I further illustrates the host computer may

consist of one or more computers, including a “graphics board” that can render the image for projection. [Pinhanez I, Sec. 3.1, 1st method, at ¶ 4.]

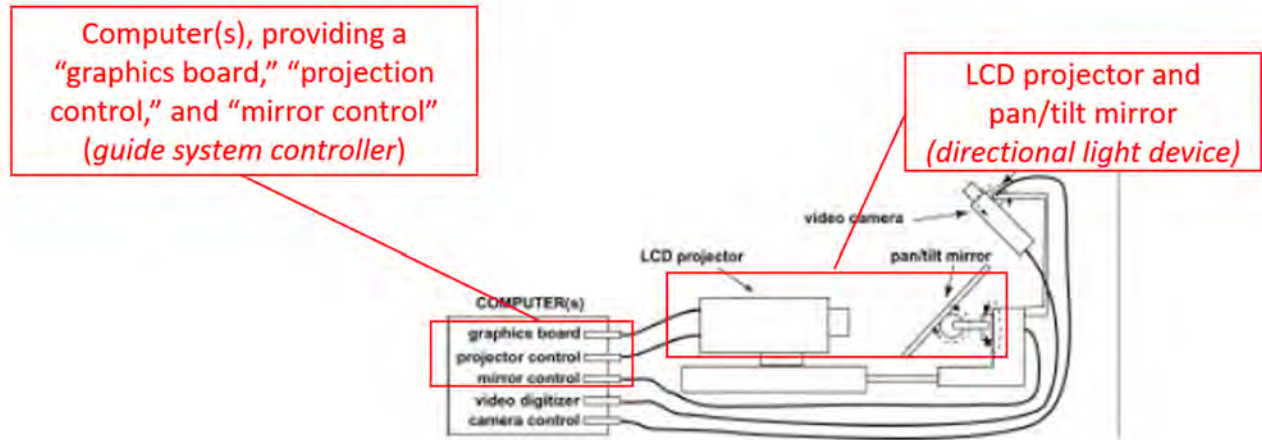


Figure 2. Diagram of the components of the ED-projector.

Pinhanez I, Fig. 2 – Annotated.

210. In addition, Pinhanez I details the software process of the *guide system controller*. For example, Pinhanez I teaches the calculations necessary to correct the distortion to the images when projected on an oblique surface. [See Pinhanez I, Sec. 3.1.] As another example, Pinhanez I discusses how projected images change in response to input events from the computer vision system. [See Pinhanez I, Sec. 3.2.]
211. Moreover, the video camera in the ED-projector is connected to the video digitizer within the (host) computer(s) [see, e.g., Pinhanez I, Fig. 2], and “[t]he video output of the camera is sent to a digitizer board in the host computer where the imagery is processed.” [Pinhanez I, Sec. 3, ¶ 1; see also

Pinhanez I, Sec. 3.2, *generally*.] Thus, the *guide system controller* receives *a sequence of one or more input signals* at least including the camera video.

212. As another example, like Kjeldsen, Pinhanez I also describes a vision subsystem that detects user actions (such as a button touch) from the camera video, and a distinct “projector subsystem [that] is responsible for rendering the view” based on the “*controller* input events” outputted from the vision subsystem based on detected actions. [Pinhanez I, Sec. 3.3, ¶ 2; *see also* Pinhanez I, Sec. 4.2, ¶ 3.] For purposes of this Challenge, the messages from the vision subsystem to the projector subsystem are *input signals* because they are signals that reflect inputs (i.e., controller input events). Pinhanez I thus discloses that its projector subsystem performs the step of *receiving* one or more *input signals* from the Pinhanez I’s “vision subsystem.” [Pinhanez I, Sec. 3.3, ¶ 2.]
213. More specifically, Pinhanez I teaches interpreting user actions from the camera video using software elements called “widgets” or “interface widget.” [Pinhanez I at 5-6]. Different widgets are created for “buttons that respond to touch-like motions; sliders, 1-dimensional tracking regions, and touch pads, which are 2-dimensional tracking regions.” [Pinhanez I, Sec. 3.2, ¶ 4 (emphasis omitted).] “These three widget types rely on tracking the user’s fingertips. Convolution template matching is used to find fingertip

candidates in the motion mask image” based on images in the camera video. [Pinhanez I, Sec. 3.2, ¶ 5]. “The result is a projected image that ***generates application events*** when user gestures occur in the areas defined in the camera view ...” [Pinhanez I, Sec. 3.3, ¶ 3 (emphasis added); *see also* Pinhanez I, Sec. 3.3, ¶¶ 1-2.]

214. Accordingly, the combination of Kjeldsen, Pinhanez III, and Pinhanez I discloses and renders obvious the *guide system controller* limitations. The remaining limitations are disclosed and rendered obvious for the same reasons discussed above for Challenge 1. Accordingly, claims 2-12 are obvious for the same reasons as in Challenge 1, as further supplemented by the combination of teachings with Pinhanez I.

C. CHALLENGE 3: Claims 3, 9, and 12 Are Obvious over Kjeldsen combinations in Challenges 1-2 in view of Pinhanez II

1. Rationale for combining Kjeldsen combinations and Pinhanez II

215. As discussed above in Section IX, at [G], it would have been obvious to combine teachings from Kjeldsen, Pinhanez III, Pinhanez I, and Pinhanez II because all four references are authored by the same group of authors and discuss the same ED-projector. Pinhanez II also explicitly cites to Kjeldsen. [Pinhanez II at 2, 8, citation 4.] In addition, Pinhanez II discloses more details about the computational structure of the ED-projector system (*i.e.*

using two computers instead of one). [Pinhanez-II at 2.] Thus, it would have been obvious for a POSITA to look to Pinhanez II for more teachings on the ED-projector, and the combination would have been nothing more than using a known technique (i.e., the arrangement of computers powering the ED-projector in Pinhanez II) to improve similar devices (ED-projector in Kjeldsen) in the same way (i.e., by using multiple computers to power the ED-projector so that the device had more computing power).

216. In addition, each of the ED-projector references is directed at “create[ing] ubiquitous interactive graphics in a real-world environment” [Pinhanez I at Abstract; *see also* Kjeldsen at Abstract (“[turning] any surface in an environment ... into an interactive interface”); Pinhanez II at Abstract (“interactive computer interfaces [is] created anywhere in a space”); Pinhanez III at Abstract (“overlaying and embedding information and visualization on *real* objects and surfaces in the remote environment.”).] A POSITA would recognize that the creation of ubiquitous interactive graphics would require massive amounts of computation. Furthermore, the required computational ability would not be centralized in one place, such as on a remote server. Rather, the computational hardware would need to be distributed throughout the world and would be beneficially located near the hardware requiring the computation. Therefore, a POSITA would find it

obvious to utilize a local computer to perform the camera-related computations. Correspondingly, it would have been obvious to use a separate computer to handle the computational requirements of the projection system. The methods to distribute computing requirements between at least two computers were also well-known by the 2001-2003 timeframe. Therefore, to the extent that Kjeldsen does not clearly teach using separate computers for the projector- and camera-related computations, a POSITA would recognize that the two-computer structure explicitly taught in Pinhanez II would be beneficial for the system described in Kjeldsen, and their combination is nothing more than combining prior art elements according to known methods to achieve predictable results (i.e. reducing load and computing requirement for each component). Given that Pinhanez II describes the same system as Kjeldsen, a POSITA would know that they would be successful in using the two-computer computational structure.

217. Lastly, Pinhanez II is also analogous to the '036 patent for the same reason as discussed above with respect to Kjeldsen, Pinhanez I, and Pinhanez III. Pinhanez II is directed to the same ED-projector system and within the field of projector-camera systems described in the '036 patent.

2. Claim 3 Analysis

[3.0]: “The method of claim 2,”

218. As shown above, the Kjeldsen combinations in Challenge 1 and 2 discloses claim 2. [See analysis above in Challenges 1 and 2 at [2.0] - [2.1].]

[3.1]: “wherein the sequence of one or more input signals are provided by a separate computer system or controller to the guide system controller.”

219. This claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” may entail. Assuming that “a sequence of one or more input signals” refers to one input signal or a sequence of input signals (two or more input signals), this limitation is disclosed by the Kjeldsen combinations. [See analysis above in Challenge 1 at [3.1].] To the extent that the Board concludes that Kjeldsen does not expressly disclose this claim limitation, Pinhanez II discloses it.

220. Specifically, Pinhanez II expressly discloses implementing the ED-projector with “one [computer] responsible for the application software and the projector software.” [Pinhanez II, Sec. 3, ¶ 2.] This first computer includes the *guide system controller*, because the *guide system controller* in the ED-projector are the portions of the host computer that are “responsible for the application software and the projector software,” [Pinhanez II, Sec. 3, ¶ 2], as discussed above in Challenge 1 at claim 2.

221. Pinhanez II further discloses a second computer “run[ning] the computer-vision system responsible for detecting user interaction.” [Pinhanez II, Sec. 3, ¶ 2.] The second computer is separate from the first. Furthermore, this separate computer provides *input signals* to the *guide system controller* because it detects user interactions that drive the actions of the projector system. [Pinhanez II, Sec. 3, ¶ 4 (“The vision system implements widgets that detect touch events and that report continuous motion of the user’s hand on a surface.”); Pinhanez II, Sec. 4.3, ¶ 6 (“The vision system is able to detect touch events, hand position and movement”); Pinhanez II, Sec. 4.4, ¶ 4 (“The vision system can detect user activity in each of the . . . touch events”); *see also* Kjeldsen at 3 (“A vision system examines the video stream for user actions and generates events for the application software.”).]
222. Thus, it would have been obvious to a POSITA that the projection subsystem and vision subsystem of Pinhanez I can be implemented on different computers, because this is exactly how those subsystems are disclosed in Pinhanez II.
223. Accordingly, the combined teachings of the Kjeldsen combinations from Challenges 1-2 and Pinhanez II discloses claim element 3.1 and render obvious claim 3.

3. Claim 6, 9, and 12 Analysis

224. Claims 6, 9, and 12 also require a *separate computer system or controller*.

For the reasons described above for Challenge 3 claim 3, the combined teachings of the Kjeldsen combinations render these claims obvious.

D. CHALLENGE 4: Claims 1-12 Are Obvious over Machino I and Machino II

225. In my opinion, the claims of the '036 patent are rendered obvious by the combination of Machino I and Machino II.

226. *Remote-Augmented Communication: A Remote-collaboration System based on a Shared Field of View in Real Space* (“Machino I”) is one of a series of technical papers authored by Tamotsu Machino and other researchers at NTT Cyber Solutions Laboratories on a remote communications system for performing remotely assisted maintenance operations. I have been informed that it is prior art to the '036 patent.

227. *Remote-Collaboration System Using Mobile Robot with Camera and Projector* (“Machino II”) is another paper describing the SCOPE system with the same primary author. It was presented at the IEEE International Conference on Robotics and Automation in May 2006. I have been informed that it is prior art to the '036 patent.

1. Rationale for combining Machino I and II

228. The rationale for combining Machino I and Machino II is discussed above.

[See analysis above in Section IX, at [J].]

2. Claim 1 Analysis

229. The combination of Machino I and Machino II renders claim 1 obvious. The following limitation-by-limitation analysis provides detailed reasoning for the obviousness.

[1.0]: “A method of projecting visual indicators to guide actions of an individual for a particular guided operation, said method comprising:”

230. If the preamble is limiting, then Machino I and II disclose it. Both Machino I and II disclose *a method of projecting visual indicators to guide actions of an individual for a particular guided operation*. Both Machino I and II describe a “remote-collaboration system named SCOPE (sight collaboration by projection effect).” [Machino I at 1; *see also* Machino II at 2-3 (describing SCOPE).] “This system consists of a projector unit with a camera, a multiple control unit (MCU) for video/voice communications, and PCs connected via a network.” [Machino I at 1; *see also* Machino II at 1 (“A prototype remote-collaboration system called SCOPE (sight collaboration by projection effect) was developed as a maintenance robot ... which featured image projecting and capturing capability.”).] In addition,

Machino II also discusses the mobile configuration of the SCOPE system where the projector and camera are mounted onto a planar mobile robot. [See Machino II at Abstract (“[w]e propose a mobile SCOPE that can significantly expand the area of activity of the conventional SCOPE.”); see also Machino II at 3.]

231. The following is a diagram of the SCOPE system disclosed in Machino I:

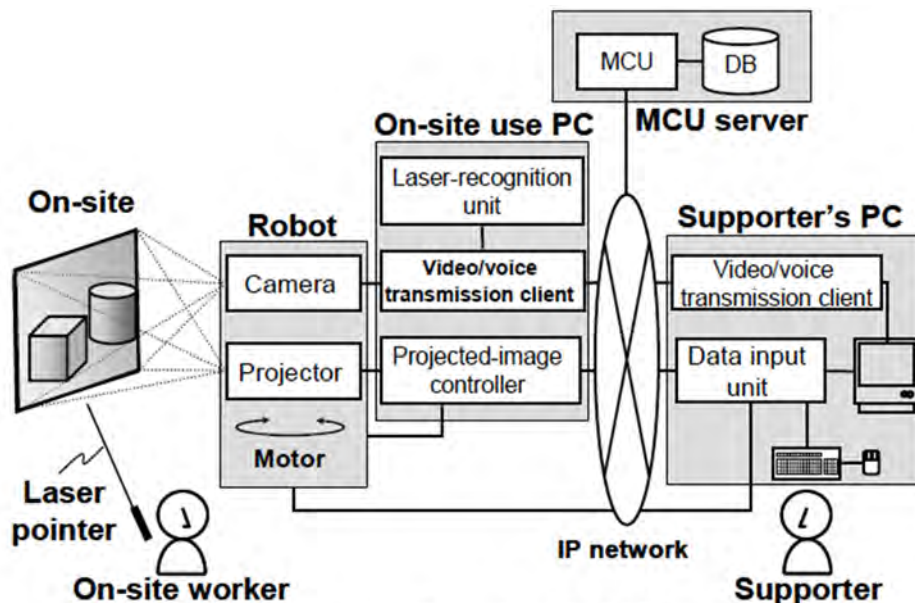


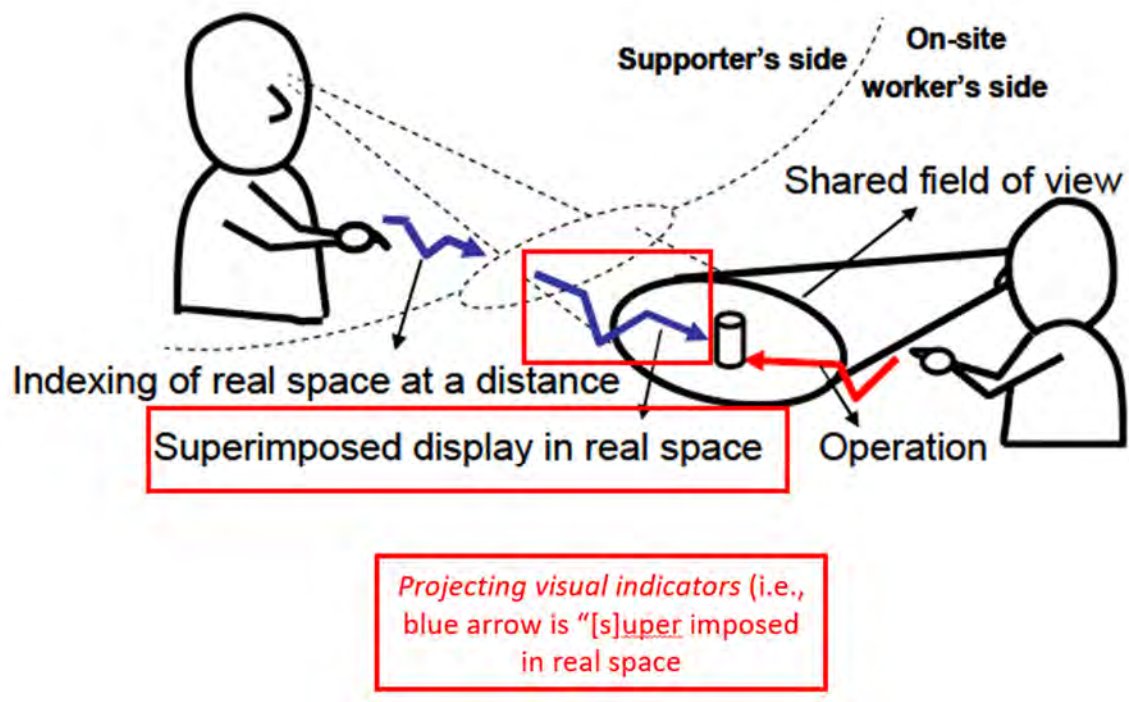
Fig. 3 Schematic configuration of SCOPE system.

Machino I, Fig. 3

232. As Figure 3 of Machino I above shows, the SCOPE system includes a robot having a camera and a projector for *projecting visual indicators*. [See also Machino I at Abstract (“[SCOPE] has three key functions ... [including] projecting meta-information onto the objects”), 3-4 (describing SCOPE’s “indexing function” for displaying “text, still images, video,” etc.); Machino

II at 3 (describing same “indexing function”).] The purpose of the projections is to *guide actions of an individual* (on-site worker) *for a particular guided operation*. [Machino I at 3 (“Information needed for carrying out operations (referred to as ‘attribute information’ hereafter), is affixed to the target object in terms of position coordinates in the working space, controlled, and displayed as occasion demands”); Machino II at 3 (same); *see also* Machino I at 4 (“receiving instructions regarding equipment maintenance work from a skilled worker at a remote support center.”).]

233. Machino I uses the following figure to explain how *projecting visual indicators* can be used to *guide actions of an individual for a particular guided operation*:



Machino I, Fig. 2 (annotated)

As shown in this figure, the “on-site worker” (right side) is performing an “operation” under the guidance of a “supporter.” The blue arrows represent a projection (either using a projector or a headset that creates the illusion of a projection). The blue arrow on the supporter’s side represents the projection that the supporter wishes to display. The blue arrow on the right represents the corresponding projection—i.e., a “superimposed display in real space.” [see also Machino I at 3 (“Superimposed-information function: Information is presented directly in real space, where it can be selected and manipulated.”)] The “indexing of real space at a distance” refers to the ability, to “[f]rom a remote place, affix information to objects in on-site real

space or in specified locations.” [Machino I at 3.] Machino I confirms that the projector in fact projects images that are viewed by the on-site worker. [Machino I at 3 (“In the SCOPE system, by unifying the camera’s viewing field and projector’s projection area and displaying a frame on the projected images, it is possible to present the remote supporter’s viewing field to the on-site worker.”).] The purpose of projecting this information is to *guide the actions of an individual*. [Machino I at 3 (“Information needed for carrying out operations (referred to as ‘attribute information’ hereafter), is affixed to the target object in terms of position coordinates in the working space, controller, and displayed as occasion demands.”)] The red arrow represents the operation performed by the on-side worker while under the guidance of the projected images provided by the supporter. This is a teaching of *projecting visual indicators to guide actions of an individual for a particular guided operation*.

234. Machino II further illustrates how the SCOPE system *project[s] visual indicators to guide actions of an individual for a particular guided operation*, as shown in the annotated Machino II Figure 3 below:

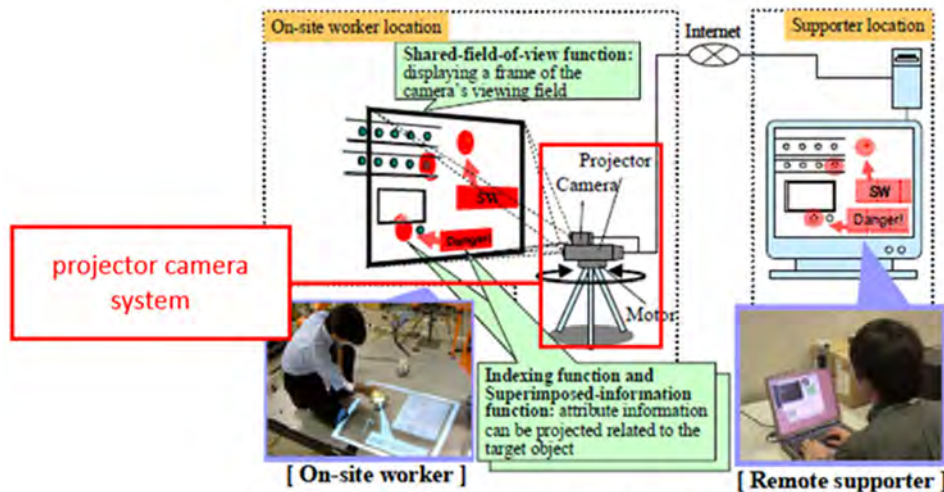


Fig. 3 SCOPE system.

Machino II, Fig. 3 – Annotated.

“Information needed for carrying out operations, ‘attribute information,’ is projected onto the target object as the occasion demands. This is like affixing notes on the target object with light.” [Machino II at 3; *see also* Machino II, Fig. 3 (projecting attribute information including red circles, arrows, and boxes containing text “SW” and “Danger!” at on-site worker location.).] The on-site worker is, therefore, able to perform maintenance work “with the help of SCOPE and a remote support person.” [Machino II at Abstract; *see also* Machino at 1 (“... an on-site human worker, who may not be skilled in maintaining the target object, are assisted by a veteran operator of the object at a remote support center.”).]

235. The same functionality of the conventional SCOPE was also present in the mobile SCOPE. [See Machino II at 5-6 (“the indexing and superimposed-information functions of the conventional SCOPE were also

implemented.”).] As is illustrated below in Figures 1, 11, and 12 of Machino II, attribute information is projected by the mobile robot to guide actions of the on-site worker in performing maintenance operations.

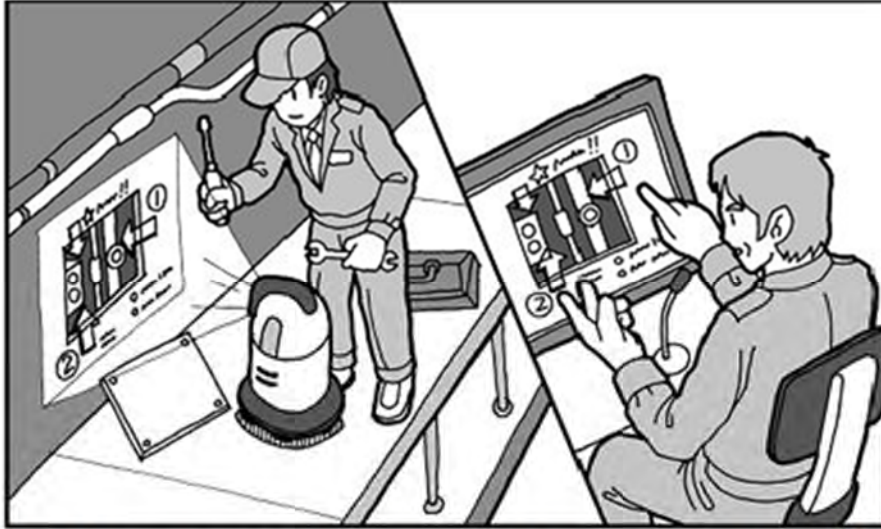


Fig. 1 Future scene of remote support using mobile SCOPE Machino II, Fig. 1.

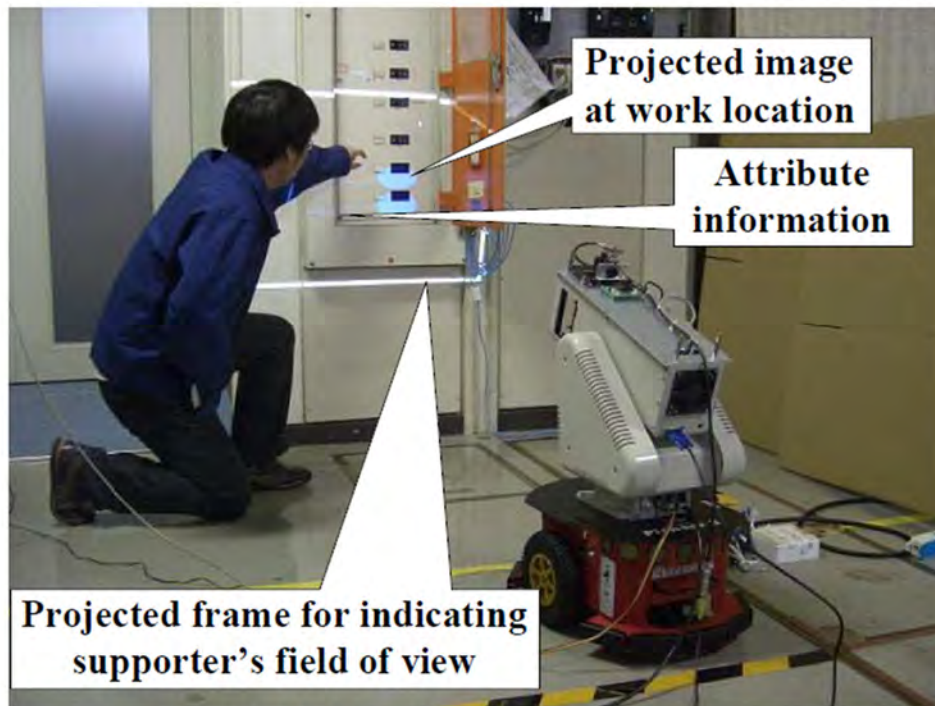


Fig. 11 Mobile SCOPE (on-site location).

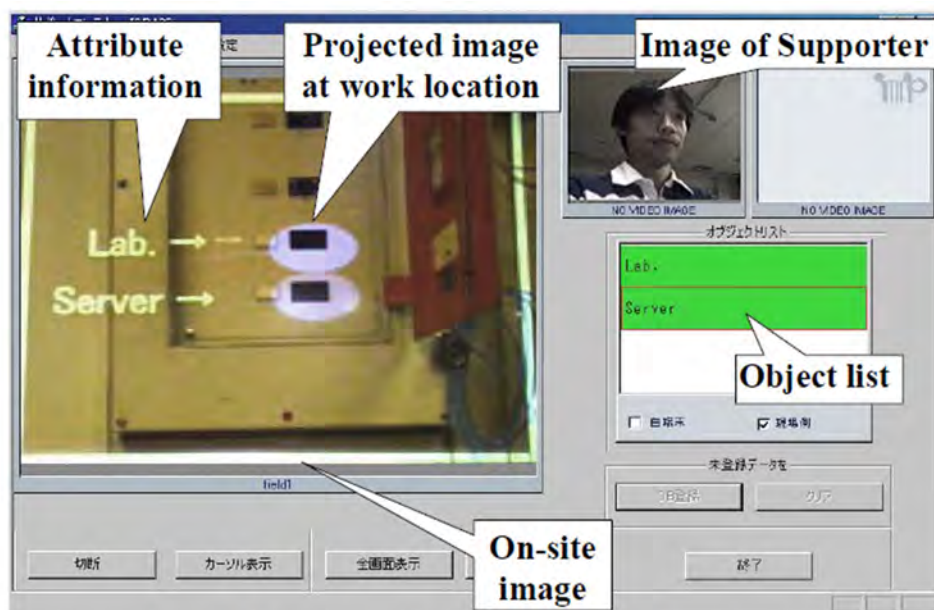


Fig. 12 Screen shot (supporter's location).

Machino II, Figs. 11-12.

Thus, the combination of Machino I and II discloses claim element 1.1.

[1.1]: “projecting a visual indicator using a directional light device onto a physical object associated with the particular guided operation;”

236. Both Machino I and II disclose *projecting a visual indicator using a directional light device*. For example, both Machino I and II explain that the SCOPE system “consists of a projector unit with a camera.” [Machino I at 1; *see also* Machino II at Title (“Remote-Collaboration System Using Mobile Robot with Camera and **Projector**”) (emphasis added), etc.]
237. Both Machino I and II further disclose *projecting a visual indicator . . . onto a physical object associated with the particular guided operation*. For example, Machino I explains that the SCOPE system “has three key

functions,” including “projecting meta-information onto . . . objects.”)

[Machino I at 1; *see also* Machino I at 3 (discussing “superimposing meta-information onto a target object” by “utilizing a projector”); Machino II Figs 1, 3, 11-13.].

238. Machino I also provides an example of how the SCOPE system projects visual indicators onto objects. Section IV of Machino I describes experiments used to “measure the time taken for the on-site worker to comprehend the indicated target object and, thus, estimate the worker’s efficiency.” Machino I describes one of these experiments as follows:

The experiments consist of one person as the on-site worker and another person as the remote supporter. The task of the worker is to pick out a target object stuck to a wall by following instructions from the remote supporter, and then stick that object in a different place. As target objects, 20 cards painted with various graphical forms were stuck to a wall on the worker’s side; the same cards were also laid out on the supporter’s side. The supporter arbitrarily chose five cards from the 20 and then instructed the worker to pick out these cards in sequence. The graphics on the cards were framed by random free-form curves.

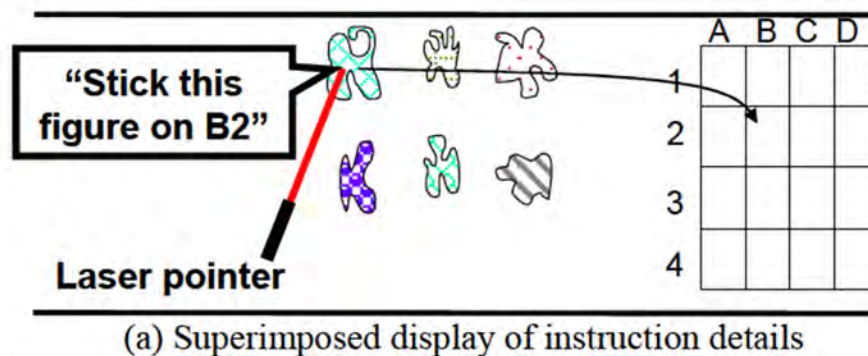
[Machino I at 4.] Another experiment was described as follows:

Experiment 1: Ease of transmission of instruction details

As target objects, 16 cards each drawn with a different graphic

figure are stuck to a wall, and each card is fixed with corresponding instructions. The worker thus performs operations according to these 16 sets of instructions. As shown in Fig. 7, the worker transfers each card to a specified position on a four-by-four matrix, and by following the two different instruction methods only, the worker correlates the cards on the matrix. In method (a), the indexing function of SCOPE is used beforehand to record the instructions on the cards in text. When the card is pointed out by laser pointer, the recorded instructions are superimposed onto the card.

[Machino I at 4.] Machino I also includes the figure below to describe how this experiment worked.



Machino I, Fig. 7(a).

In this example, the shapes represent real-world objects. When a local user selects one of them (with a laser pointer), the SCOPE system projects the instruction "Stick this figure on B2." This is a specific example of *projecting a visual indicator . . . onto a physical object associated with the particular guided operation.*

239. As another example, Machino I and II disclose the conventional and mobile SCOPE systems *projecting a visual indicator ... onto a physical object associated with the particular guided operation* by projecting attribute information to an on-site worker in a maintenance operation. As discussed above in Challenge 5 at [1.0], both the SCOPE and the mobile SCOPE systems project attribute information “onto a target object” associated with the maintenance operation at the on-site worker’s side. [Machino I at 3; *see also* Machino II at 3 (“attribute information [] is projected onto the target object as the occasion demands”) (internal quotation marks omitted).]

240. As explained in Machino I:

The location of related attribute information affixed to the target object is marked as a graphical image with a circular form (known as a ‘projected object’). For example, in a scene in which a chemical solution is selected from a shelf of items, attribute information is recorded as its characteristic properties and appropriate handling procedures, and a projected object is displayed at the location of the bottle containing that chemical.

[Machino I at 4.]

241. Machino II further illustrates projecting attribute information in its Figures 3 and 11, as shown below.

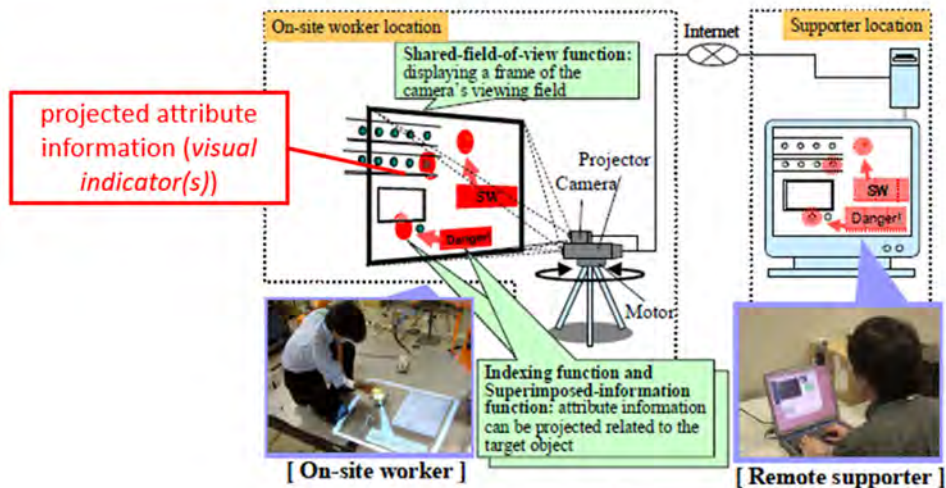


Fig. 3 SCOPE system.

Machino II. Fig. 3.

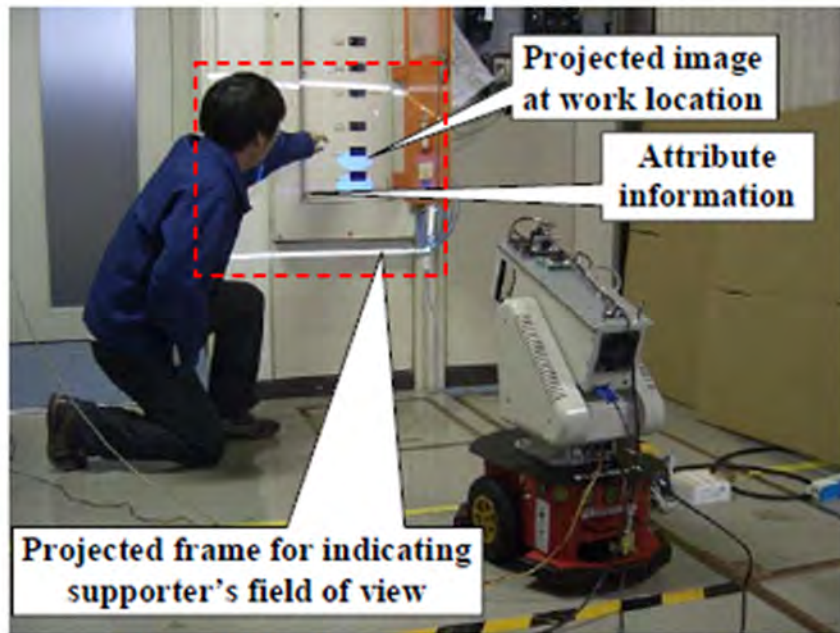


Fig. 11 Mobile SCOPE (on-site location).

Machino II, Fig. 11 – Annotated

In these examples, images and attribute information (*visual indicators*) are displayed onto the floor and an electrical panel (*physical objects*), respectively.

242. Thus, the combination of Machino I and II discloses claim element 1.1.

[1.2]: “imaging the projected visual indicator with a camera located proximate to the directional light device;”

243. Both Machino I and II disclose *imaging the projected visual indicator with a camera located proximate to the directional light device*.
244. First, both Machino I and II disclose *a camera located proximate to the directional light device* because in both SCOPE and mobile SCOPE, “[o]n the on-site worker’s side, a camera and a projector are integrated as one.” [Machino I at 3; *see also* Machino II at 2 (“[a]t the on-site worker’s location, a camera and a projector are integrated in one piece”).] The camera and projector are shown to be integrated in the same robot, as illustrated below.

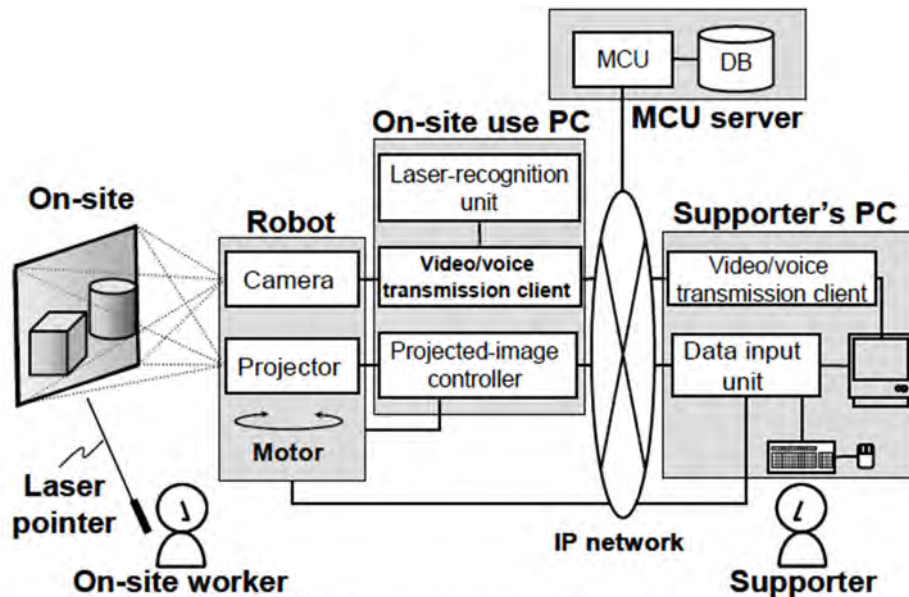


Fig. 3 Schematic configuration of SCOPE system.

Machino I, Fig. 3

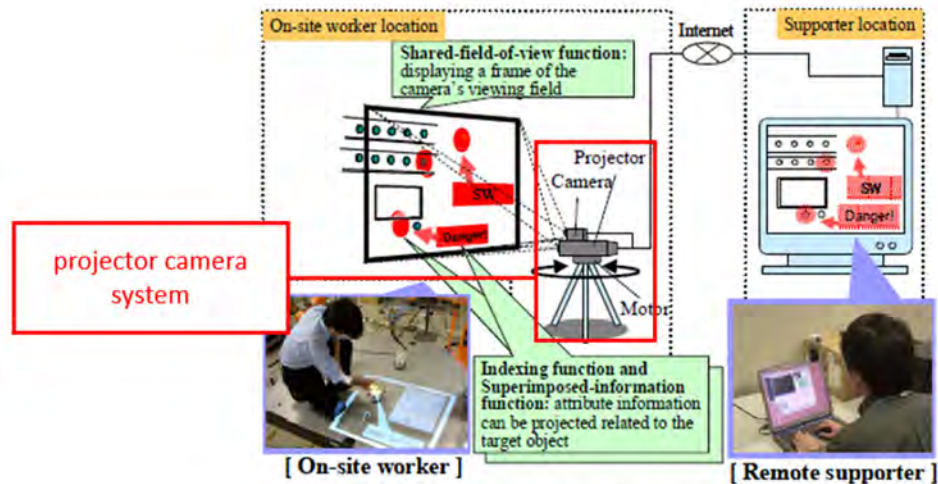
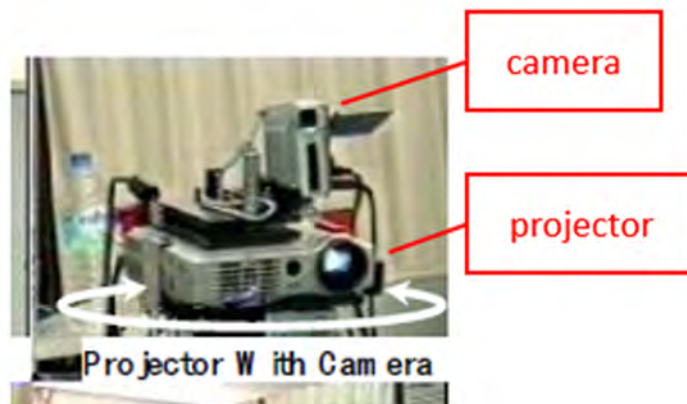


Fig. 3 SCOPE system.

Machino II, Fig. 3 – Annotated (schematic of SCOPE system.)

245. The following figures, Machino I FIG. 5 and Machino II FIG. 8, further illustrate that the cameras and projectors in SCOPE and mobile SCOPE systems are close to one another and integrated within the same device. Thus, Machino I and II discloses *a camera located proximate to the directional light device.*



Machino I, Fig. 5 – Annotated (experimental setup of SCOPE.)

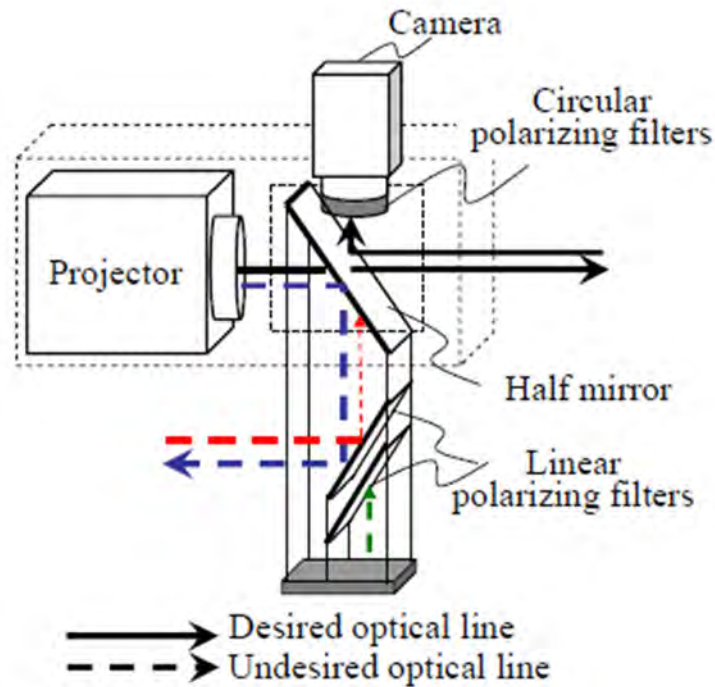


Fig. 8 Construction to eliminate ghost image.

Machino II, Fig. 8 (configuration of camera and projector in mobile SCOPE) [see also Machino I, Fig. 8; Machino II, Fig. 5.]

246. Second, Machino I and II disclose *imaging the projector visual indicator[s] with a camera*. An important feature of both SCOPE and mobile SCOPE is the “shared-field-of-view function” that “unif[ies] the camera’s viewing field and projector’s projection area” to provide context for any verbal instructions from the remote supporter (e.g. “on the right”), [Machino I at 3; see also Machino II at 3], even for mobile SCOPE systems where the distance from the camera and projector to the projected image is variable. [See Machino I at 6-7; see also Machino II at 4-5]. In other words, the

camera in SCOPE systems *imag[es] the projected visual indicator* because the camera and projector share the same field-of-view, as illustrated below:

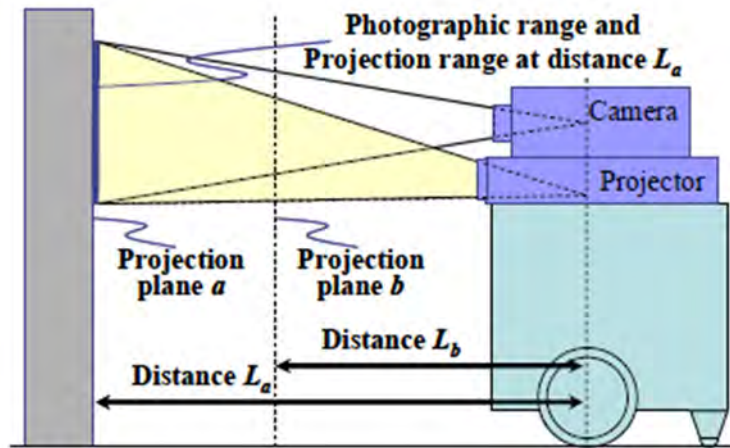


Fig. 4 Relationship between distance to projection plane, and photographic and projection ranges.

Machino II, Fig. 4 (showing unified projection plane or field-of-view at projection plane a)

247. Both Machino I and II show camera images available at the remote supporter's location that includes projected objects/images and projected attribute information, thus confirming that those images are captured by the camera. [See Machino I at 4; see also Machino II at 3.] These camera images appear in Machino I Figure 4 and Machino II Figure 12, as shown in the annotated versions of those figures provided below.

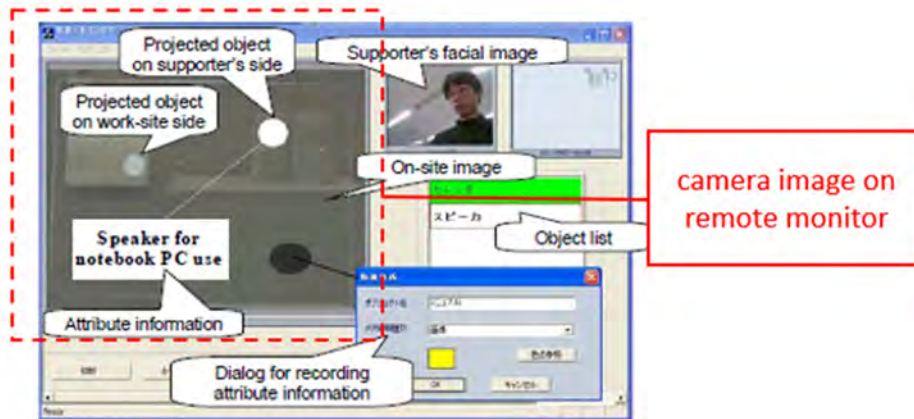


Fig. 4 View of a support screen.

Machino I, Fig. 4 – Annotated.

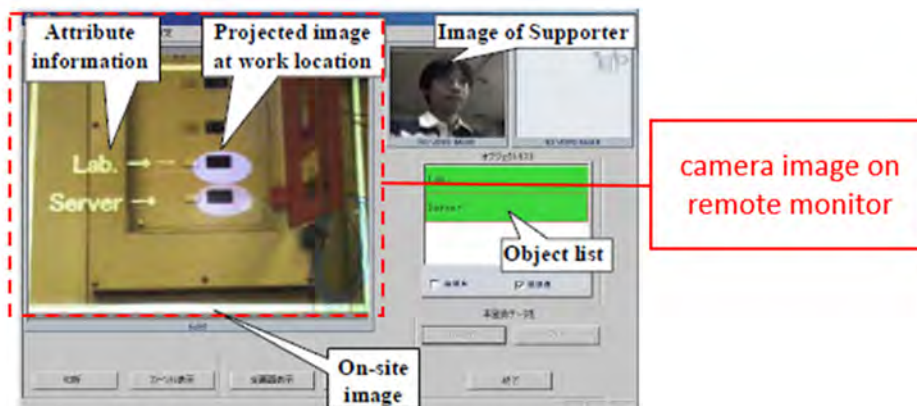


Fig. 12 Screen shot (supporter's location).

Machino II, Fig. 12 – Annotated.

Thus, the combination of Machino I and II discloses claim element 1.2.

[1.3]: “transmitting images from the camera to a monitor located remotely from the directional light device; and displaying images from the camera on the monitor;”

248. Both Machino I and II disclose *transmitting images from the camera to a monitor located remotely from the directional light device; and displaying images from the camera on the monitor*. For example, both Machino I and

II describe that “on the supporter’s side, the projected object is shown on a communication screen displaying images transmitted from the on-site worker’s side,” indicating that images are transmitted from the camera to *a monitor located remotely from the directional light device (projector)*.

[Machino I at 4; see also Machino II at 3 (“[a]t the supporter’s location, the projected image is shown on a communication screen.”).] Machino I Figure 3, reproduced below, is a diagram showing how this works. The remote monitor is shown on the right side where the supporter is located.

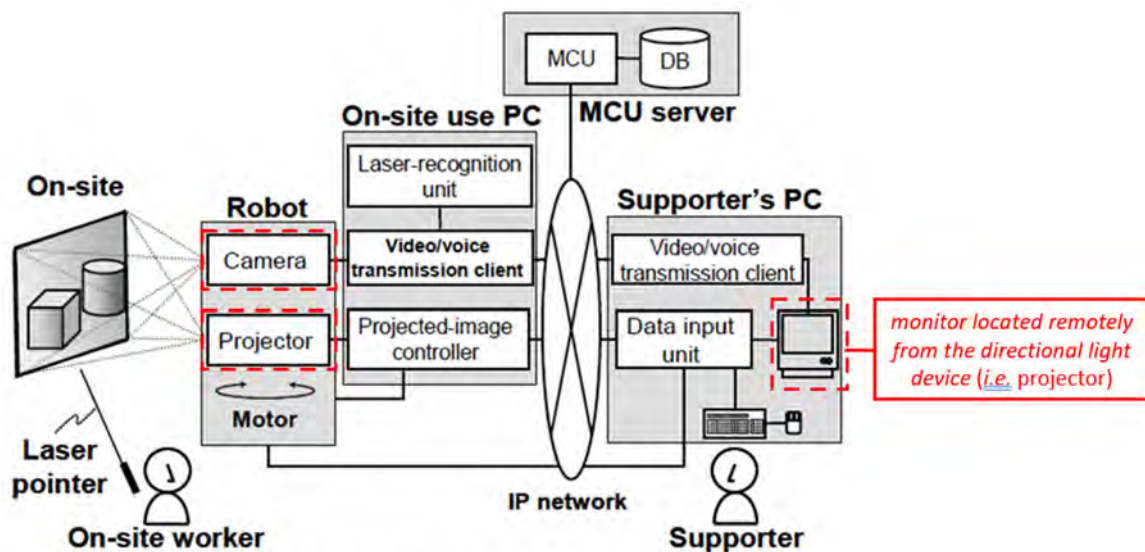


Fig. 3 Schematic configuration of SCOPE system.

Machino I, Fig. 3 (annotated).

As shown in this figure, information from the SCOPE robot is transmitted over an IP network to the Supporter’s PC, which includes a monitor.

249. Machino II Figures 1 and 3, reproduced below in annotated form, further illustrate the same process of transmitting camera images to a remote supporter's PC monitor and displaying said camera images on said monitor:

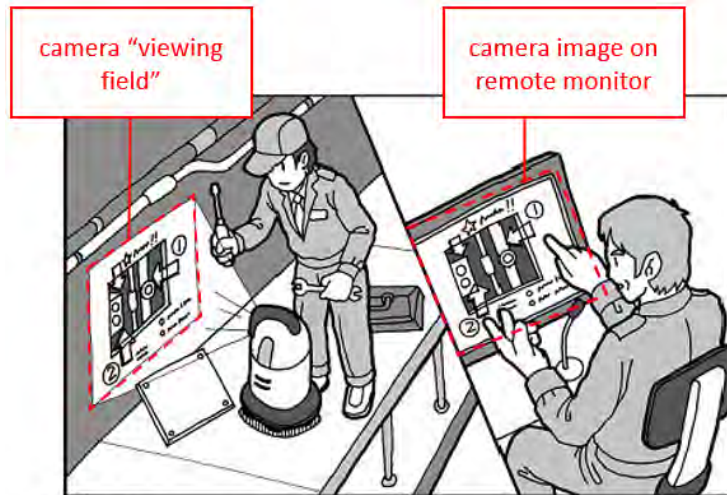


Fig. 1 Future scene of remote support using mobile SCOPE

Machino II, Fig. 1 – Annotated.

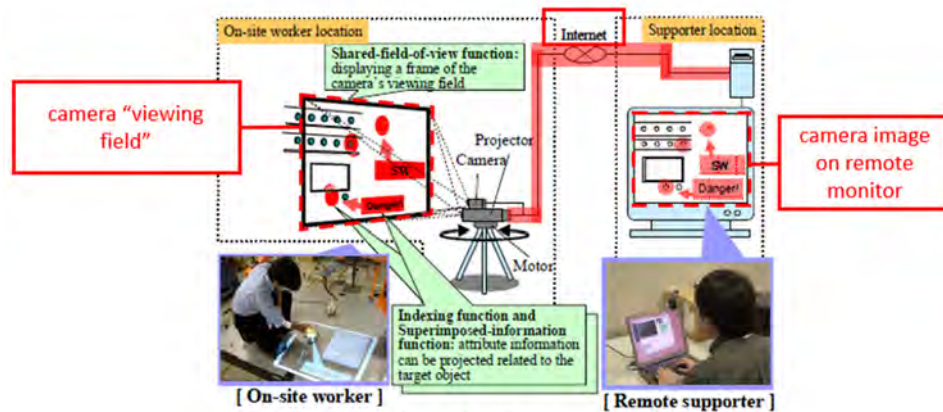


Fig. 3 SCOPE system.

Machino II, Fig. 3 – Annotated.

250. Thus, the combination of Machino I and Machino II discloses claim element 1.3.

[1.4]: “wherein said imaging, by the camera, captures images of at least the individual being guided, the physical object and the projected visual indicator.”

251. The combination of Machino I and Machino II renders obvious the requirement that *said imaging, by the camera, captures images of at least the individual being guided, the physical object and the projected visual indicator.*
252. Machino I and II include images taken by its SCOPE (or mobile SCOPE) camera capturing both the *physical object* and the *projected visual indicator*: Those images are shown below in annotated versions of Machino I Fig. 4 and Machino II Fig. 12.

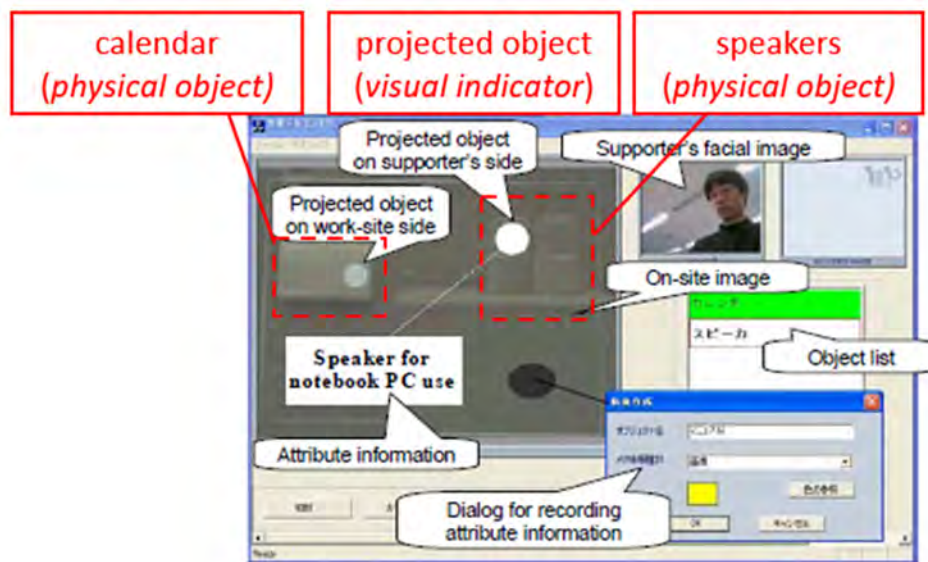


Fig. 4 View of a support screen.

Machino I, Fig. 4 - Annotated.

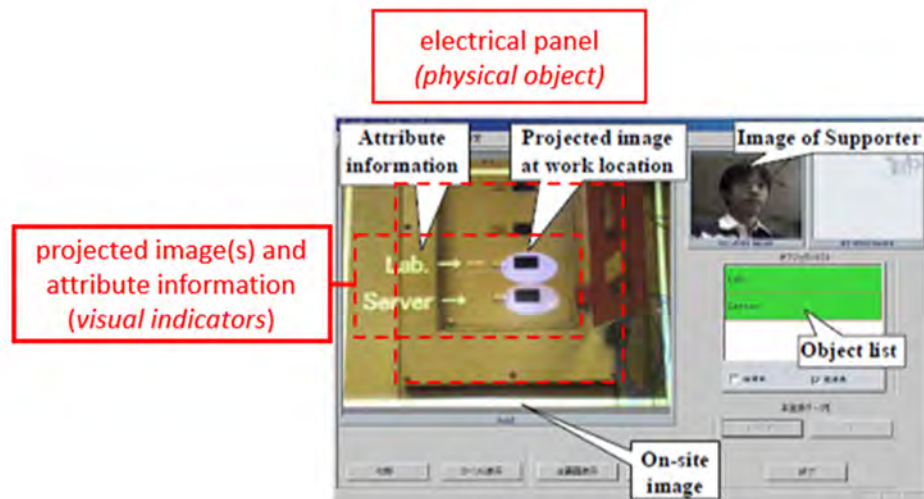


Fig. 12 Screen shot (supporter's location).

Machino II, Fig. 12 - Annotated.

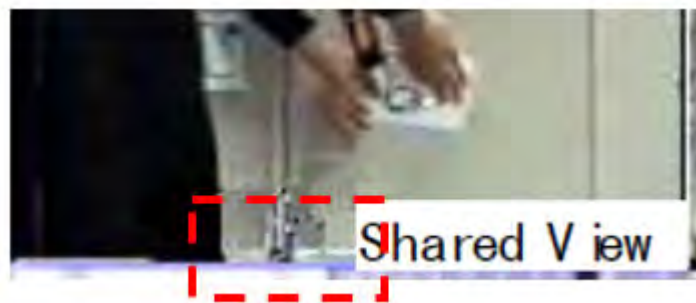
Specifically, both figures show camera images including various real-world objects and projected *visual indicators* (i.e., “projected object[s],” “projected image,” and “attribute information”). Both images provide examples of a camera *captur[ing] images of at least . . . the physical object and the projected visual indicator*.

253. As another example, Machino I Figure 5, provided below, shows a “shared view” (or image captured by the SCOPE camera and shared with the remote supporter) including at least *the individual being guided* (on-site worker) and *the physical object* (pieces of paper, or “cards”). [See Machino I at 3 (“To attain the capability of a “shared viewing field” as explained later, the domains of the viewing fields of the camera and the projector are adjusted so that they line up as one”; Machino I at 4 (Figure 5 depicts “[s]cenes of verification experiments.”).]



Machino I, Fig. 5.

254. Further, the white line at the bottom of Machino I Figure 5 is part of a projected frame that indicates the shared-field-of-view between the worker and supporter (*projected visual indicator*), as shown in the cropped and annotated version of Machino I Fig. 5 below.



Machino I, Fig. 5 – Cropped and Annotated.

Specifically, the verification experiments depicted by Machino I Figure 5 involves a remote supporter guiding an on-site worker in completing tasks (*i.e.* moving or pairing up cards) using different methods of instruction.

[Machino I at 4-6.] Specifically, methods (a) and (c) both involve projecting instructional texts directly onto the cards using the SCOPE system. [See Machino I at 4 (“the shared-field-of view function of SCOPE is used to indicate the target object”); Machino I at 5 (method (a) superimposes “recorded instructions” onto a card pointed out by a laser pointer); Machino I at 6 (method (c) includes “descriptions (letters of the alphabet) [being] superimposed on [cards].”).]

255. Thus, a POSITA reading Machino I would understand that the SCOPE camera would have captured *the individual being guided* (the on-site worker), *the physical object* (cards), and *the projected visual indicator* (projected images) together during at least the first two verification experiments employing methods (a) and (c).
256. Machino II also provides a disclosure of this limitation. As shown below, the bottom left of Machino II Figure 3 shows an on-site worker reaching into the projector’s projection area (the same as the SCOPE camera’s field of view) to manipulate projected images.

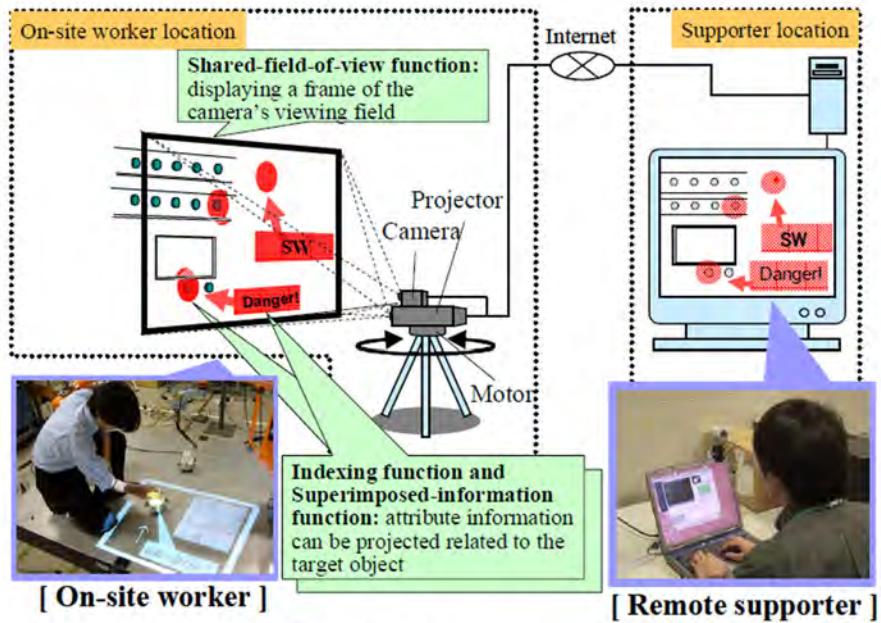


Fig. 3 SCOPE system.

Machino II, Figure 3.

257. Similarly, Machino II Figure 11, provided below, shows the on-site worker reaching inside the camera's viewing field (indicated by the projected frame).

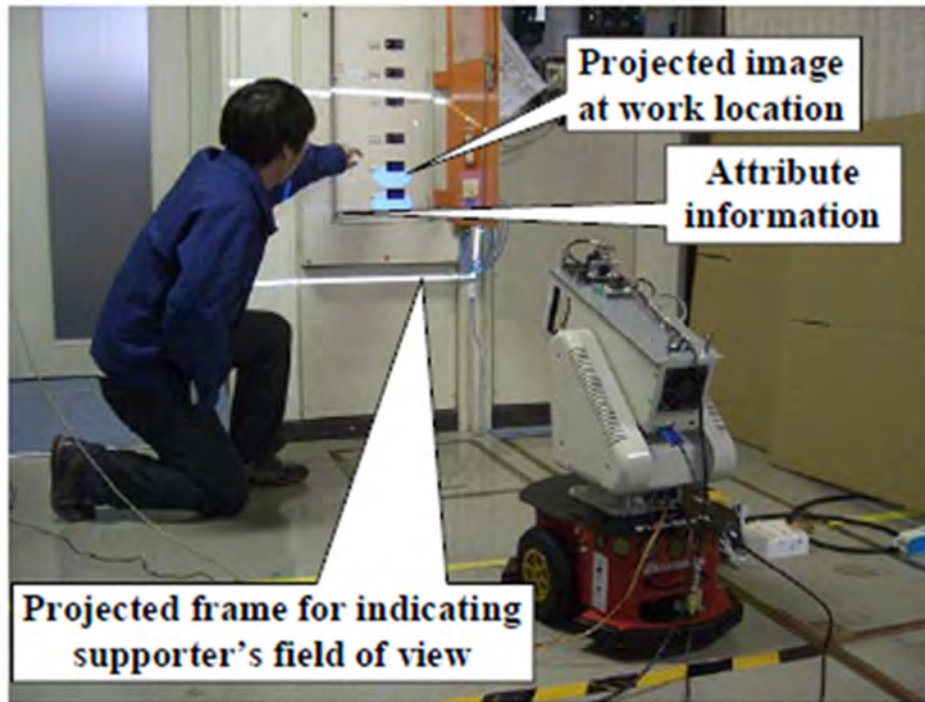


Fig. 11 Mobile SCOPE (on-site location).

Machino II, Fig. 11 – Annotated.

258. In both use cases, the SCOPE camera captures images including *at least the individual being guided, the physical object and the projected visual indicator*.
259. Further, a POSITA would understand that in the natural course of using SCOPE (*i.e.* the use cases contemplated in Machino I and II) would include capturing images that satisfy the claim limitations in element [1.4]. As shown below, by juxtaposing Figure 4 (a remote supporter's screen) and Figure 5 (scenes from the experiment) of Machino I, a POSITA would understand that images captured by the SCOPE camera would include the

worker, the cards, and the projected image when said worker reaches for the cards in the shared field-of-view:



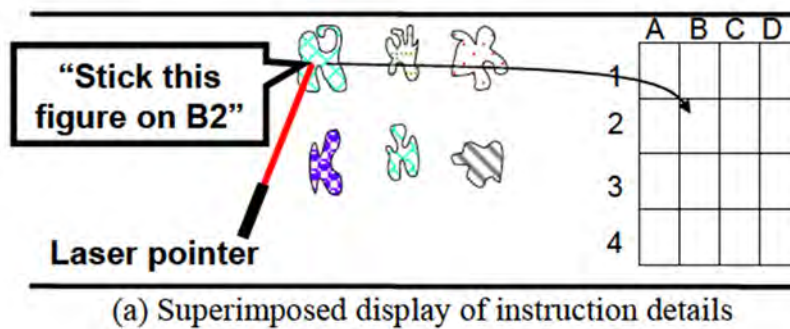
Fig. 4 View of a support screen.



Fig. 5 Scenes of verification experiments.

Machino I, Figs. 4-5.

260. Specifically, at least one of the verification experiments (Experiment 1) requires “the worker [to] transfer[] each cards to a specific position on a four-by-four matrix” following instructions projected onto the cards (*i.e.* “Stick this figure on B2”). This is illustrated in Machino I Fig. 7 below. Therefore, this requires the worker to reach into the projector’s projection area (and thus the camera’s viewing field). [Machino I at 5.]



Machino I, Fig. 7.

261. Similar teachings are shown in Machino II Figure 11 and Figure 12, which are reproduced below in annotated form. A POSITA would understand that, to perform the maintenance operation, the on-site worker would interact with the target objects (*i.e.* the electrical panel including “Lab” and “Server” switches). Such interactions require that some portion of the worker's body enter the projection area.

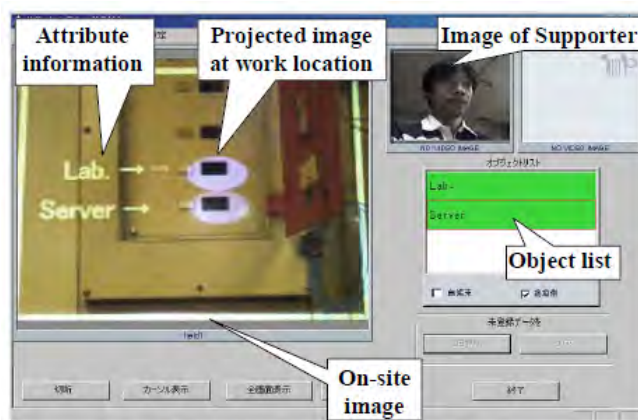


Fig. 12 Screen shot (supporter's location).

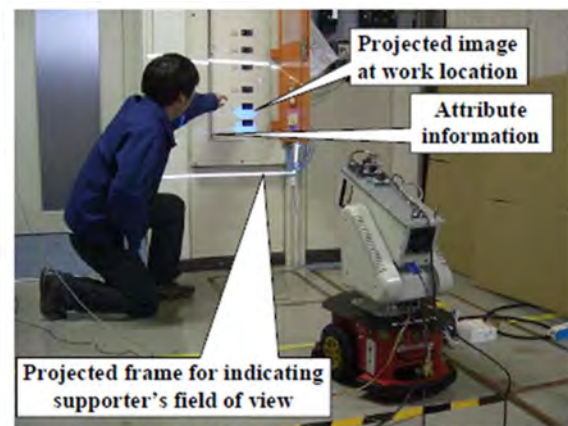


Fig. 11 Mobile SCOPE (on-site location).

Machino II, Figs. 11-12.

[See also Machino II, Figs. 1, 10, 13.]

262. Lastly, it would also have been advantageous—if not unavoidable—for the camera in SCOPE (or mobile SCOPE) to capture *the individual being guided, the physical object, and the projected visual indicators* together. Because the SCOPE systems are remote-collaboration systems designed to enable “an on-site human worker [to be] assisted by another skilled human operator at a remote support center,” [Machino I at Abstract; *see also* Machino II at 1], it would be desirable for the remote support operator to observe actions of the on-site worker and to have *projected visual indicators* in their field-of-view in order to orient themselves and understand what is occurring at the remote site.
263. Accordingly, the combination of Machino I and II discloses or renders obvious claim element 1.4 and render obvious claim 1.

3. Claim 2 Analysis

[2.0]: “The method of claim 1,”

264. As shown above, the combination of Machino I and II renders obvious Claim 1. [See analysis above in Challenge 4 at [1.0] - [1.4].]

[2.1]: “further comprising receiving, by the guide system controller, a sequence of one or more input signals and prompting the directional light device to project the visual indicator for the particular guided operation.”

265. This claim appears to be indefinite (1) due to the lack of antecedent basis for “the guide system controller,” as there is no “guide system controller” in

claim 1; and (2) because a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” would entail. Assuming “the guide system controller” has sufficient antecedent basis and that “a sequence of one or more input signals” refers to one input signal or a sequence of input signals (two or more input signals), the limitation is disclosed by the combination of Machino I and II.

266. Specifically, Machino I discloses a *guide system controller* in the form of the on-site use PC, as shown below in Machino I Figure 3.

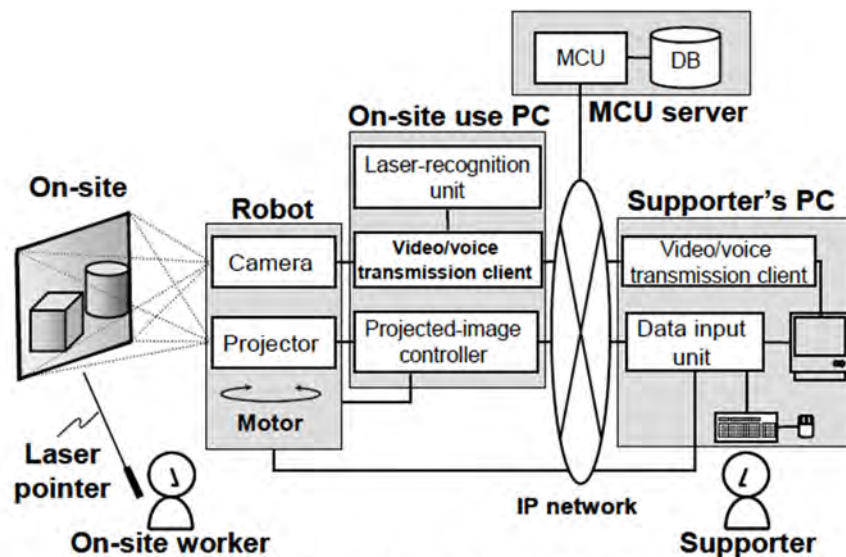


Fig. 3 Schematic configuration of SCOPE system.

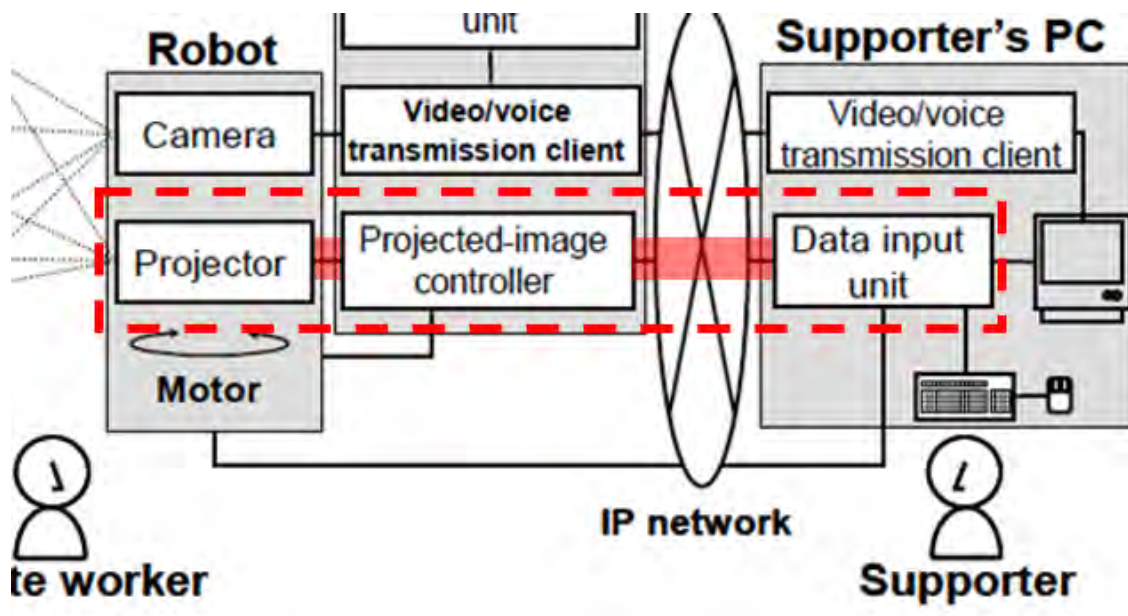
Machino I, Fig. 3.

The on-site use PC is a *guide system controller* because it includes a “projected-image controller” able to control the projector (*directional light device*). Specifically, the projected-image controller is shown above to be

connected to the projector in the SCOPE robot and the IP network (and the data input unit of the remote supporter's PC).

267. Machino I and II further disclose receiving a sequence of one or more input signals at the guide system controller and prompting the directional light device to project the visual indicator for the particular guided operation.

For example, the on-site use PC receives at least one *input signal* from the remote supporter's PC with regards to the objects to be projected. "[In] the SCOPE system, the camera and projector on the on-site worker's location can be manipulated from the supporter's side, and the domains of the viewing field and the information presentation can be changed." [Machino I at 4; *see also* Machino II at 3.] The annotated version of Machino I Figure 3 below illustrates this process.



Machino I, Fig. 3 – Annotated.

268. As shown below in Machino I Figure 4, a remote supporter is able to add/edit objects to be projected and their associated attribute information on their PC. The same objects are then projected on-site using the projector (as shown by the camera feed), which “enables the on-site worker to intuitively recognize the relationship between a stationary object in real space and its attribute information.” [Machino I at 4.]

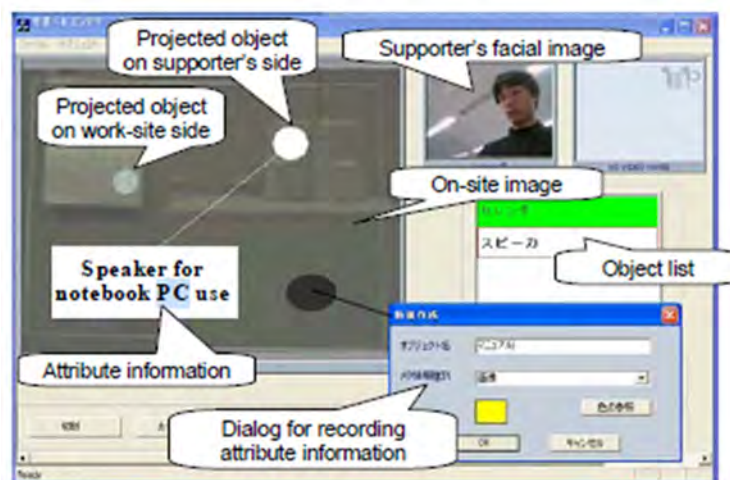


Fig. 4 View of a support screen.

Machino I, Fig. 4.

269. Similarly, Figures 11-12 in Machino II, reproduced below, show a similar process using the mobile SCOPE. Specifically, a remote supporter is able to add/edit objects “Lab” and “Server” on his PC, and the images and attribute information corresponding to the two objects are projected on-site and captured in the on-site camera feed. See Machino II at 3 [(“Information needed for carrying out operations, “attribute information,” is projected onto the target object as the occasion demands. This is like affixing notes on the

target object with light. . . . At the supporter's location, the projected image is shown on a communication screen, which displays images transmitted from the on-site worker's location, and manipulated using the PC's mouse.")]. This projection can be used by the remote supporter to instruct the on-site worker regarding the maintenance operation, such as by pointing out which electric connection corresponds to the "Lab" and the "Server", respectively.

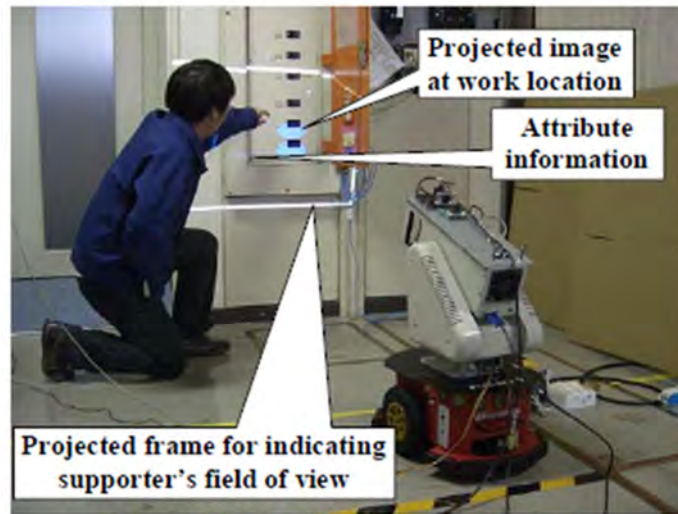


Fig. 11 Mobile SCOPE (on-site location).

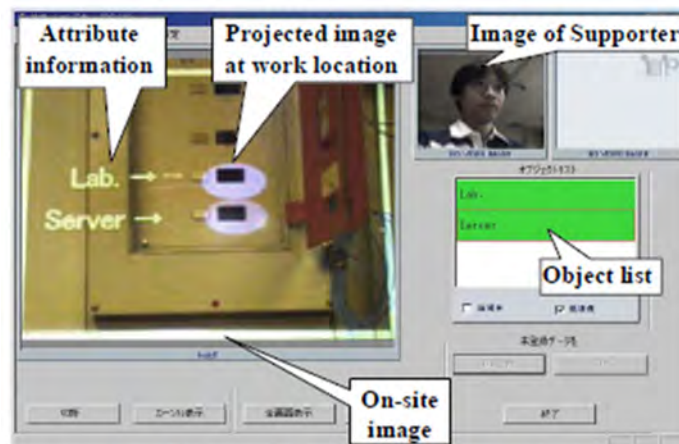


Fig. 12 Screen shot (supporter's location).

Machino II, Figs.11-12.

270. As another example, Machino I discloses allowing a remote supporter to draw with their mouse, and then project such “free-hand” drawings at the on-site location:

By projection of images to the on-site work's [sic] side by moving the mouse of the remote supporter's PC, an action referred to as “pseudo-finger pointing” is performed. The mouse-cursor mode can be selected to show or hide the track of the cursor. Accordingly, by

choosing to show the cursor tracks, it is possible to write simple text and draw signs in real space.

[Machino I at 4.] Here, the *guide system controller* receives *one or more input signals* related to the track taken by the remote supporter's cursor. The projector (*directional light device*) subsequently projects this track at the on-site worker's location, which may resemble text or signs regarding the operation at hand (*visual indicator for the particular guided operation*).

271. Thus, the combination of Machino I and II discloses claim element 2.1 and renders obvious claim 2.

4. Claim 3 Analysis

[3.0]: “The method of claim 2,”

272. As shown above, the combination of Machino I and II discloses and renders obvious claim 2. [See analysis above in Challenge 4 at [2.0] - [2.1].]

[3.1]: “wherein the sequence of one or more input signals are provided by a separate computer system or controller to the guide system controller.”

273. This claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” would entail. Assuming that “a sequence of one or more input signals” refers to one input signal or a sequence of input signals (two or more input signals), the limitation is disclosed by Machino I and II.

274. As discussed above in Challenge 4 at [2.1], the *guide system controller* (on-site use PC) in SCOPE receives *a sequence of one or more input signals* from the supporter's PC. Thus, the input signals are *provided by a separate computer system or controller*, because the on-site use PC and the supporter's PC are separate computers located at different physical locations, as shown below in Machino I Fig. 3.

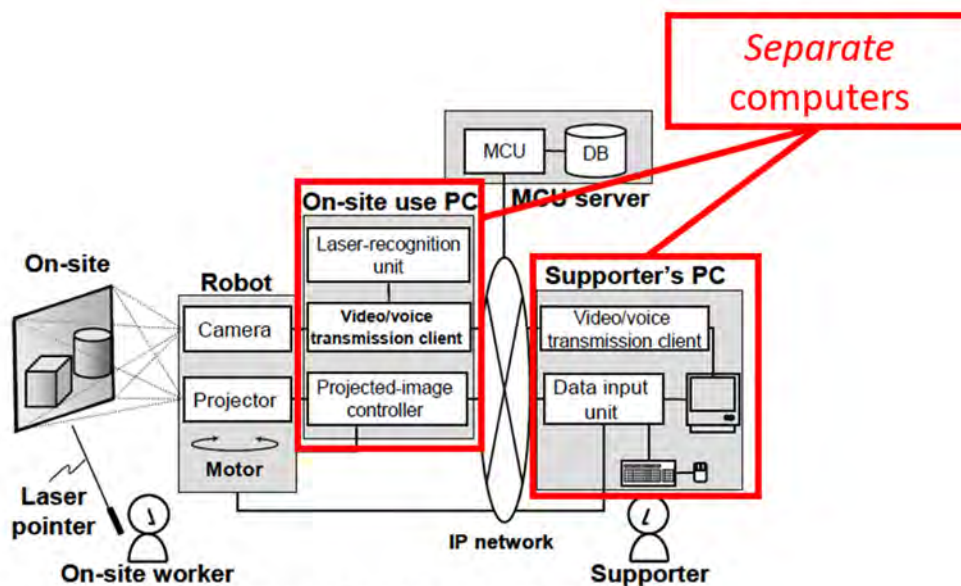


Fig. 3 Schematic configuration of SCOPE system.

Machino I, Fig. 3 (annotated).

275. Accordingly, the combination of Machino I and II discloses claim 3.1 and renders obvious claim 3.

5. Claim 4 Analysis

[4.0]: “The method of claim 1,”

276. As shown above, the combination of Machino I and II discloses and renders obvious claim 1. [See analysis above in Challenge 4 at [1.0] - [1.4].]

[4.1]: “further comprising receiving, by the guide system controller, a sequence of input signals and prompting the directional light device to dynamically project a sequence of visual indicators onto the physical object for the particular guided operation based on the sequence of the input signals.”

277. As with claim 2, there is an apparent lack of antecedent basis for “the guide system controller,” as there is no “guide system controller” in claim 1.

Additionally, a POSITA could not understand with reasonable certainty what “a sequence of one [input signal]” would entail. Assuming “the guide system controller” has sufficient antecedent basis and that “a sequence of one or more input signals” refers to one input signal or a sequence of input signals (two or more input signals), the limitation is disclosed by Machino I and II.

278. As discussed above in Challenge 4 at [2.1], the *guide system controller* (on-site use PC) receives *a sequence of input signals* from the remote supporter’s PC regarding objects to be projected, specifically, the indexing/attribute information received from the remote supporter’s PC. [Machino I at 3.]
Machino I and II further disclose projecting images and attribute information

of said objects (*a sequence of visual indicators*) on target objects at the maintenance site (*physical object for the particular guided operation*). [See analysis above in Challenge 4 at [1.1] and [2.1].] Accordingly, Machino I and II discloses *project[ing] a sequence of visual indicators ... based on the sequence of input signals*. [See, e.g., Machino I, Fig. 4; Machino II, Fig. 12.]

279. Furthermore, because the on-site projections change based on inputs by the remote supporter, the projection is *dynamic*. For example, both Machino I and II discloses *dynamically project[ing] a sequence of visual indicators*, including “graphical image” marking the location of target objects, and attribute information (“information needed for carrying out operations”) of the respective objects. [Machino I at 3-4; *see also* Machino II at 3.] Such projections are made “as occasion demands,” [Machino I at 3], such as in response to (1) the local user’s manipulating projected objects by a laser pointer, and/or (2) the remote supporter manipulating the projected objects using a PC mouse. [See *also* Machino I at 4; Machino II at 3.] For example, Machino I Figure 4, reproduced below, shows a user interface (“communication screen”) showing a remote supporter “manipulating the projected object ... by PC mouse.” The projections are *dynamic* because

they may change in response to *input signals* generated from actions of the on-site worker or remote supporter. [Machino I at 4.]

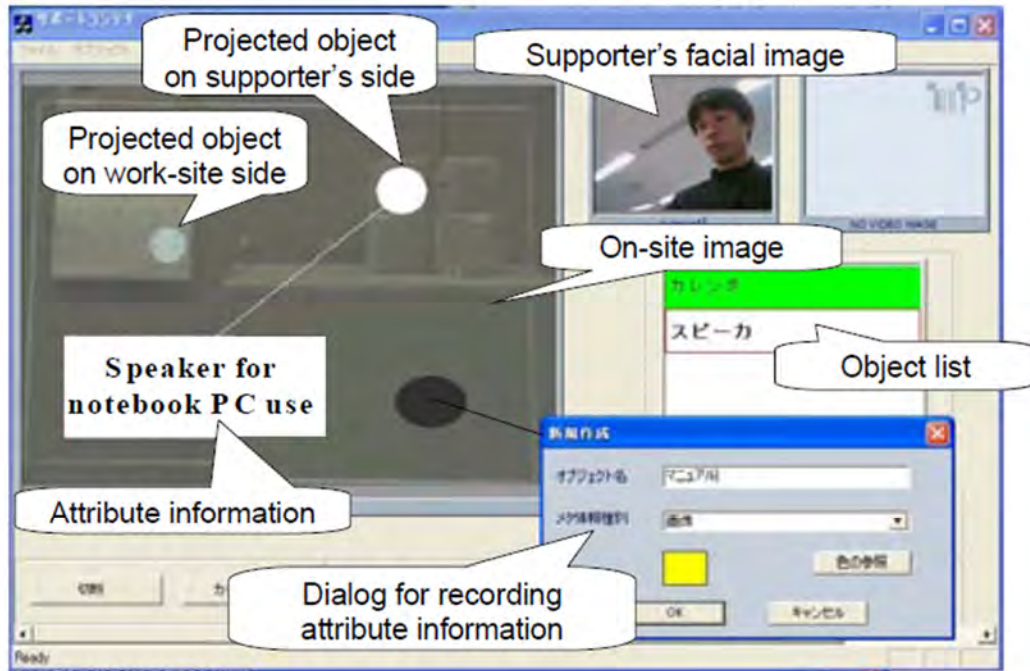


Fig. 4 View of a support screen.

Machino I, Fig. 4.

280. Machino II Figure 3, with its relevant parts reproduced below, provides additional examples of the on-site worker and the remote supporter interacting with the SCOPE system to generate *dynamic* projections:



Machino II, Fig. 3.

Here, the on-site worker is pointing at a projected image with a laser pointer, whereas the remote supporter is using a laptop's keyboard inputs.

281. Machino II Figure 12, reproduced below, shows a user interface that allows a remote supporter to enter and manipulate projected visual indicators in real time, similar to Machino I Figure 4. A POSITA would understand that the disclosures in Machino I and II show that the remote supporter is able to add or remove *visual indicators* (including attribute information “Lab.” “Server” and projected images) using the “Object List” user interface.

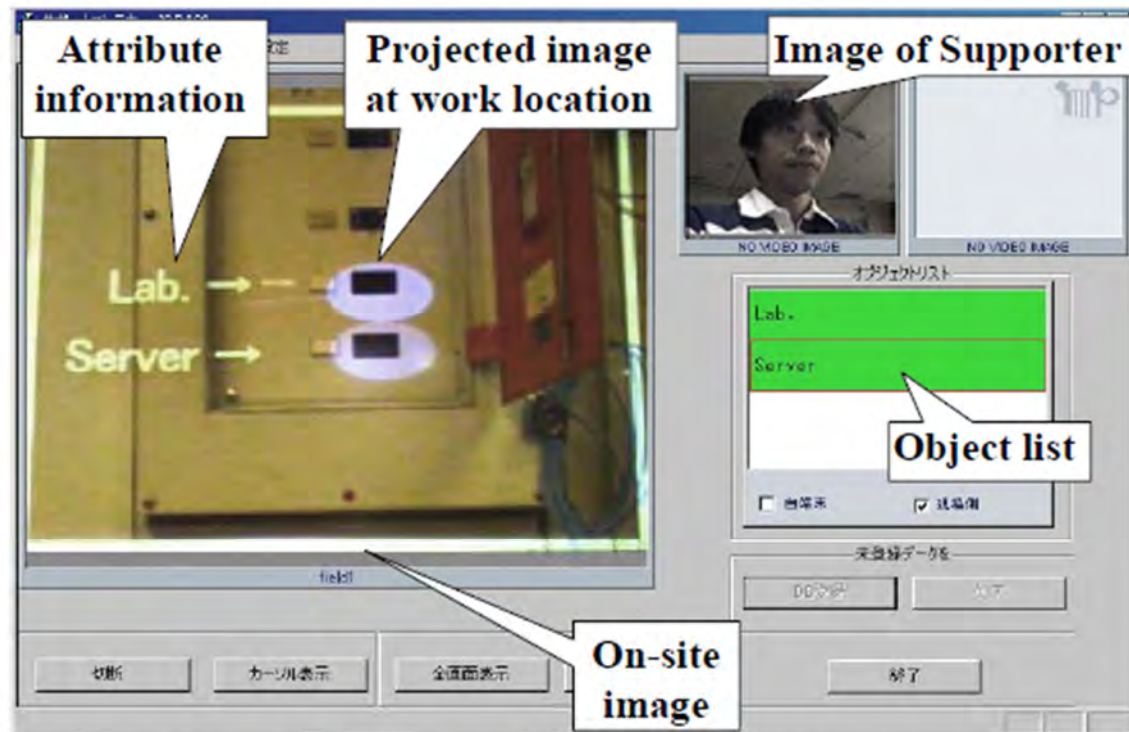


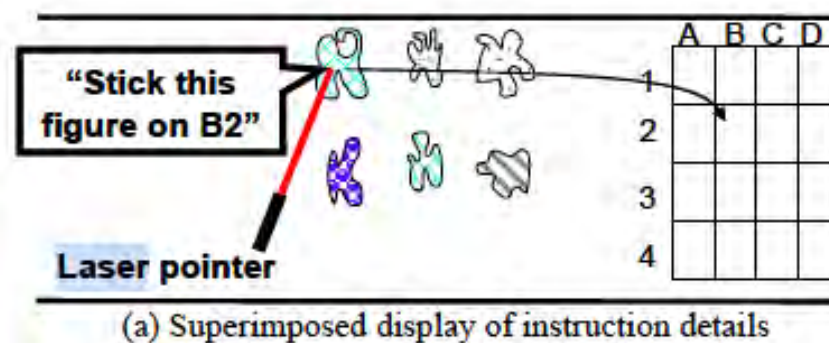
Fig. 12 Screen shot (supporter's location).

Machino II, Fig. 12.

282. As another example, Machino I discloses *dynamically project[ing] a sequence of visual indicators* through its “pseudo finger-pointing” functionality. During pseudo finger-pointing, movement of a remote supporter’s PC mouse is projected in the form of “cursor tracks” at the on-site worker’s location. [See Machino I at 4 (“[B]y choosing to show the cursor tracks, it is possible to write simple text and draw signs in real space. Moving the operation target object in this way is exploited when the operation instructions involve directions.”).] The remote supporter is thus able “to write simple text and draw signs in real space” with this

functionality. [Machino I at 4; *see also id.* (“by displaying the PC mouse cursor, specified points within the shared viewing field can be pointed out.”).] These projections are *dynamic* because they are unscripted and depend on the *input signals* generated by the remote supporter’s actions.

283. As another example, Machino I also discloses verification experiments where a recorded instruction is projected onto a card identified by the on-site worker using a laser pointer. [See Machino I at 5 (“In method (a) ... [w]hen the card is pointed out by laser pointer, the recorded instructions are superimposed onto the card”); *see also* Machino I at 6 (“Cards are selected by laser pointer, and their descriptions (letters and alphabet) are superimposed on them.”).] Accordingly, the projected instruction is *dynamic* because it is based on an on-site worker’s choice. Machino I Figure 7(a), reproduced below, illustrates a scene where the instruction “Stick this figure on B2” is displayed in response to a laser pointer identifying one of the cards.



Machino I, Fig. 7(a).

284. Accordingly, the combination of Machino I and II discloses claim 4.1 and renders obvious claim 4.

6. Claim 5 Analysis

[5.0]: “The method of claim 4,”

285. As shown above, Machino I and II disclose and render obvious claim 4.

[See analysis above in Challenge 4 at [4.0] - [4.1].]

[5.1]: “further comprising receiving, by the guide system controller, a combination of the sequence of the input signals and generation of a dynamic, real-time projection, via the directional light device, of the sequence of said visual indicators.”

286. As discussed above, this claim appears to be indefinite because a POSITA could not understand it with reasonable certainty. See analysis above in Challenge 1 at [5.1]. However, to the extent the meaning of this claim limitation can be interpreted as the guide system controller receiving the sequence of input signals results in a generation of a dynamic, real-time projection of the sequence of said visual indicators via the directional light device, Machino I and II disclose it.

287. Specifically, both Machino I and II disclose the guide system controller receiving *the sequence of input signals* and prompting the directional light device to dynamically project *the sequence of visual indicators*. [See analysis above in Challenge 4 at [4.1].] The projection of said visual

indicators are further *dynamic* and *in real-time*. As discussed above in Challenge 4 at [4.1], Machino I and II disclose manipulating on-site projections based on the remote supporter and/or on-site worker's actions, which are not known in advance (*i.e.* pre-scripted). A POSITA would also understand the projections need to reflect the actions of the individuals relatively quickly for the system to appear responsive. In fact, results from the verification experiments show that the operation time of the on-site worker is reduced when the workers are instructed using projected instructions. [Machino I at 5-6.] Thus, any delay between a user action (e.g. pointing to a card with laser pointer) and a projection reflecting this user action is small enough that this method of instruction results in a net time savings.

288. Further, Machino I discloses a *dynamic, real-time* projection in the form of “pseudo-finger pointing” where a remote supporter's free-hand drawing with a cursor is projected at the on-site location.
289. Accordingly, combination of Machino I and II discloses claim element 5.1 and render obvious claim 5.

7. Claim 6 Analysis

[6.0]: “The method of claim 5,”

290. This claim appears to be indefinite because it depends from invalid claim 5. Nevertheless, Machino I and II disclose and render obvious claim 5. [See analysis above in Challenge 4 at [5.0] - [5.1].]

[6.1]: “wherein the sequence of input signals are provided by a separate computer system or controller to the guide system controller.”

291. Machino I and II disclose this claim limitation. [See analysis above in Challenge 4 at [2.1], [3.1].]
292. Accordingly, Machino I and II disclose claim element 6.1 and render obvious claim 6.

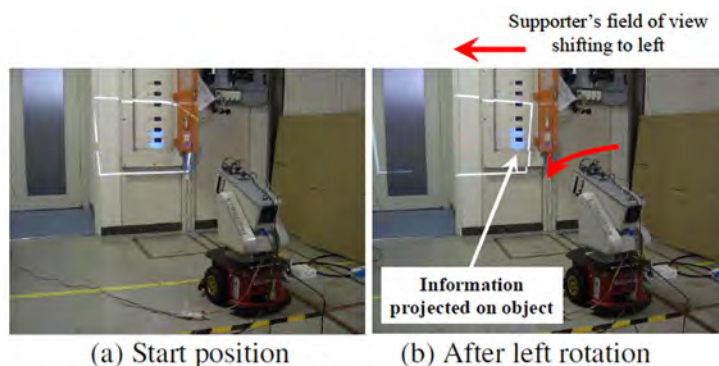
8. Claim 7 Analysis

[7.0]: “A guide system adapted to provide visual indicators to an individual to guide actions of the individual for a particular guided operation, said guide system comprising:”

293. If the preamble is limiting, then Machino I and II disclose it. As discussed above in Challenge 4 at [1.0], Machino I and II discloses the SCOPE and mobile SCOPE systems *adapted to provide visual indicators* (projected images and attribute information of objects) to *an individual* (on-site worker) *to guide actions of the individual for a particular guided operation* (e.g. on-site maintenance operations).

[7.1]: “a directional light device, said directional light device being selectively operable to project and target at least one indicating light;”

294. As discussed above in Challenge 4 at [1.1], Machino I and II discloses a *directional light device* including a projector.
295. Machino I and II further teaches *said directional light device being selectively operable to project and target at least one indicating light* by projecting *visual indicators* with the SCOPE projector. [See analysis above in Challenge 4 at [1.1].] Further, the remote SCOPE system has an “automatic correction” functionality that allows it to *project and target* images consistently onto target objects even if the projector-camera unit moves. As shown below in Machino II Figure 13, the projected images and attribute information remains in the same location on the wall even as the projector-camera unit is rotated to the left and the shared field-of-view (marked by the projected frame) shifts with it.



(a) Start position (b) After left rotation
Fig. 13 Result of automatic correction of projected attribute information.

Machino II, Fig. 13.

296. Thus, the combination of Machino I and II discloses [7.1].

[7.2]: “a guide system controller, said guide system controller being operable to control said directional light device to project a visual indicator with said indicating light onto a physical object associated with the particular guided operation;”

297. As discussed above in Challenge 4 at [2.1], Machino I discloses *a guide system controller operable to control said directional light device* because the on-site use PC (including the “projected-image controller”) controls the projector. Machino I and II also discloses *projecting a visual indicator ... onto a physical object associated with the particular guided operation by projecting images and/or attribute information onto target objects at the on-site location*. [See analysis above in Challenge 4 at [1.1].] The *visual indicator* is further projected by projecting or targeting *an indicating light*. [See analysis above in Challenge 4 at [7.1].]

298. Thus, the combination of Machino I and II discloses [7.2].

[7.3]: “a camera located proximate to said directional light device and configured to capture an image of at least the individual, the physical object and said visual indicator when said visual indicator is projected onto the physical object;”

299. As discussed above in Challenge 4 at [1.2], Machino I and II disclose *a camera located proximate to said directional light device* (projector). Machino I and II further render obvious that said camera is *configured to capture an image of at least the individual, the physical object and said*

visual indicator when said visual indicator is projected onto the physical object. [See analysis above in Challenge 4 at [1.4].] Thus, the combination of Machino I and II discloses or renders obvious [7.3].

[7.4]: “a monitor, said monitor being remote from said directional light device and said guide system controller, with said monitor being operably interfaced with said camera to display the image captured by said camera.”

300. Machino I and II disclose a *monitor being remote from said directional light device and said guide system controller*. Specifically, the monitor for the remote supporter’s PC is located “at a remote support center” away from the on-site use PC and the projector. [Machino I at Abstract; Machino II at 1; *see also* Machino I, Fig. 3; *see also* analysis above in Challenge 4 at [1.3].] Said remote monitor further *operably interfaces with said camera to display the image captured by said camera*. [See analysis above in Challenge 4 at [1.3]; *see also* Machino I, Fig. 3 (showing hardware and network connection between camera and remote monitor), Fig. 4 (remote monitor displaying on-site camera images); Machino II, Fig. 12 (same).]
301. Thus, the combination of Machino I and II discloses [7.4] and renders obvious claim 7.

9. Claim 8 Analysis

[8.0]: “The system of claim 7,”

302. As shown above, the combination of Machino I and II discloses claim 7.

[See analysis above in Challenge 4 at [7.0] - [7.4].]

[8.1]: “wherein said guide system controller is configured to receive a sequence of one or more input signals causing said directional light device to project said visual indicator for the particular guided operation.”

303. As discussed above, this claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a sequence of one

[input signal]” may entail. [See analysis above in Challenge 4 at [2.1].]

Nevertheless, assuming this claim limitation is not indefinite, it is also disclosed by Machino I and II. [See analysis above in Challenge 4 at [2.1].]

304. Accordingly, the combination of Machino I and II discloses [8.1] and renders obvious claim 8.

10. Claim 9 Analysis

[9.0]: “The system of claim 8,”

305. This claim appears to be indefinite because it depends from invalid claim 8.

Nevertheless, the combination of Machino I and II discloses claim 8. [See analysis above in Challenge 4 at [8.0] - [8.1].]

[9.1]: “further including a separate computer system or controller and wherein said separate computer system of controller is configured to provide the sequence of one or more input signals to said guide system controller.”

306. Machino I and II disclose this claim limitation. [See analysis above in Challenge 4 at [3.1].]

307. Accordingly, the combination of Machino I and II discloses claim element 9.1 and renders obvious claim 9.

11. Claim 10 Analysis

[10.0]: “The system of claim 7,”

308. As shown above, the combination of Machino I and II discloses claim 7.

[See analysis above in Challenge 4 at [7.0] - [7.4].]

[10.1]: “wherein said guide system controller is configured to receive a sequence of input signals and to cause said directional light device to dynamically project a sequence of visual indicators onto the physical object for the particular guided operation based on the sequence of the input signals.”

309. Machino I and II discloses this claim limitation. [See analysis above in Challenge 4 at [4.1].]

310. Accordingly, the combination of Machino I and II discloses claim element 10.1 and renders obvious claim 10.

12. Claim 11 Analysis

[11.0]: “The system of claim 10,”

311. As shown above, the combination of Machino I and II discloses claim 10.

[See analysis above in Challenge 4 at [10.0] - [10.1].]

[11.1]: “wherein a combination of the sequence of the input signals results in a generation of a dynamic, real-time projection of the sequence of said visual indicators.”

312. This claim appears to be indefinite because a POSITA could not understand with reasonable certainty what “a combination of the sequence of input signals” would entail. Assuming that “a combination of the sequence of input signals” refers to two or more input signals, the limitation is disclosed by the combination of Machino I and II.

313. Machino I and II discloses *a combination of the sequence of the input signals results in a generation of a dynamic, real-time projection of the sequence of said visual indicators*. Specifically, both Machino I and II disclose the guide system controller receiving *the sequence of input signals* and prompting the directional light device to dynamically project *the sequence of visual indicators*. [See analysis above in Challenge 4 at [4.1].] The projection of said visual indicators are further *dynamic* and *in real-time*. As discussed above in Challenge 4 at [4.1], Machino I and II disclose manipulating on-site projections based on the remote supporter and/or on-

site worker's actions, which are not known in advance (*i.e.* pre-scripted). A POSITA would also understand the projections need to reflect the actions of the individuals relatively quickly for the system to appear responsive. In fact, results from the verification experiments show that the operation time of the on-site worker is reduced when the workers are instructed using projected instructions. [Machino I at 5-6.] Thus, any delay between a user action (e.g. pointing to a card with laser pointer) and a projection reflecting this user action is small enough that this method of instruction results in a net time savings.

314. Further, Machino I discloses a *dynamic, real-time* projection in the form of “pseudo-finger pointing” where a remote supporter’s free-hand drawing with a cursor is projected at the on-site location.

By projection of images to the on-site work’s [sic] side by moving the mouse of the remote supporter’s PC, an action referred to as “pseudo-finger pointing” is performed. The mouse-cursor mode can be selected to show or hide the track of the cursor. Accordingly, by choosing to show the cursor tracks, it is possible to write simple text and draw signs in real space.

[Machino I at 4.]

315. Accordingly, the combination of Machino I and II discloses claim element 11.1 and anticipates claim 11.

13. Claim 12 Analysis

[12.0]: “The system of claim 11,”

316. As discussed above, the combination of Machino I and II discloses claim 11.

[See analysis above in Challenge 4 at [11.0]-[11.1].]

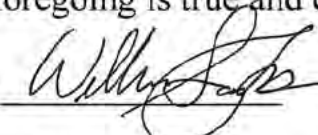
[12.1]: “further including a separate computer system or controller and wherein said separate computer system or controller is configured to provide the sequence of input signals to said guide system controller.”

317. Machino I and II disclose this claim limitation. [See analysis above in Challenge 4 at [6.1].]

318. Accordingly, the combination of Machino I and II discloses claim element 12.1 and renders obvious claim 12.

319. I declare under penalty of perjury that the foregoing is true and correct.

Date: September 11, 2023

By: 

William Singhose

* * *

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