UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SONY CORPORATION
Petitioner

v.

YISSUM RESEARCH DEVELOPMENT COMPANY
OF THE HEBREW UNIVERSITY OF JERUSALEM
Patent Owner

Cases IPR2013-00218 (Patent 6,665,003 B1)
IPR2013-00219 (Patent 7,477,284 B2)

Deposition of

TREVOR J. DARRELL, Ph.D.

Wednesday, November 6, 2013

REPORTED BY:

JOHN WISSENBACH,

RDR, CRR, CBC, CCP,

CLR, CSR 6862

FILE NO. 13-16497

BE IT REMEMBERED that, pursuant to the laws governing the taking and use of depositions, on Wednesday, November 6, 2013, commencing at 10:31 a.m. thereof, at the law offices of Tensegrity Law Group LLP, 555 Twin Dolphin Drive, Suite 360, Redwood Shores, California, before me, JOHN WISSENBACH, CSR 6862, personally appeared TREVOR J. DARRELL, Ph.D., called as a witness by the Petitioner, who, being by me first duly sworn, was thereupon cross-examined by the Patent Owner as a witness in said action.

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INDEX OF EXAMINATIONS

EXHIBITS

PRIOR EXHIBITS REFERENCED

Sony-1003

Sony-2004

Sony-1006

Sony-1010

Sony-1013

Sony-1040

Sony-1113

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MR. NELSON: I guess we need to enter appearances. My name is William Nelson. I'm here on behalf of the patent owner, Yissum Research Development Corporation and HumanEyes Technologies. With me is Gregory Huh and Irfan Essa.

MR. HANLEY: I'm Walter Hanley, representing the petitioner, Sony Corporation. With me is Michael Sander. We are both from Kenyon & Kenyon.

CROSS-EXAMINATION BY MR. NELSON

Q. Okay. Professor Darrell, are you ready to proceed here today?

A. Yes.

Q. Very good. Have you had your deposition taken before?

A. Yes.

Q. How many times, as an expert, sir?

A. Four or five or six. I can't remember the number. Maybe once in this building already.

Q. How many times have you had your deposition taken as an expert in a patent case?

A. As I said, around a half dozen.

Q. Would you list the matters in which you've served as an expert and had your deposition taken.

A. I've provided that to the counsel who I'm working with. I don't -- I don't have it by memory.

MR. NELSON: Counsel, has that been provided to us?

MR. HANLEY: I'm not sure I've seen it, actually.

THE WITNESS: Well, then I would not --

MR. HANLEY: So if -- and when you say "counsel" -- do you mind if I ask him?

MR. NELSON: No.

MR. HANLEY: To whom are you referring?

THE WITNESS: The counsel who is sitting to my left.

MR. HANLEY: Okay. So --

THE WITNESS: Not to my --

MR. HANLEY: I will look into that. I don't -- I've seen his CV. I don't recall his CV listing the cases in which he's testified. So if it's not on the CV, then we'll have to look into --

MR. NELSON: Okay.

MR. HANLEY: -- where that information can be --

MR. NELSON: Well --

MR. HANLEY: -- put together.

THE WITNESS: I have a document I can provide if you'd like.

BY MR. NELSON:

Q. Rather than --

A. I can try and recite them by memory if you'd like.

Q. Please.

A. How far back do you want me to go?

Q. Oh, since 2008.

A. 2008? So I worked as a -- it was a fact witness for a matter involving Microsoft, and I think it was called Impulse, regarding to technology from Alive, the Alive system. And I'm currently retained as an expert in a matter in London by the firm called Bristows. And that involves Philips and Nintendo on a -- and I'm an expert in a case in their judiciary about infringement of one of Philips' patents.

I worked with Quinn, in this building, on the Samsung-Apple fun stuff, as you, I'm sure, are aware of. And my patent was dropped from the case before it went to trial, but -- and I was driving down here to do a deposition when I was informed of that. So I didn't get to participate in that -- that trial.

Then -- yeah, I can't -- it's hard for me to remember. One of the first ones I ever did was for a company called Cytyc, involving imaging systems for cytology screening, that I was deposed and went to a mock trial. I also did one for Quinn in San Francisco

involving Bally Gaming, for imaging systems in gaming tables in Los Vegas. And that's just what's coming off the top of my head, so -- I sort of --

Q. Thank you.

A. Yeah.

Q. With respect to your service as an expert in patent infringement or patent matters, how many of those engagements have you served as an expert on behalf of the patent holder?

A. About three. Well, served as an expert? Have I worked for the patent holder? Around three of them, including the current one with Philips.

MR. NELSON: Before we move on, I forgot the one thing I said I was going to do, which is that I wanted to note with Mr. Hanley and Mr. Sander on the record that -- we'll talk about the implementation details perhaps after the deposition, but that the intent of this deposition is to serve as a single deposition for the 218 and 219 matters, rather than having two distinct depositions of Professor Darrell as to these issues at this time.

MR. HANLEY: We agree with that.

MR. NELSON: Thank you.

Q. Professor Darrell, have you ever created images for stereoscopic viewing?

A. Certainly.

Q. How many times?

A. I can't count. I can't remember.

Q. More than you can count?

A. Yes.

Q. When was the last time you created an image for stereoscopic viewing?

A. That's a good question. So as a professor, I don't personally do the research, but often I direct the research, so images would have been created, in my supervision, of course. We use stereo -- we -- we, including myself and the collaborators in my research projects, have used stereo cameras in a number of research projects over the years, most notably those which involve the perception and tracking of objects and people. And the -- those systems would collect stereo images, and we would often view them to verify their nature.

Q. So I appreciate your answer, but my question is, when was the last time you did this?

A. I don't recall the specific date.

Q. Have you ever created a left-eye and right-eye image for stereoscopic viewing by taking portions of images and mosaicing them together?

A. I don't have a specific recollection of that.

Most of the stereo images that I've been -- that I've created or were used in my work came from specific stereo camera rigs that collected images that were meant for display and processing.

Q. I just want to make sure I understand your answer. When you say you don't have a specific recollection of that, do you have any recollection of ever creating left and right-eye images for stereoscopic viewing by taking portions of images and mosaicing them together?

A. I believe I just answered that question. I said I don't have a specific recollection. That means I don't have a recollection.

Q. Now you've answered my question. Thank you.

A. Is there a difference?

Q. Yes.

Have you ever created a panoramic image for stereo viewing?

A. That would roughly be the same thing that you just asked, as well. So I do not have a specific recollection of that.

Q. Again, my problem is with your word "specific recollection." If you don't recall ever doing it, I'd like to get that answer.

A. I don't -- it's a natural thing to have done.

I don't recall personally having done it.

Q. Thank you. When were you first engaged by counsel as an expert in connection with the -- with Sony's inter partes reexamination petition?

A. I don't recall the date.

Q. Do you recall the time frame generally?

A. No. I mean, they -- I've -- I was speaking with these counsel prior to that as well. So I don't remember exactly when that event happened.

Q. You were engaged by counsel for Sony in connection with a matter before the International Trade Commission; is that correct?

A. Yes.

Q. How many hours have you spent working on your declaration or any other role in connection with Sony's IPR petitions?

A. I don't recall a specific number. It's on the order of several dozen.

Q. Several dozen hours?

A. Uh-huh.

Q. What's your hourly fee?

A. $400.

Should I increase it?

(Discussion off the record.)

THE WITNESS: $400. And I was making an

irrelevant comment, asking if I should increase it.

BY MR. NELSON:

Q. We'll see.

A. One never knows what the going rate is.

Q. Have you billed Sony yet for your work in connection with this IPR?

A. I believe --

Q. Or these IPRs?

A. I believe I have.

And you've paid.

But, again, I only have a sporadic recognition. I have several clients.

Q. Do you know the amount that you billed Sony for your work on this petition?

A. I don't recall. It was -- I think it was around $5,000. That's my guess. Maybe more. But I haven't billed for all the time that I've put in.

Q. You're being paid for your testimony today?

A. My time, yes. I don't believe I'm being paid for my testimony.

Q. What were you asked by counsel to do in connection with the IPR petitions?

A. I don't remember.

You mean originally, when they first started -- they've asked me to provide declarations or reports. I

can't remember what they're specifically called, but have certain statements. And they asked me to review certain documents that they provided to me and discuss with them various points of those documents.

Q. Have you ever reviewed source code associated with any product or technology produced by HumanEyes Technologies?

MR. HANLEY: Objection.

THE WITNESS: No.

MR. HANLEY: Irrelevant.

THE WITNESS: Not to my knowledge.

BY MR. NELSON:

Q. Have you ever reviewed any document produced in litigation by HumanEyes Technologies in connection with your work for Sony?

MR. HANLEY: Objection; irrelevant.

THE WITNESS: Unless they've provided it -- only if they've provided it to me. I have no idea what those documents would be.

BY MR. NELSON:

Q. Do you have any recollection of being provided with any document produced in litigation by HumanEyes Technologies in connection with your work for Sony?

MR. HANLEY: Same objection.

THE WITNESS: I -- how would I know if it

had -- what such documents would be? I mean, I know it's -- I've never been told I have been, and it's never been -- there's never been markings to that effect on a document that I've seen.

BY MR. NELSON:

Q. I understand that you've provided several declarations in connection with these petitions. Is that right?

A. Yes.

Q. In forming the opinions expressed in those declarations, what materials did you rely upon?

A. I relied on various documents that the counsel sitting to my left provided to me, including the patents that are at issue and various pieces of prior art that are discussed in my report. Or is it a report or a declaration? I can't remember. Can I refer to it as my report?

Q. That's up to you.

A. Okay. The document.

Q. Is it your understanding that all of the written material which you relied upon for your declarations is listed in those declarations?

A. Yes.

Q. Apart from counsel, did you meet with or speak with any person in connection with your investigation of

the issues discussed in your declarations?

A. No.

Q. You didn't meet with Hiroshi Ishiguro?

A. No, not if you -- not in conjunction with the statements in my declaration.

Q. Have you ever met with Hiroshi Ishiguro?

A. I may have. I don't recall.

Q. To use your words, do you have a specific recollection of meeting with Hiroshi Ishiguro?

A. I mean, I've been to Osaka University, and I probably met him when I went there, so -- I don't remember exactly which ones -- who I met at that time.

Q. Have you ever spoken with Masashi Yamamoto?

A. Again, these are all professionals who go to all of the annual conferences. And so I don't have a specific recollection, but I would have generally interacted with them professionally over the years. But I certainly have never spoken specifically about these patents or these papers with them.

Q. How about Saburo Tsuji, T-S-U-J-I?

A. Same answer.

Q. With respect to Kawakita, have you ever met with Yasuhiro Kawakita?

A. I'm not familiar -- I don't think I know him. And I don't think I've ever met him.

Q. Yoshitaka Hamaguchi?
A. Same answer.
Q. Toshihiko Miyazaki?
A. Same answer.
Q. Were any of the opinions stated in any of your declarations in these petitions opinions that were provided you by counsel?
A. No, they're my opinions.
Q. In connection with forming the opinions stated in your declarations, did you review or were you shown anything which contradicted your stated opinions?
A. Could you repeat that question?
Q. Sure. In connection with the analysis that you undertook to form the opinions stated in your declarations, did you review or were you shown anything which you regarded as contradicting --
A. No.
Q. -- your stated opinions?
A. No.
Q. Were there any opinions that you provided to your counsel that were not included in your declarations?
A. I've certainly talked about a lot of things about a lot of topics with counsel and -- so not everything I've said to counsel is written in those

declarations. But there were no specific opinions that were directly relevant to the formal opinions in those declarations that differed, in my opinion, as I see it.

Q. Were there any opinions that you were asked by counsel to give but refused to give?

A. No.

When you say opinions -- I mean, I -- I was never asked to give an opinion, in the sense they never said, "Could you say this." You mean asked -- yeah, I'm not sure if I totally understand your question. But I never refused to say anything or refused to put something, you know --

Q. Well, I think we're there, but let me try a different way of asking the question.

A. Sure.

Q. Was there any conclusion or statement you were asked to offer by counsel but you refused to do so?

A. No. But I would never accept counsel telling me what to say anyway, so --

Q. I didn't ask about telling you to say. I asked you about being asked to support a conclusion.

A. Yes, no. The answer to your question is no.

Q. Okay.

A. But it also would reflect the wrong way of doing the -- of having opinions, in my view.

Q. With respect to the opinions stated in your declarations here, did you perform any experimentation to confirm your conclusions?

A. No.

Q. You relied, then, on your analysis of the written materials that are listed in your declaration?

A. Yes.

Q. I'm just going to pull out the various declarations so that we have them in front of us.

Why don't I get them all together, and then I'll hand them over to you.

I am handing you and your counsel here what has previously been marked by Sony in these matters as Sony Exhibit 1010, Sony Exhibit 1113, Sony Exhibit 1013, Sony Exhibit 1040. And at this point, Professor Darrell, I'm not going to dive in yet. I would just like you to confirm that you know what those documents are.

A. Yes.

Q. And I've got some questions for you about them there. Do you know what those documents are?

A. Yes.

Q. What are they?

A. They're my expert declarations that were provided in this matter.

Q. Apart from these four documents, are you aware

of any other declaration that you've offered in connection with these petitions?

A. Before the patent trial board? No. However -- yeah, no.

Q. So looking at Exhibit Sony-1010 -- do you have it in front of you?

A. I do.

Q. This is your March 28 or your original declaration in connection with the '003 patent petition?

A. Is that a question?

Q. Do you think it's a question?

A. No.

Q. Is it?

A. Yes.

Q. Are you okay?

A. I just go a little --

Q. I can get you some water.

A. I actually have a little bit. I'm a little cold. If that AC can be turned off, that might be nice. But not too much.

Q. In connection with this declaration, it states that you reviewed the patent, in paragraph 6; is that correct?

A. Yes.

Q. It also states that you reviewed a "Certified

English Translation of VRSJ Research Report." Do you see that?

A. Yes.

Q. This is -- will you agree with me that we can for this deposition call that certified English translation the Kawakita reference or the Kawakita article?

A. Yes.

Q. Okay. And you'll know what I'm talking about when I say that?

A. Yes.

Q. It also says in paragraph 9(b) that you reviewed an article titled "Acquiring Omnidirectional Range Information," by Ishiguro, et al. Is that correct?

A. Yes.

Q. Can I call that, for this deposition, Ishiguro, or the Ishiguro reference, and you'll know that we're talking about this article?

A. Yes.

Q. Okay. So just to confirm, there's nothing else here in this declaration that you state that you reviewed or analyzed or did to generate the conclusions or opinions stated here; is that correct?

A. Correct.

Q. And not only is -- is that what you state, that's the truth. You didn't look at anything else?

A. Not to make the conclusions in this document.

Q. Let's look at Sony Exhibit --

A. Let me -- I just want to amend that by saying, for example, there are other versions of that Ishiguro paper, like the one at the ICCV conference that I reviewed. But it's not necessary to support the conclusion of this document.

Q. Well, did you rely on that other version --

A. Not in this document.

Q. -- of -- I apologize for pausing, but this record's going to get messed up if you cut me off each time. So give me a minute to finish. Thank you. All right.

Did you rely on that other version of Ishiguro or any other article or writing not disclosed in this declaration in forming the opinions stated in this declaration?

A. No.

Q. Thank you. Let's look at Exhibit Sony 1113.

Actually, let's -- let's step back. I apologize. I'd like to go back to 1010.

With respect to Kawakita, what was your assignment by counsel for this declaration.

A. I'm not sure what "assignment" means here.

Q. What were you asked to do?

A. I was asked to review these documents and review the patent and make statements about the content of some of the prior art, the -- some of the content of Kawakita and Ishiguro.

Q. At any time during your analysis that led to this declaration, did your assignment change?

A. I mean, we would -- did it change?

Over the months of having conversations with the counsel sitting to my left, they asked me various questions about various documents. So I never -- I never felt that I had a formal assignment. With regard to this declaration, this is all they asked me to do.

Q. With respect to Kawakita, did counsel ask you to state the opinion that "Kawakita discloses a technique to generate" stereo -- "stereoscopic panoramic images by excising slit images from images captured by a rotating camera and mosaicing the respective slit images together"?

A. Could you repeat the question?

Q. Sure. With respect to Kawakita, did counsel ask you to state the opinion that "Kawakita discloses a technique to generate stereoscopic panoramic images by excising slit images from images captured by a rotating

camera and mosaicing the respective slit images together"?

A. So I was not given the specific instruction to make a specific statement. I was not asked to state a specific conclusion. I was asked to describe my opinion on what Kawakita disclosed. And I then made that statement.

Did I answer your question?

Q. Yes, sir.

Were you asked to render an opinion on whether Kawakita discloses each element of any claim of the '003 patent?

A. No.

Q. And same question with respect to Ishiguro. Were you asked to render an opinion on whether Ishiguro discloses each element of any claim of the '003 patent?

A. No.

Q. Thanks for your patience.

Let's look at the -- Sony-1113. You agree with me that is your second declaration in connection with the '003 patent, dated June 27th, 2013?

A. Yes.

Q. Do you agree with me that you don't state any opinion about any prior art reference in this declaration?

A. Yes.

Q. Was there any -- with respect to this declaration, was there any opinion you were asked to offer but did not?

A. No.

Q. Let's take a look at Sony-1013. Let me know when you're there.

A. I have it in front of me.

Q. Do you agree with me that this is your first declaration in connection with the IPR petition related to the '284 patent?

A. Yes.

Q. Paragraph 6 of this declaration, Sony-1013, states that you reviewed the '284 patent; you -- as well as the '003 patent. Is that what you did?

A. Yes.

Q. Okay. Paragraph 9(a) states that you reviewed Kawakita, correct?

A. Yes.

Q. Paragraph 9(b) states that you reviewed the Ishiguro reference?

A. Yes.

Q. In connection with the opinions about Kawakita stated in paragraph 10, did you review any other document or did you rely on any other document other

than what we've just discussed?

A. No.

Q. In connection with your opinion about Ishiguro at paragraph 11, apart from Ishiguro, as well as the patents, did you rely on any other document in generating the opinions stated in paragraph 11?

A. No specific document. I referred to common sense, however.

Q. In connection with Sony-1013, with respect to Kawakita and Ishiguro only -- I don't intend to ask you about the other parts of -- of this declaration today -- what was your assignment?

A. I'm not sure what "assignment" means here. Can you be more specific?

Q. What were you asked to do?

A. I was asked to make a declaration that described the content of Kawakita and Ishiguro regarding the generation of stereoscopic panoramic images.

Q. In the course of your analysis that led you to express the opinions stated in paragraphs 10 and 11 of Sony-1013, were there any changes or modifications to what you were asked to do?

A. No.

Q. Any opinions that you were asked to give but refused to give?

A. No.

Q. Let's look at Sony-1040. Do you agree with me that this is your second declaration in connection with the IPR petitions concerning the '284 patent?

A. Yes.

Q. Why did you do a different declaration?

A. I was asked to do so. And I don't recall the reason the counsel sitting to my left desired it.

Q. For your opinions expressed in paragraph 10, letters (a) through (e), regarding Kawakita, did you rely on any information in forming those opinions other than your past as an expert, your reading of Kawakita, and your reading of the patents?

A. Only the items listed in paragraph 9.

Q. For your opinions expressed regarding Ishiguro in paragraph 11, did you rely on anything other than what's stated in paragraph 9(b) and 6?

A. 9(b) and 6? Sorry.

No, I did not. I only relied on those.

Q. By the way, Professor Darrell, we didn't talk about it, but I know you've had enough depositions to know that if you ever decide you need a break or need to stop, or you've gone on for a while, just let me know, and I'm happy to take a pause.

A. Thank you.

Q. So just so that I understand your testimony before we move on, with these four different declarations in front of you, your earlier testimony was that you estimated the amount of time that you spent in your work to prepare these declarations was in the possibly dozens of hours; is that right?

A. Several dozens.

Q. Several dozens of hours.

Professor Darrell, what is a stereoscopic image?

A. "Stereoscopic image" is a broad term but most naturally would be defined as a pair of images that view a scene from multiple -- that view a scene from two different viewpoints, although you can have generalizations of that concept that have more than two views.

Q. So just so I understand, your testimony that -- is that a stereoscopic image has as its most natural meaning a pair of images that view a scene from two different viewpoints?

A. Yes.

Q. Do I have that right?

A. Yes.

Q. Is there anything else that you'd add to that natural or most natural definition?

A. No.

Q. Now, you did say it was a broad term. Are there other meanings that you believe, as an expert, could be ascribed to the term "stereoscopic image"?

A. You can have multiview stereo, where you have more than two, and the like.

Q. Anything else that comes to mind?

A. Not that's relevant right now.

Q. Humor me. Anything that might not be relevant in the judgment of Professor Darrell but that nonetheless --

A. Not right now.

Q. In view of your definition of a stereoscopic image, is -- my next question was going to be, do you have an understanding or -- of the term "stereoscopic image pair." And is it -- based on that definition that you've given, do you think they're one and the same, a stereoscopic image and a stereoscopic image pair are the same thing?

A. Generally, yes.

Q. What's your reaction, as an expert, to this definition?

A stereoscopic image pair is "two images...of a scene recorded from slightly displaced positions, which, when viewed simultaneously by the respective eyes,

provides a perception of depth."

A. It seems reasonable, although maybe not completely limiting. One could have stereo with wider baselines, for example.

Q. What do you mean by that?

A. You -- I think -- I don't remember exactly what you said, but you were referring to a very small displacement between the cameras, or some language like that. So that doesn't seem a requirement for stereo, but it is often the case.

Q. So you reject that part of my definition that recites "two images...of a scene recorded from slightly displaced positions"?

A. It may not be a completely precise term. There's some elasticity in this definition. I'm just trying to give a sense of that.

Could you repeat the definition again for me?

Q. Sure. "Two images...of a scene recorded from slightly displaced positions, which, when viewed simultaneously by the respective eyes, provides a perception of depth."

A. This is also, obviously, referring to stereo pairs being viewed by a human, which I think is an issue being -- that's in discussion, as I've understood it. And I think that it's also possible to have stereo

images that are viewed by algorithms or machine vision as well. But I -- but for the purposes of this discussion, I'm happy with either definition for the legal definition. For the academic definition, it could be any pair of images that views a scene, that is taken of a scene.

Q. So I just want to make sure I understand. In your view as an expert within your field, the concept of a stereoscopic image pair includes not only human vision but stereo images, as you say, that are viewed by algorithms or machine vision as well?

A. It could. As I said, it's a very broad term, and if -- if I was having a discussion with a fellow colleague at -- at a conference, it could have either meaning.

Q. Is the provision -- is it a requirement, to be a stereoscopic image pair, that the images when viewed simultaneously by the respective eyes of a human provides a perception of depth?

A. Are you asking me with regard to these patents or the field in general?

Q. I'm asking you about the field.

A. In the field in general, the definition is broad enough to include both -- either meaning.

Q. So you would reject any definition that limited

a stereoscopic image pair to being one that, when viewed simultaneously by human eyes, provides a perception of depth?

A. With regard to this patent?

Q. I'm asking you in the field. I'm not sure what you mean by in "this patent."

A. Well, when -- let's see. "Reject."

Could you ask your question again?

Q. So would you reject any definition of a stereoscopic image pair, from the standpoint of a person in the field, that required that when those images were viewed simultaneously by humans, that they provide a perception of depth?

A. They can -- the definition I would adhere to would not require that a human actually view them, but that if a human were to view them, suitably transduced, the human would get a sense of depth.

Q. That would be a requirement, if suitably transduced. I'm going to ask you what that means. But if -- if so transduced, that -- that's a requirement?

A. In the --

MR. HANLEY: Objection; form.

THE WITNESS: I would be willing to accept such a definition. But I don't think it's the only definition of stereo that would be relevant --

"stereoscopic image" that would be relevant, and that one can have stereoscopic images that are computed solely for robotic vision, and that that would be a reasonable use of the term as well, in -- for a specific academic subfield.

BY MR. NELSON:

Q. I just want to make sure I understand your testimony. Your testimony is that you would be willing to accept a definition of "stereoscopic image pair" that required the perception of depth by a human when those images are viewed as suitably transduced, correct?

A. I would accept it in the sense that if you gave that to me as a definition to work with, it would be meaningful to me, and I would understand what to do. If somebody else gave me a definition that said a stereo image pair also includes robotic computer vision stereo processing, I would understand that definition, and I would know how to have a conversation using those terms.

Q. What did you mean in your testimony by "suitably transduced"?

A. For example, the brightness or contrast of an image might need to be changed to make it perceivable. The -- there may need to be geometric transformations to an image to make it appear within a position that an -- that it could be viewed by -- by an observer.

Q. You asked me earlier in our discussion of the meaning of "stereoscopic image pair" whether I was asking you generally in the field versus as it applies to these patents. With respect to the topics of discussion today, these patents, is an appropriate definition of "stereoscopic image pair" "two images...of a scene recorded from slightly displaced positions, which, when viewed simultaneously by the respective eyes, provides a perception of depth"?

A. Yes, I could accept that.

Q. So using that definition here today, if a pair of images does not provide a perception of depth to the human eyes when viewed simultaneously, it doesn't meet that definition of a stereoscopic image pair, correct?

A. Correct.

Q. What does it mean in your field to provide a perception of depth to a human?

A. I would say that it would mean that if a human viewed the stimulus, that they would sense differential distances of objects or surfaces or other elements of a scene, and that they could distinguish that from the case where there were no such differences in depth of such elements.

Q. Are you familiar with the term "stereo fusion"?

A. Yes.

Q. Is stereo fusion the concept that you just discussed, which is that a human would sense differential distances of objects or surfaces from other elements of a scene, and that they could distinguish that from the case in which there were no such differences in depth?

A. No.

Q. What is stereo fusion?

A. Stereo fusion refers to a process whereby corresponding points in two scenes are brought together by the vision system, the visual system, so as to create that sense of depth that I referred to in my previous answer.

(Deposition Exhibit YRD-2007 was marked for identification.)

BY MR. NELSON:

Q. I'm going to hand you what has been marked for this deposition as Exhibit YRD-2007.

A. Do I get the glasses, too?

Q. Stay tuned.

Given what you've just asked, I take it you have a sense of what this image represents?

A. Yes, I hope.

Q. What does it appear to be?

A. A printed reproduction of a stereo pair,

displayed in two colors, which will likely be viewed by a device that filters colors to the respective eyes.

Q. Is this a -- is what you've just described a well-known method of displaying an image pair for stereoscopic viewing?

A. Yes.

Q. A special pair of glasses would be used in connection with this form of stereoscopic viewing?

A. Some device to filter color in the eyes, yes, usually a pair of glasses.

Q. Sir, I do have a pair of glasses for you. Have you ever worn a pair of anaglyph glasses before?

A. Sure.

I'm so happy there's no videographer today.

Q. I'm going to ask you to put those on and observe the image for me.

A. I should say my sense of stereo has never been a very strong one.

Q. I understand that. And understanding that there are differences in subjective perception of stereo using these techniques, do you perceive depth in the picture that's been provided to you in YRD-2007?

A. I do.

Q. What -- what is your perception of which objects are in the foreground?

A. The lion is in the foreground.

Q. And the structures behind -- or there is a structure that appears to be in the background, behind the lion, by virtue of your viewing this?

A. A building.

Q. A building? Okay.

Okay. You can take off the glasses. Thank you.

A. Thank you for not asking me to auto-fuse.

Q. Would you -- well, do you know how an image like YRD-2007 could be generated?

A. Yes.

Q. Are there conventional techniques for doing so?

A. Yes.

Q. Would you describe for me how an image like this could be generated using a two-camera setup, or a two-lens setup?

A. Sure.

Q. Please.

A. One could take a pair of cameras that are spaced closely together, aligned along the same direction of view, and take two pictures and superimpose those two pictures with different -- in different color channels to produce the image that we see here.

Q. And just to further make sure we're on the same

page, because those have been -- those two images have been rendered in red and blue, would you explain how the use of the anaglyph glasses allows the perception of depth in such an image.

A. When you view the printed image through one of the colored filters, you only see one of the images, and then when you view it through the other colored filter, you see the other image. So it effectively transmits or conveys one image to one eye and the other image to the other eye. So the two eyes see the two different views that the two cameras originally captured, and so it's as if your two eyes are sitting where those two cameras were, and you see the same viewpoint -- each of your two eyes sees the same viewpoints as if they were from those two cameras. And since humans would naturally perceive depth in such a scene, they -- they do when viewing the reproduction of that scene using this mechanism.

Q. So just to tie back to something we talked about a few minutes ago, if successful -- if depth perception in a human is successful when undertaking this viewing, what has occurred is stereo fusion, correct?

A. There will, yes.

Q. Now, you -- we talked about one conventional way to create this kind of image, which is, as you

described, to have two cameras which are displaced from each other by some amount. Is that correct?

A. Yes.

Q. What amount of separation or displacement between those two cameras is required so that a human would perceive depth in connection with those images?

A. To be required I think would only -- let me restart the sentence.

The positions would have to be such that with regard to the positions of objects in the scene, the positions of the cameras would produce images that would allow fusion, stereo fusion.

Q. In a human, correct?

A. If we're -- if we're so limiting our definition of stereoscopic images, then yes.

Q. In the method we're discussing for generating these types of images with two cameras, is there a relationship between the necessary distance between the cameras for human perception of depth and what is understood to be the normal or average distance between the human eyes?

A. Sorry. Could you repeat the question?

Q. I won't repeat it. I'll try a different way to get there. Maybe that will clarify it.

I think you've testified and we both agree that

in order for a stereophotography method to work to create these types of images in a two-camera setup, there must be some displacement between the cameras, some distance --

A. Yes.

Q. -- that they are separated.

My question to you as an expert is around, well, what's the necessary distance to enable the perception of depth by a human from the resulting images? And my question to you was whether there -- that necessary distance to create a human perception of depth is related to the distance between a human's eyes.

A. There's -- there's certainly a relationship. And it would be likely that the optimal position would be that. But humans will perceive depth when viewing images taken from two views of a scene, under conditions where they can fuse the images of those scenes, as we've discussed, across quite a range, almost arbitrary sets of positions of cameras. So I don't have a strict definition of what the requirements on the positions would be, other than that they be such that they're -- cameras are viewing the same scene and that the displacements in the two images are within the range such that stereo fusion is possible.

Q. Isn't your answer to my question about how much

displacement is required to create stereo fusion circular, in that it answers it by saying, well, the displacement needs to be enough so that stereo fusion is possible?

A. I thought you asked --

MR. HANLEY: Objection; argumentative.

THE WITNESS: I thought you asked the question what displacement is needed to create a sense of depth. Did it change, and I not notice the change, to displacement?

BY MR. NELSON:

Q. I'm happy to reask the question.

Isn't your answer to my question about how much displacement is required between the cameras to create a perception of depth circular, in that it answers my question by saying, well, the displacement needs to be enough so that perception of depth is possible?

A. No.

MR. HANLEY: Same objection.

BY MR. NELSON:

Q. What amount of displacement is required in the image acquisition arrangement here to create a perception of depth in a human?

A. I'm not aware of a bound on that quantity, other than stating that -- what I've already stated.

Q. And -- and what you've stated, correct, is that it just needs to be displaced enough so that it results in the perception of depth, correct?

A. I believe I said that it needs to be displaced enough such that stereo fusion is possible.

Q. Is it your opinion as an expert that the state of the art in generating stereoscopic images is that the only guideline provided for the capturing of these images in terms of the required camera displacement is that it needs to be displaced enough such that stereo fusion is possible?

A. Across all the range of possible scenes and stereo images that stereo photographers would wish to collect, my answer would be yes.

Q. Are you aware of any academic work, or any work, relating the necessary displacement between the images to the distance between the human eyes?

A. I have a general recollection of having read papers that discussed the issue of the perception of depth under different conditions than -- different conditions than when they're taken. I believe there are papers that discuss that. But I don't have specific references on my mind right now.

Q. Did you, in forming the opinions stated in your declaration, particularly your opinion that the Kawakita

reference discloses a technique for generating stereoscopic panoramic images, consider the question of what displacement was necessary between resultant images to create stereo fusion in a human being?

A. Yes.

Q. What were your considerations in that regard with respect to Kawakita?

A. I believe Kawakita discloses a method for generating a stereoscopic omnidirectional image pair which has an effective baseline that's reasonably close to the human intraocular distance. However, even if it didn't, I think it also discloses that there are a range of possible set -- intraocular distances that could be captured using their apparatus. And, further, even if you had quite a divergent intraocular distance relative to the human intraocular distance and collected images of a scene and offered them to a human observer, that human observer still would have some sense of depth when viewing those images of that scene.

Q. In forming your opinions stated in your declaration with regard to Ishiguro, in particular your opinion that the Ishiguro reference "discloses a method for generating a stereoscopic omnidirectional image pair," did you consider the question of what displacement was necessary between the resultant images

in order to create stereo fusion in a human being?

A. Yes.

Q. And in connection with Ishiguro, what were your considerations in this regard?

A. That the apparatus disclosed in Ishiguro would collect images of scenes that, when presented to human viewers, could be fused and provide a sense of depth to the human viewers.

Q. And like Kawakita, did you discern from Ishiguro that Ishiguro discloses a method for generating a stereoscopic omnidirectional image pair which has an effective baseline that's reasonably close to human intraocular distance?

A. Maybe less close, but you would still have a sense of depth when perceiving those images.

Q. Let's return for the moment to discussion of the kind of conventional image-taking arrangements to generate images like YRD-2007.

Apart from a necessary -- you need not wear the glasses.

Apart from some necessary displacement between the cameras, are there other considerations, with respect to the image-taking process, that are necessary for a captured image to provide a perception of depth?

A. Certainly the images have to be exposed

properly and be viewing the same scene. So there are others. I'm not quite sure where your question is going.

Q. Well, it was open-ended. I'll ask you a more closed-ended one.

Are there -- is there anything about the scene that is to be captured that are necessary for that scene to provide a perception of depth when viewed in this way?

A. I'm not sure a scene -- I'm not sure I understand the question, insofar as the scene doesn't provide a sense of depth. The image would present a sense of depth.

Q. Is there any minimum distance from the cameras to objects depicted in the scene required for human perception of depth from a resultant image?

A. The objects would have to be sufficiently distant from the camera such that stereo fusion could occur, because there's a limit on the displacement within an image that humans can accommodate.

Q. What is that limit?

A. I forget the precise number. But you can -- you can find it out for yourself by saying if you focus at infinity, at what point can you no longer fuse the object in front of you.

Q. Did you have the precise minimum distance from the camera to objects in the scene in mind when you performed the analysis that led to the conclusions stated in your declarations?

A. No.

Q. Is there any maximum distance of objects in a scene beyond which the capturing cameras and resultant images will not provide a perception of depth to a human?

A. I mean, you can take images of a scene with an arbitrarily wide baseline of objects that are nearly arbitrarily far away, subject to the -- you know, subject to your optics and resolution of your sensor, and show those images to a person and get a sense of depth. So it's hard for me to quantify that.

Q. Is your answer no, that there is no maximum distance you're aware of?

A. Well, there will have been a maximum distance that's ever been tried, and I -- so I -- it's much larger than any number you were probably thinking of.

Q. With respect to human perception when viewing an image or an image pair in which the minimum distance from the camera to objects in the scene has not been respected, will perception of depth occur?

MR. HANLEY: Objection; foundation.

THE WITNESS: In your question, did you -- in the hypothetical your question constructed, were all of the objects closer than that distance, or were only some of the objects closer than that distance?

BY MR. NELSON:

Q. It's a fair objection to my question.

With respect to human perception of depth with respect to an object in an image wherein that object is closer than the minimum distance that we've been discussing necessary to provide a perception of depth, will a human viewer be able to perceive depth as to that object?

A. The general answer to that question would be no. But I would want to note that I believe that if you looked into the literature, you would probably learn that when -- in that condition, humans would still sense something was very -- was wrong and very close to them. So I think there would be no precise sense of depth, but there might be a sense of like your nose is in front of your face and you can still see it there, even though it's not being fused and you know it's very close.

Q. Would such an image be a stereoscopic image, in your opinion?

MR. HANLEY: Objection; lacks foundation.

THE WITNESS: I think so, yes.

BY MR. NELSON:

Q. Why?

A. Because it's two views of a scene, taken from overlapping views, and different humans will have different abilities to fuse, so a different -- another human might come and look at it and be able to fuse it. So it's a -- it's a bit of a gray area with respect to the definition.

Q. So as long -- your definition is that so long as some human somewhere could perceive depth, it's still a stereoscopic image?

A. If we're still limiting the definition of "stereoscopic image" to incorporate a human view.

Q. Again, with respect to a two-camera arrangement for generating or capturing stereoscopic images of the type we've been discussing, is it necessary, to create human perception of depth, that there be some disparity between the objects in the scene with respect to their distances from the camera?

A. Could you ask that question one more time, please? Please repeat the question.

Q. With respect to generating or capturing stereoscopic images of the type we've been discussing, is it necessary, for the resultant images to create perception of depth, that there be some disparity

between the objects in the scene with respect to their respective distances from the camera?

A. I want to make sure I fully understand the question and your use of the term "disparity" there. Were you referring to disparity between the two views or were you referring to disparity between the objects' depths or between -- the disparity of the disparity in fact?

Q. All the objects in the scene to be recorded are roughly the same distance from the cameras. Will the resultant image provide a perception of depth as to those?

MR. HANLEY: Objection; incomplete hypothetical.

THE WITNESS: It would -- it would -- it would provide the degenerate sense of depth, that everything was at the same distance. So generally one would answer the question no, because you -- you want to see depth differences. But strictly speaking, you would probably see everything at infinity or close to you, in whatever depth it was. So it depends exactly on the precise definition of "depth" that you'd like to work with and whether it includes the notion that there has to be some depth differences in the scene.

I apologize for a somewhat circular answer, but

I think it was the correct answer.

MR. NELSON: Let's take a short break.

(Recess taken.)

BY MR. NELSON:

Q. All right, Professor Darrell. Before we broke, one of the questions I was asking you related to whether -- in connection with arrangements for capturing stereoscopic images, whether there was any maximum distance beyond which that resultant images would not produce human perception of depth. And I want to return to that by asking you a slightly narrower version of that question.

In an arrangement in which the two cameras are distant by an amount that approximates human intraocular distance, is there a maximum distance for objects in the scene beyond which the images will not provide a perception of depth to a human?

A. There is a -- if I understood your question correctly, there is a distance for -- with -- when two cameras with the intraocular distance of -- human intraocular distance, there's a distance beyond which the disparities will be so small as to not be able to be resolved by the resolution of the imaging sensors, such that everything will seem infinitely far away. So that is true. And did that answer your question?

Q. Yes. And is there some formula or algorithm that can be used to determine that maximum distance?

A. Sure. It would depend on the resolution of the sensor and the intraocular distance, which -- but we're setting that to be human intraocular distance. So it would just be the resolution of the sensor.

Q. Okay. I'm going to ask you now to return to your declarations, which are Exhibits Sony-1010, Sony-1113, Sony-1013, and Sony-1040. And when I've got a specific question, I'll direct you to the appropriate declaration. But I just want to confirm that these declarations represent the full extent of the opinions you've offered regarding the Kawakita reference as it concerns the '003 patent and the '284 patent.

A. In this matter, yes.

Q. Do you hold any other opinion about these references as they pertain to the '003 or '284 patents that you intend to offer in this case?

A. Not at this time.

Q. If I could ask you to look at Exhibit Sony-1010, paragraph 10(a), on page 4. Let me know when you're there, please.

A. I'm here.

Q. Your declaration, at paragraph 10(a), states that "Kawakita discloses a technique to generate

stereoscopic panoramic images by excising slit images from images captured by a rotating camera and mosaicing the respective slit images together. In Section 1 of the paper, Kawakita also discusses creating a 2D panoramic image using center slit images."

Did you write that paragraph?

A. I wrote it with -- with the counsel sitting to my left, and we had iterated on several versions. It was originally my idea, and they put it to paper, and then I revised it.

Q. With respect to your use of the term "stereoscopic panoramic images," what do you understand a stereoscopic panoramic image to be?

MR. HANLEY: Objection; asked and answered.

THE WITNESS: Yeah, I don't see why my definition would have changed from earlier. My -- it is a panorama that is, you know, viewable -- you can have a stereo view that can -- can look through a very wide field of view, hopefully 360 degrees, but certainly very wide.

(Discussion off the record.)

THE WITNESS: "Certainly very wide."

BY MR. NELSON:

Q. And those images provide a perception of depth when viewed by a human, under your definition, correct?

A. Yes.

Q. So the only difference in the definition or the meaning that you're trying to convey here from what we talked about with respect to stereoscopic image pairs earlier is the introduction of panorama?

A. Yes.

Q. Okay. This is not a memory test, so I'm going to give you Kawakita, which has been marked as Exhibit Sony-1003.

Just so we're on the same page, do you recognize Sony-1003?

A. Yes.

Q. You've seen it before?

A. Yes.

Q. It's an English translation of Kawakita, to your understanding?

A. A booklet that includes Kawakita, yes.

Q. Is it your understanding that Kawakita was written and published in the Japanese language originally?

A. Yes. I think the abstract might have been in English. I'm not sure.

Q. Do you speak or read Japanese?

A. No.

Q. You relied upon the English translation that's

in front of you now in forming your opinions?

A. Yes.

Q. What is the technique disclosed in Kawakita for generating stereoscopic panoramic images?

A. It excises "slit images from images captured by a rotating camera and mosaicing the respective slit images together." I'm reading from my declaration.

Q. What is the camera setup disclosed in Kawakita?

A. It's illustrated in figure 1 quite clearly. A camera is mounted on the end of an arm atop a tripod or other axis around which it can rotate.

Q. How many lenses does the camera have?

A. One.

Well, it could have a compound lens, which has multiple lenses inside of it. But there's only one optical center in this camera.

Q. You understand -- putting aside the question of what it could have, you understand this article to disclose a single-lens camera, correct?

A. When you say "single lens," I mean, if you want to be -- strictly speaking, many of the single lenses actually have many lenses inside of it. That's not what you meant, though. But generally, yes.

Q. Is there any -- in the Kawakita disclosure of the camera arrangement, are there slits?

A. There are slit images.

Q. So it's your understanding that there is no filter or other covering over the lens that provides for the capturing by the camera itself of slits; rather, slits are excised from a complete image. Is that correct?

A. I think that's the most likely case.

Q. Do you know one way or the other?

A. Well, I'm not -- they could have put slits in here. It would have worked. I didn't see a description of -- of a mask in their camera in this document.

Q. You testified that the camera is mounted on a tripod and rotated; is that correct?

A. Yes.

Q. Is the -- does Kawakita disclose a manual or motorized rotation of the camera?

A. It could be either. I think it suggests that the technique described here is especially designed for a manual one.

Q. Directing your attention to section 2, on page 14 of this exhibit, Sony-1003, doesn't it say that the camera is rotated manually?

A. Yeah, it could be manual, or it could be automatic. It's saying that because the technique here does not have the limitation of constant rotation, you

can have erratic rotation, such as manually. At least that's how I interpret the translation.

Q. How does Kawakita disclose that slit images are determined and excised?

A. Kawakita extracts optic flow between frames to estimate the angle of rotation between views, uses that to determine the width of the slit image, that is then used to determine which regions of the image are extracted to create the resulting mosaics that are shown on figure 5.

Q. Is it your understanding that Kawakita discloses that that determination of optical flow determines the width of the slit images?

A. Yes.

Q. So, for instance, would this result in the speed of the rotation from frame to frame affecting the width of the slit images?

A. Yes.

Q. From each frame, how many slit images does Kawakita disclose are created?

A. At least two, corresponding to the left panorama and right panorama, the left eye and right eye slit images.

Q. And is it your understanding that Kawakita discloses that the left eye slit images are for the left

panorama or for the right panorama?

A. I don't recall that detail right now. I would have to review the document to check that. I remember a discussion like that, but I can't remember which document it was in at this moment.

Q. What does Kawakita disclose is done with the slit images once they're determined?

A. They're composited continuously into a sequence.

Q. How many sequences?

A. Two.

Q. Is it your understanding that Kawakita discloses the result of that process are images of the sort shown in figure 5 of page 16?

A. Yes.

Q. Does the process of acquiring images, excising slits, and compositing left and right eye -- left and right panoramas result in the creation of a stereoscopic panoramic image pair?

A. Yes.

Q. Those images will result in a human perception of depth?

A. When viewed.

So my answer was yes, in case it wasn't clear.

Q. Where is it described in Kawakita that the

process we've just described, of acquiring images, excising slit images, and compositing left and right panoramas, results in the creation of an image pair that results in a human perception of depth?

A. At the bottom of what's marked as page 16, in section 6, in the section entitled "Stereoscopic Viewing Using Depth Parallax Angle," the first sentence of that section discloses that.

Q. And that sentence reads, "When the left and right panoramic images obtained using the foregoing procedure are viewed binocular stereoscopically, a stereoscopic view is possible that faithfully reproduces the positional relationships, if the image was captured from a sufficient distance." That's the sentence you're referring to?

A. Yes.

Q. And that sentence is where in Kawakita a description is provided that this process results in the creation of a stereoscopic image pair?

A. Yes.

Q. Does Kawakita describe that the image composition process we've just discussed always result in a stereoscopic panoramic image pair, as you've defined that term?

A. If a pair was created with everything so far

away as to have no depth differences, then we might not consider it to have any depth variation.

Actually, let me -- let me -- let me strike that answer and ask you to repeat the question.

Q. Does Kawakita describe that the image composition process we've just discussed always result in a stereoscopic panoramic image pair, as you've defined that term?

A. I think so, in that there would always be some sense of depth, broadly defining "depth."

Q. Doesn't Kawakita disclose that there are some circumstances in which faithful stereoscopic viewing is impossible?

A. Yes. Kawakita discloses that in certain scene conditions, depth will not be faithfully reproduced, or, more specifically, that the depth perception will not faithfully reproduce the positional relationships.

Q. In light of that testimony, I'm going to ask you again, does Kawakita describe that the image composition process that we've just discussed always result in a stereoscopic panoramic image pair, as you've defined that term?

A. Yes.

Would you like me to make a clarifying comment?

Q. I'm satisfied with your answer.

A. Okay.

Q. If an image doesn't provide a perception of depth to a human viewer -- let me rephrase the question.

If an image pair created by the Kawakita process doesn't provide a perception of depth to a human viewer, is it a stereoscopic panoramic image pair?

A. No. It need not faithfully reproduce the positional relationships, however, to provide a sense of depth.

You can have an unfaithful relationship -- an unfaithful reproduction or an approximate reproduction or a ordered relationship that -- that perceives the ordering but not the metric properties of the depth.

Q. So even, if I understand your testimony, in circumstances where Kawakita and his colleagues themselves state that for certain image pairs objects appear to overlap or have some other fault, making faithful stereoscopic viewing impossible, for you it's nonetheless a stereoscopic panoramic image pair?

A. I -- you didn't quote his language exactly. Could you repeat the question?

Q. So if I understand your testimony, even in circumstances where Kawakita and his colleagues themselves state that for certain image pairs "objects appear to overlap or some other fault, making faithful

stereoscopic viewing impossible," for you that image pair is nonetheless a stereoscopic panoramic image pair?

A. Can you show me -- can you guide me to the language you're quoting?

Q. You don't recall seeing this in Kawakita?

A. I may recall.

Q. It's on page 17, directly above figure 6.

A. So when you have faithful stereoscopic viewing, such that "a stereoscopic view is possible that faithfully reproduces the positional relationships," I take that to mean, by the authors, they're expressing the goal of a very high-fidelity, accurate reconstruction and perception, I should say, of the depth relationships in the scene, and that is a stricter definition of depth perception than the one that I would use when defining the term "stereoscopic panorama."

Q. So even in the circumstances described by Kawakita and his colleagues in which objects appear to overlap, such objects are still part of a stereoscopic panoramic image pair under your definition?

A. In that hypothetical case, if there were other objects in the scene that didn't overlap, that did have proper depth, there would be some depth perception in that scene. It may not be a very high-quality perception, or faithful.

Q. So even -- in your view, even an image pair that produces an inaccurate perception of depth is a stereoscopic image pair, under your definition?

A. If "inaccurate" means imperfect, then I would agree with that.

Q. Under what -- excuse me.

Under what circumstances does Kawakita describe that their process will not generate images capable of faithful stereoscopic viewing?

A. When the image is not captured from a sufficient distance or if the distance from the camera to the objects vary greatly in similar circumstances.

Q. Let's talk about the scenario that Kawakita describes regarding when an object is not captured from a sufficient distance. Do you agree with the conclusion of Kawakita that that would result in an image that does not provide -- or, rather, it makes "faithful stereoscopic viewing impossible"?

A. Correct.

Q. You agree with that statement?

A. Yes.

Q. Why?

A. Because the "faithful stereoscopic viewing" means that it faithfully reproduces the positional relationships, and if the objects we're discussing are

too close, those objects will not be fused, using the process of stereo fusion that we described earlier in this deposition, and therefore there won't be a accurate or faithful sense of depth possible for those objects, so at least part of the scene would be inaccurate or disturbing to view.

Q. What distance from the camera does Kawakita say is sufficient to permit faithful stereoscopic viewing?

A. I don't recall that he gave a number for that.

Q. Do you know one way or the other whether Kawakita states what distance is sufficient to permit faithful stereoscopic viewing?

A. I don't recall.

Q. What would a skilled artisan in your field understand to be a sufficient distance for perception of depth resulting from the Kawakita process?

A. Again, it's the analysis you would go through for a typical human. Say if they're -- if they're fixating at infinity, how close can -- an object can they perceive as not appearing as two objects or ghosting. So it's some distance in front of the observer. I don't have that number in my head right now, but it's well understood.

Q. At the top of page 17, Kawakita describes that "However, if the camera was placed at a comparatively

close distance, or if the distance from the camera to the object varies greatly, the positions representing the left and right panoramic images must be adjusted."

What do you understand Kawakita to mean by a comparatively close distance?

A. That the distance was too close for faithful perception of depth, because -- most likely because fusion was impossible.

Q. An image generated using the Kawakita process in which the objects in the scene are too close or comparatively close, as Kawakita describes, is nonetheless a panoramic stereoscopic image pair, in your view?

A. If everything in the scene is -- in your hypothetical, could you clarify whether everything in the scene is too close?

Q. Let's call that hypothetical 1. Everything in the scene is comparatively close, using Kawakita's terminology. Is it a stereoscopic -- is the resultant image pair a stereoscopic panoramic image?

A. So nowhere in the scene -- if it is the case that nowhere in the scene fusion is possible, there's not a single object that can be fused, then I would probably not characterize that as a stereoscopic image pair that's viewable by a human.

Q. If one portion of the panorama provides a perception of depth but the others do not, is it a stereoscopic panoramic image pair?

A. I believe it would, because the human would perceive depth in a portion of that stereoscopic panorama.

Q. Does Kawakita disclose that faithful stereoscopic viewing is impossible if the distance from the camera to the objects in the scene varies greatly?

A. Yes.

Q. Do you agree with that statement by Kawakita, that faithful stereoscopic viewing would be impossible if the distance from the camera to the objects in the scene varies greatly?

A. Yes.

Q. Why?

A. Because it's difficult to have a perception of depth that's consistent for all the objects in that condition.

Q. What do you understand "varies greatly" to mean in connection with the disclosure of Kawakita?

A. I think it has the ordinary definition, just a lot of variation.

Q. How would one of skill in the art take that statement, that faithful stereoscopic viewing is

impossible when objects in the scene vary greatly with respect to their distance from the camera and implement an arrangement that results in images that are capable of being viewed stereoscopically?

A. Could you repeat that question?

Q. How could one of skill in the art take what's said here about faithful stereoscopic viewing being impossible when the distance from the camera to the objects in the scene varies greatly and ensure that they are capturing images that do not produce that problem?

A. They could follow the instructions -- the -- they could follow the ideas described in this paper that provide for such corrections to overcome that problem.

Q. You're referring to the process of adjustment that is described in sections 6 and 7 of the Kawakita reference?

A. Section 6, yes. Section 7 I believe describes the field test, so I would not include it in my reference there.

Q. Short of the adjustment process disclosed in section 6, Kawakita provides no guidance as to how to avoid or what distance from objects to the camera would count as varying greatly?

MR. HANLEY: Objection; vague.

THE WITNESS: Yeah, I didn't quite catch the

question. Can you repeat the question, please?

BY MR. NELSON:

Q. Other than the adjustment process disclosed in section 6, it's your understanding that Kawakita provides no guidance as to what it means for objects to vary greatly in terms of their distance from the camera?

A. That is correct, other than the reference to the fact that there would be sufficient distances. But that's not defined precisely either.

Q. And it's your understanding, as you've just testified, that Kawakita does describe, in section 6, a technique to address the issue of providing proper depth perception for images that aren't captured from a sufficient distance or do have objects that vary greatly in their distance?

A. I think my testimony was that they do that such that you can have faithful reproduction of -- and faithful stereoscopic viewing.

Q. What does Kawakita describe as the adjustments that must be made to make stereoscopic -- faithful stereoscopic viewing possible?

A. In section 6, Kawakita describes various mechanisms to adjust the parallax angle computed when constructing these stereo panoramas.

Q. How does Kawakita describe these mechanisms are

implemented in a viewing system?

A. When you say "implemented," are you referring to -- I'm not sure I understand the question.

Q. Well --

A. He says that computations can be taken to compute these quantities.

Q. And then he calls it a day? Or does he implement it in a system to permit what he describes as faithful stereoscopic viewing?

A. He has built artifacts that perform these functions, yes.

Q. So what does he describe there?

A. Where are you -- where are you referring to in the document?

Q. You've testified that Kawakita has built artifacts that perform these adjustment functions. Describe the artifacts for me.

A. Well, in section 7 he refers to "A field test...conducted applying these techniques to panoramic images of an elevator hallway in which...distance to objects varies greatly."

Q. And what does he do?

A. What does his document describe, or what do I speculate he did? What -- I'm not sure what you're asking.

Q. Well, let's start with what the document describes. What does the document describe as the implementation in section 7?

A. The implementation?

The -- this -- the -- section 7 does not describe an implementation. It describes a field test. So I don't know how to answer your question.

Q. Do you know what he did?

A. Yes.

Q. He and his colleagues did?

What did they do?

A. They used the method that they describe in sections -- in the previous sections on images that they collected in their laboratory.

Q. So describe the artifact that performs these adjustment functions as disclosed in Kawakita.

A. Kawakita does not describe the precise model number of any computer or camera that they use for a specific experiment, so I would not be able to tell you, based on this document, with -- any description of such artifact. I can certainly speculate as to what I would imagine they have done, if you'd like -- if that's what you're asking me to do. But it would be clear to -- it was clear -- it would have been clear to me at the time, and anyone in our field, how to implement the ideas that

are described here using the conventional tools and processes that our field has.

Q. Does Kawakita describe any display mechanism for displaying images and adjusting them according to their technique?

A. It describes that panoramic images were viewed stereoscopically and that there was stereoscopic viewing with alignment control. I do not recall any disclosure of which specific stereoscopic viewing technique. But if it's in there and I just don't recall it, please draw my attention to it.

Q. Did you discern in this Kawakita article any mechanism to perform the adjustments they describe so as to permit faithful stereoscopic viewing of these images?

A. Yes. They say that the method -- they disclose the method in section 6 which performs the adjustments of depth parallax angle and applied that in a field test, using an apparatus that they constructed, and had human viewers -- they mentioned ten research personnel -- view the panoramas stereoscopically, through some apparatus that isn't specifically disclosed, but a stereoscopic viewing apparatus that could have had double images, which is indicative of the failure of stereoscopic fusion, and they say those ten personnel experienced a faithful reproduction of

their -- of a sense of depth.

Q. How does Kawakita disclose that that apparatus performs the necessary adjustments?

A. I believe I've already answered that question. It's described -- disclosed using the technique described in section 6.

Q. Well, section 6 describes a technique for calculating what adjustments must occur, correct?

A. Uh-huh.

Q. I'm asking you a different question, sir. Where does Kawakita describe the implementation of those adjustments with respect to an image pair to permit faithful stereoscopic viewing? Where?

A. I believe it's -- I'm not sure I fully understand your question. But section 6 describes how one would actually manipulate the panoramic images. And there's a reference to figure 7, that shows the rotation of the panoramic images, that would perform the corrections or adjustments that section 6 is spending all of its time talking about. And those were the implementation I believe you're asking for of the -- of the -- that would be realized in an apparatus.

Q. So your testimony is that Kawakita describes rotating the images so that faithful stereoscopic viewing is possible?

A. In part, yes.

Q. What else does it disclose, other than rotating the images?

A. It discloses all of the content of section 6.

Q. Where in section 6 other than rotating images is manipulation of the images to permit stereoscopic viewing described?

A. I'm not sure. I haven't studied this section in detail recently. But I could do so if -- if it was useful.

Q. Do you think an understanding of how this occurs is necessary to your conclusion that Kawakita discloses a technique for generating stereo panoramic image pairs?

A. No, not at -- not beyond what I've testified today.

Q. As far as you know, does Kawakita describe anything other than image rotation to perform the adjustments that it describes as necessary to permit faithful stereoscopic viewing?

A. I haven't given an opinion on that, and I don't have an opinion on that.

Q. Do you understand what Kawakita did in his field test to permit faithful stereoscopic viewing?

A. Yes, sir.

Q. What did he do?

A. He continuously varied the depth parallax angle using linear interpolation, such that "correspondences were made with the panoramic images." I'm reading the text from section 7.

Q. What does that text mean?

A. It means what it says. I don't know exactly what you're trying to -- where you're trying to steer my testimony.

Q. What does it mean in the field test when it states that "the depth parallax angle obtained was continuously varied using linear interpolation?

A. It means there's a correction term, that's computed as described in the previous section, that's based on the depth -- the depths of the objects in the scene at that point, and that that value is one that changes continuously through the panorama, because the depths change, and that is then used to correct the panoramic images.

Q. And how does Kawakita describe that it's used to correct the images?

A. I don't recall precisely where. I haven't memorized this text before the deposition.

Q. I didn't ask you precisely where. I asked you how Kawakita describes that it's used to correct the

image.

A. I believe it's done in the last part of the section.

Q. Are you referring to section 7?

A. Yeah. It -- I mean, rather than reread the text as I sit here now, I think it's better for me just to answer other questions that you have. I don't know exactly which sentence is the one that does describe that computation. But I could reread it and -- and -- and find it.

Q. Sir, you either have an answer to my question or you don't have --

A. I think that --

Q. -- an answer to my question.

A. Would you like to repeat your question?

Q. How does Kawakita describe that the information that you have described is calculated is used to perform these corrections?

A. As I've testified, I believe it's disclosed in figure 7, which is described in the last paragraph on page 17. That's my understanding of my testimony.

Q. And what is done? What is actually happening? You've just repeated the words to me. What is being done?

A. It's rotating the panoramic images for display.

Q. And how is the degree of rotation determined and applied, according to Kawakita?

A. I don't recall the specific details on that.

Q. Did you --

A. Based on my memory of this document.

Q. Did you consider those details in forming your opinions stated in your declaration?

A. I -- no. I don't believe that is necessary to support the conclusions that I've made.

Q. Let me direct your attention to section 7. It says first, "A field test was conducted applying these techniques to panoramic images of an elevator hallway in which the distance to objects varies greatly." Do you see that?

A. I do.

Q. Do you understand that to be referring to figure 5, on page 16?

A. It might be. It's not specifically referring to that.

Q. Figure 5 is labeled "Panoramic Images of an Elevator Hallway"?

A. There may be more than one elevator hallway in their laboratory.

Q. Uh-huh.

A. So I -- I'm not sure of that.

Q. I note that Kawakita here, in section 7, does not refer to the images on which these adjustments are being performed as stereoscopic panoramic images. Instead they're panoramic images. Do you agree with me?

A. That's literally true in the document, yes. However, this is a translation, so I don't know what it said in the original Japanese.

Q. Section 7 says then, "First, while actually looking at the panoramic images, alignment was performed in several sight line directions so faithful stereoscopic viewing would be possible." What do you understand is occurring in connection with that statement in this field test?

A. I understand that most likely to be the process of finding corresponding regions of the scene in the two stereo panoramic images which can then be presented for stereoscopic viewing.

Q. So there's some one or some ones viewing the two images, as a starting point. Someone's looking at them, correct --

A. They --

Q. -- in Kawakita?

A. They will -- the -- to look at a panorama, you would -- to view a panorama, you have to view a region of the panorama corresponding to a viewpoint. You --

you can't view 360 degrees at the same time, usually. At least that's not my understanding of what they're talking about here.

Q. And is that why here Kawakita describes that alignment was performed in several sight line directions?

A. Yeah, I'm not exactly sure what that specific phrase was referring to.

Q. You don't know what this phrase refers to?

A. I -- my understanding is that it's aligning the two panoramic images such that corresponding regions of the scene can be viewed by the human observer.

Q. Is it performing such alignment repeatedly across different sight line directions, as disclosed by Kawakita?

A. It sounds like a circular question. Could you repeat the question?

Q. Sure. Is -- let me ask it a different way.

Does this process of adjustment that you've read in Kawakita describe a single adjustment for a pair of panoramic images or does it describe performing multiple adjustments as a viewer observes the images?

A. I'm not sure it actually says whether the -- the alignments are performed while the viewers are viewing the images or as -- let me strike that, that

answer. I got it sideways.

Kawakita discloses performing the alignment in several sight line directions while viewing the panoramic images.

Q. So for each sight line direction in a pair of images, Kawakita describes that a new adjustment must be made for each of those sight lines when an observer is viewing?

A. I think so. Yes.

Q. Does Kawakita describe how these adjustments are being made while a human is viewing the image pair?

A. I believe Kawakita discloses that those adjustments are made according to the algorithm and computations described in the previous section.

Q. I have a much more basic question.

Does Kawakita describe that a person is making these adjustments, depending on where the viewer is looking?

A. That's not my understanding.

Q. How are the adjustments described in Kawakita, then, made as one views an image pair in this process?

A. I mean, I think we're back to the previous questions that you've -- I've already testified to. Section 6 describes a process of assessing the depths of -- displayed of objects in the scene and a mechanism

to rotate images according to the depth parallax angle. And those are the techniques that are employed in the test that they -- that they conducted.

Q. I agree with you that section 6 describes assessing depths. I want to know what Kawakita teaches you, as an expert, about how to implement this. What does it tell you about how to implement this, so that I can go look at a pair of images captured using the Kawakita process?

A. I don't believe I formed an opinion on that for my declarations. Reading this document, when I first read it, and as I look at it again today, you know, it -- the instructions that it provides to one -- to me or one of ordinary skill in the art seems straightforward to realize using conventional methods and processes that one would know. That's all I can say, is it appears to be something that would be straightforward to implement. I haven't done that myself, so I don't know that I can say exactly how you would do it. But it appears to be straightforward.

Q. Does Kawakita describe to you how to build such a mechanism?

A. That's what I just said. Yes.

Q. Well, it's different than what you testified. If I understand your earlier testimony, you said it

seems straightforward to realize using conventional methods. And my question to you, sir: Was Kawakita telling you how to do it? I'm not asking you if someone could figure it out. Does --

A. No, no, no, no.

Q. -- Kawakita tell you how to do it?

A. I -- maybe I should -- let me tell you what I believe my testimony to be, which is that Kawakita explains methods that you could realize using conventional tools and processes.

Q. What are those tools and processes? Describe how you would --

A. Oh, you --

Q. -- implement this.

A. You -- you have computers and -- with a certain -- with operating systems and image processing toolboxes, and you have methods for collecting images and loading images into memory and computing image processing operators on those. Is this -- is this the kind of that that you're -- you are looking for?

I'm really not sure what direction I'm supposed to go in to help you with your understanding with this material.

Q. I'm asking about your understanding of this material. And I'm looking for the answer of, do you

understand how to build what Kawakita discloses?

A. I have not tried to build what Kawakita discloses. And based on my review and reading of the method, it appeared to me that it would not be difficult to do so. But I have not gone through the exercise of specifically determining how I would build it or how I would direct a student to build it.

Q. And can you determine, from what you've read in Kawakita, what he built?

A. I -- can you tell me at what level you -- you want that question answered? I don't know exactly what type of computer or camera or image processing software he used. I do know the level of mathematics that he used, because that's what's disclosed in here. So that's the best answer I can give to you.

Q. You've stated that you don't know what type of computer or camera or imaging processing software he used. Do you know what form of display was used?

A. No.

Q. Do you know what mechanism was used to actually perform the adjustments?

A. Can you define "mechanism"?

Q. Any mechanism to rotate the images as we've described.

A. Well, the mathematic -- the mathematical

mechanism is disclosed directly. When one goes to rotate images in a particular image processing environment, one would call various functions or operators that would perform the digital manipulations of the data structures that contain the pixels corresponding to the images or panoramas or other data -- or other representations, to do the rotation. That would be one way one could do it.

Q. And when does Kawakita disclose that the -- that the adjustments must be implemented when viewing an image pair?

A. I don't understand that question.

Q. Does Kawakita disclose that a set of adjustments is implemented once and then the image pair is ready for faithful stereoscopic viewing?

A. I think that -- no, because I believe he discloses continuously varying adjustments.

Q. And on what principle does the adjustment continuously vary?

A. I'm not sure he states it in that -- in that fashion.

Q. Does it vary according to what portion of the scene the viewer is looking at?

A. Of course.

Q. That's when an adjustment must occur in the

Kawakita disclosure: when someone looks at a different part of the scene?

A. According to the different -- the adjustment is based on the depths of the objects in the scene. So one wouldn't have to recompute it when one looks at the same part of the scene again.

Q. But is it your understanding that what's being described here in Kawakita is that when a viewer of the image pair that's been generated using the Kawakita process shifts their viewing to a different part of the panorama --

A. I see where you're going now.

Q. -- an adjustment must then be implemented?

A. No.

Q. No?

A. No.

Q. It does not disclose that?

A. I think it discloses the adjustment once for the entire scene, based on the composition of the scene. That's my understanding.

Q. And this is how you interpret the statement in the field test that "the depth parallax angle...was continuously varied using linear interpolation"?

A. That is, yes.

Q. And the statement there in section 7 goes on

that "the depth parallax angle for all sight line directions was calculated." Do you see that?

A. I do.

Q. In the Kawakita process, would a different depth parallax angle in one sight line direction require a different level of rotation than another depth parallax angle for a different sight line direction?

A. Can you repeat the question?

Q. Well, maybe we can get at it a different way.

You agree with me that Kawakita here describes determining the depth parallax or calculating the depth parallax angle for all sight line directions in a panoramic image?

A. Yeah.

Q. So just we don't know for sure, but let's assume there's at least a far left view and a far right sight line direction.

A. At least. But I would expect there to be many more.

Q. Many more across the panoramic image?

A. Yeah.

Q. And you agree with me that Kawakita describes that you must calculate a depth parallax angle for each of these sight line directions?

A. I would agree that it discloses that they did

it. I don't know if he says that you always have to do it. But it was done.

Q. And do you understand, then, that the description is that there may well be different depth parallax angles for each sight line position --

A. Indeed.

Q. -- that are calculated?

Does that fact, of different depth parallax angles across the scene, mean that in fact a new adjustment must be performed at each sight line direction to permit faithful stereoscopic viewing?

A. Yeah. Yes.

Q. So as Kawakita describes in the field test, when the viewer switches their field of view to a different sight line direction, there's a new adjustment to that image pair to be made, correct?

A. It may have been precomputed just once for the whole scene. But if it hadn't been computed yet and this is the first time the viewer looked there, it could be computed at that moment. But that would be the more awkward way to do it.

Q. I understand your testimony about it may have been computed previously. And my question is slightly different, which is, when the focus of the viewer changes, regardless of whether it has already been

computed, doesn't Kawakita describe that a new adjustment may be made?

A. I think it discloses that it could be done that way, yes.

Q. If it wasn't done and the depth parallax angle of the new sight line direction is different than the depth parallax angle of the old sight line direction, will faithful stereoscopic viewing of that portion of the scene be possible?

A. There may be other ways to have corrected for -- for the issue. I mean, I -- there may be other ways to precompute this data structure. But let me -- maybe if you reask the question again, I can ask it -- answer it directly.

Q. If no subsequent adjustment of the panoramic images is made when a viewer shifts their viewing to a different sight line direction in the panoramic images and the depth parallax angle that's been calculated for that new line of sight is different than the old, will faithful stereoscopic viewing of that portion of the scene be possible --

A. No.

Q. -- in Kawakita?

A. I don't think so.

MR. NELSON: You know what? We've been going

on for a little white. Let's grab some lunch, and then let's --

MR. HANLEY: Sure.

MR. NELSON: -- reconvene. Thank you.

(Whereupon, a lunch recess was taken.)

AFTERNOON PROCEEDINGS

BY MR. NELSON:

Q. Professor Darrell, before we broke for lunch, we were talking about Kawakita and the nature of the disclosure in Kawakita of an implementation of a system to adjust images. Do you remember that discussion?

A. Yes.

Q. Okay. And when we broke, I -- just before we broke, I had asked you that in the disclosure of Kawakita's system for these adjustments, that if no subsequent adjustment of the panoramic images is made when a viewer shifts their viewing to a different sight line direction in the panoramic image and the depth parallax angle that's been calculated for that new line of sight is different than the depth parallax angle associated with the old line of sight, faithful stereoscopic viewing of that portion of the scene in Kawakita wouldn't be possible absent a new adjustment. Was that your testimony?

A. It sounds right, yes.

Q. And so would you agree with me, then, that what Kawakita's process is describing is, or, rather, contemplates, that there may need to be a whole series of adjustments performed upon a panoramic image pair depending on which direction the viewer is viewing that image?

A. For faithful viewing?

Q. For perception of depth.

A. For faithful perception of depth or for -- or for perception of depth?

Q. Well, let's --

A. Maybe you should reask the question.

Q. Sure. Would you agree with me, then, that the process of adjustment described by Kawakita contemplates that depending on variance in the calculated depth parallax angle across different viewing lines in the panoramic image pair, there may need to be a whole series of adjustments performed as to that image pair in order to permit faithful stereoscopic viewing, depending on which direction the viewer is looking?

A. Yes, I think it contemplates that.

Q. And you, in your earlier response to my question, were drawing a distinction, I think, between faithful perception of depth and perception of depth.

Is that -- do I understand you to be drawing a distinction there?

A. Yes.

Q. What distinction is that, in your mind?

A. Extremely accurate versus approximate.

Q. Let me ask you, Professor Darrell, is a panoramic image pair as to which only a fragment of the panoramic image provides a perception of depth nonetheless a stereoscopic image pair?

A. Sure. Seems reasonable to me.

Q. Why do you say that?

A. Just -- I mean, I don't have any specific -- it's because it is -- it meets the definition that it is a stereo panorama, and a portion of it -- some parts of it are accurate, and some parts of it are inaccurate. The fact that parts of it are inaccurate wouldn't change its -- the nature of it as being a panoramic stereo pair.

Q. Let me ask you to look at page 19 of Kawakita. In particular I want to draw your attention to the sentence about halfway through that paragraph which reads, "However, we believe it is possible to automatically derive the depth parallax angle using the relationship between the size of the flow vector obtained from optical flow detection and the distance

from the camera to the object, and the correlation between the generated left and right panoramic images." Do you see that?

A. Yes.

Q. Do you understand the statement here that the authors believe it possible to automatically derive the depth parallax angle to indicate that Kawakita itself discloses only manual determination of the depth parallax angle along different sight lines in the scene?

A. That wasn't my interpretation.

Q. What is your interpretation?

A. That there -- that's an additional automatic derivation "using the relationship between the size of the flow vector obtained from optical flow detection and the distance from the camera to the object," and the rest of that sentence. They're describing an additional method to do it.

Q. So it -- that doesn't --

A. I interpreted that to be future work, the way it's written.

Q. So you understand Kawakita separately, earlier here, to be disclosing an automatic derivation of the depth parallax angle across all sight lines?

A. That's my present understanding, yes.

Q. What causes you to have that understanding in

this article?

A. Because everything that was described in the previous section suggested that it was computations performed using automatic means, not using manual intervention.

Q. Does the description of the field test in figure 7, in which, "while actually looking at the panoramic images, alignment was performed in several sight line directions so faithful stereoscopic viewing would be possible, and the depth parallax angle in each sight line direction was recorded" support your conclusion that what Kawakita is describing is automatic detection or derivation of depth parallax angles?

A. I think there the calibration process has an interactive component, where there's some, maybe, user intervention of that calibration process. But the continuously variation -- continuously varying depth parallax handle -- angle, excuse me, and the application of that was automatic. So -- but this calibration process that you've directed my attention to does appear to be potentially including manual intervention at that step.

Q. So -- so could I ask you a little bit about your understanding of what you've described as the calibration process. Do you understand Kawakita to be

describing a scenario in which a viewer is observing a panoramic image pair from some line-of-sight direction, some portion of it across some line of sight, and based on different adjustments of the rotation of the two images, that viewer is describing better or worse perception of depth?

A. Sorry. Could you repeat the question?

Q. Sure. I just want to know what you think is going on in this calibration process. I mean, at -- so my question is, do you understand this language to -- of -- that I won't read again, but that we're pointing at, to refer to a process in which, first of all, some viewer is viewing a pair of -- of panoramic images, designed to be a left and right pair, along a particular line of sight and looking at what's viewable --

A. Uh-huh.

Q. -- along that line of sight? Yes?

A. Uh-huh.

Q. And how do you understand Kawakita to be describing, then, that a calibration occurs? Does that person report that depth looks good?

A. It could be that, yes. It could be as simple as just a person adjusts it so that it has stereo depth perception that appears to have high fidelity.

Q. Is any other way disclosed in Kawakita that

you're aware of?

A. Well, and aside from that sentence that we were describe -- we were referring to in section 8 about the possible automatic method, I'm not -- I don't recall any at this moment.

Q. Okay. And I want to make sure I understand your testimony. Is it your testimony that Kawakita describes that once this calibration process, as you've described it, has been completed, the adjustment -- that is to say, the rotation of the image pairs -- along each line of sight is performed automatically as a viewer views the scene?

A. I think so.

Q. How would that be implemented in 1997?

A. I think it would be implemented by rotating the images using digital image processing.

Q. And how would viewing along different lines of sight be detected in such a scenario in 1997?

A. How would viewing along different lines be detected?

I'm not sure I understand the question.

Q. Well, you've already testified that different amounts of adjustment of rotation may be required at different points along the panoramic image pairs --

A. Yes.

Q. -- depending on where the viewer is looking.

A. Yes.

Q. So if it's your testimony that what Kawakita discloses is a technique by which that adjustment, that rotation, is performed automatically, I'm asking you how Kawakita -- first how Kawakita discloses that line-of-sight viewing by the viewer is detected?

A. I don't understand the detection part of that. Right? I don't know what you're referring to when you refer to "detected."

Q. Well, if -- if you're telling me you read Kawakita as automatically performing these adjustments for a viewer of the scene -- which is what you've said, I believe, correct?

A. Yes.

Q. How does the disclosure of Kawakita tell you how to know where the person is looking?

A. You mean what angle they're viewing -- they're --

Q. Yeah, what line of sight they are viewing the scene from.

A. The stereoscopic viewing apparatus would have some user interface that would presumably allow the user to change their viewpoint, so as to enjoy the panorama. So there's some mechanism for guiding the viewport to a

new location to observe a new direction.

Q. So they're only viewing a part of the panorama at a time, is your understanding?

A. I believe that's how these panoramas are viewed. You can't view 360 degrees at the same time with human eyes.

Q. So just a portion is being viewed at a given time, correct? That's your understanding?

A. That's my -- yes.

Q. And that portion is -- is, if this adjustment occurs, being displayed stereoscopically?

A. Yeah.

Q. Correct?

A. Could you repeat the question?

Q. I'm comfortable with your answer.

A. Great.

Q. I want to confirm something we talked about before lunch. It's your opinion that the image pairs generated by the Kawakita process are a stereoscopic panoramic image pair even prior to any of these adjustment techniques that Kawakita discloses, correct?

A. Quite possibly, yes.

Q. Possibly? Not always?

A. I think we discussed this very degenerate case where you had a scene where everything was so -- so --

arranged such as to not be fusible. And maybe that one wouldn't be. But if any person can look at them or any part them and get a perception of approximate depth, I would say, yeah, then it was.

Q. Could I ask you to look at figure 5 of Kawakita, on page 16.

A. Yes.

Q. You understand this to be an image pair that's the output of the Kawakita technique for capturing images, excising slit images, and compositing image pairs?

A. I think so, yes.

Q. Does figure 5 depict a stereoscopic image pair?

A. I think so.

Q. How do you know?

A. Because it meets the definition that we've been discussing throughout today.

Q. Did you test it?

A. I have not performed any operations on this image, no.

Q. Did you attempt to view it stereoscopically?

A. I have not.

Q. If viewed stereoscopically, without any adjustment for parallax depth angle, as described in Kawakita, does figure 5 provide to a human perception of

depth?

A. I believe it would.

Q. What basis do you have for making that?

A. Because it -- there are corresponding scene elements when regions -- if you present the corresponding scene region from these two panoramas to each eye, different scene elements would have different disparities, within a range that would generally be fusible, and it -- therefore I conclude that a human would get a -- at least a sense of approximate depth from this scene or scenes like it that would generally be collected by this apparatus. So I need not limit myself to just this one image. I can consider all of the images that -- that this apparatus would generally produce, although you did ask me about this one image in your question, so I should probably only talk about that in my answer.

Q. Directing your attention to Sony Exhibit 1010, your first declaration in the '003 matter, paragraph 10(b) -- do you see where I am?

A. Yep.

Q. Paragraph 10(b) states that "It would have been obvious to a person of ordinary skill in the art to combine the 2D panorama and stereoscopic panorama embodiments discussed in Kawakita by excising a center

slit as well as a left and right slit to obtain both a 2D panoramic image and a stereoscopic panoramic image pair." Do you see that?

A. Yeah.

Q. What do you mean by "it would have been obvious"?

A. It would have been readily apparent.

Q. Do you have an understanding of what the legal standard is for a piece of prior art or an activity in connection with a piece of prior art to be obvious?

A. I do.

Q. What is that standard?

A. That it would have to be obvious to someone of ordinary skill in the art, given what they knew at the time, to combine these things to achieve the outcome.

Q. Is that what you meant by "obvious" in your statement in this declaration?

A. Yeah.

Q. In forming your conclusion that it would have been obvious to combine a 2D panorama and a stereoscopic panorama as discussed in Kawakita, did you consider your own work?

A. Only generally, insofar as I considered the general knowledge that I knew people -- that I knew I had and that I knew people would have, but limiting it

to people of ordinary skill; but, no, no specific work of mine did I rely on for that consideration.

Q. And in your own work, did you rely on your entire body of work, as a general matter, in forming your opinion that it would be obvious to combine these two?

A. I didn't exclude any of my previous knowledge. I'm not sure.

Q. Okay. What about the work of others in the field? Did you consider any of -- any work by any other person in the field in coming to your conclusion that it would have been obvious to combine these two components?

A. No. It just seems obvious on the face of it.

Q. Did you consider the teachings of the '003 patent or the '284 patent to come to your conclusion that it would be obvious to combine these two?

A. No.

Q. I'd like to direct your attention to the second sentence in paragraph (b) of your declaration, which --

A. In paragraph 10?

Q. Yes, thank you, paragraph 10(b). It reads that "One of ordinary skill in the art would understand that setting the focal point of the camera at a reasonable distance away from the rotational axis will not

materially affect the quality of the center slit 2D panorama," comma, "just as it does not materially affect the quality of the left and right slit images." Do you see that?

A. I do.

Q. What is the significance of the second sentence of your opinion in paragraph 10(b) to the first sentence?

A. It's pointing out to -- pointing out that one of ordinary skill in the art would -- who might want to have a traditional panoramic view, such as was commonly done prior to -- to these works, where you rotate a camera around its own axis to get a monocular panorama, that if you also wanted that image, it could be directly excised from the center slit of the apparatus that's being described by Kawakita, and that you get the same image -- it's the same panorama. Even though that Kawakita's cameras is shifted a reasonable distance away from the rotational axis, you get the same panorama for the center slit image as you would for the -- if you hadn't translated it.

Q. Does Kawakita disclose a center slit image?

A. Yes.

Q. Where?

A. I'll have to look through it to find it.

Q. Sure.

A. I think it really just does so in the introduction, I recall, almost just the second sentence and the third sentence of the introduction.

Q. Are you referring to the sentence that reads, "In the case of a 360-degree panoramic image, a single panoramic image can be generated from images in all direction with the photographing position at the center"?

A. Yeah.

Q. You're not aware of it being disclosed anyplace else in Kawakita?

A. I'm not sure.

Q. Okay. Does this two-dimensional center slit technique disclosed here we're looking at in the introduction describe center slit images having a fixed width?

A. I'm sorry. Could you repeat that question?

Q. Does the technique for two-dimensional panoramas that you've pointed me to here describe that the center slit images have a fixed width?

A. It doesn't specify that in that disclosure right there. It refers to the fact that this has been done in the past and can be done in the present. My most natural reading would be that in the past it hadn't

been done -- sorry, it had been done with a fixed slit, but then the disclosure here would obviously include that you could take that rotation about the center axis, and if you want to estimate the rotation angle, so as to have a varying rotation angle and adjustable slit, it would be clear that that was possible here as well.

Q. Okay. But do you agree with me that the disclosure here of the single panoramic images -- image with -- from a center slit describes that the slit images from that center are of a fixed width?

A. No. I didn't say that.

Q. Does it not say, right after that sentence, "However, most generation of panoramic images requires that the camera be rotated while maintaining a precise angular speed. This limitation exists because a slit width of fixed size is set in advance corresponding to the rotation angle speed of the camera"?

A. But -- yes, it says that there. But then later in the document, it describes how to have a variable slit computed from optic flow.

Q. For left and right image pairs, correct?

A. To me it's apparent that it could also be done for the center.

Q. Understanding your testimony that it's apparent that it could be done for the center, does Kawakita

disclose that it can be done for the center?

A. I think he does.

Q. Where?

A. By virtue of talking about the traditional way of collecting a panorama with the optical axis of the camera at the center of rotation and -- and fixed slits and saying that that's a limitation and that we overcome the limitation with our interesting new technique for optic flow estimated rotation angle and thereby computing slits of varying size.

Q. I understand that you are drawing that correspondence between the center slit of fixed width and this new technique described. Where does Kawakita and his colleagues in this article describe that the center slit images may be of variable width?

A. To me, that is described in the entire section that describes how you can have -- the first sentence of section 4 says "the size of the flow vector is used to set the slit width."

Q. "And the respective right eye and left eye slit images are excised from the frame images." Isn't that what the rest of the sentence says?

A. I don't know that that's limiting. It could be any of the slit width -- any of -- the widths of any of the slits.

Q. Does it say that?

A. The words -- those words do not appear in ink, but to me it discloses it.

Q. Could I ask you to turn to Sony-1013, your first declaration in connection with the '284 patent, and in particular paragraph 10(b). Will you let me know when you're there?

A. I'm sorry. Could you tell me which -- which document to look at?

Q. 1013.

A. 1013. Good. Fine.

Q. I'm not going to read to you the entire paragraph, but I -- I would like to draw your attention to the first sentence of that paragraph, which states that "A person of ordinary skill in the art reading Kawakita would understand that the processing steps disclosed by Kawakita would necessarily have been performed by a processor within a computer or workstation." Do you see that?

A. Yes.

Q. Understanding your opinion is that a person of skill in the art who read Kawakita would understand that you'd need to use a processor, does Kawakita disclose a processor for use in this process?

A. What I said here is what I believe: that it

would be necessarily understood that the processing described in Kawakita would have been performed on a processor within a computer. And I'm not sure the precise legal definition of "disclose" that would -- that might be distinct from that statement.

Q. Does the word "processor" appear in Kawakita, to your knowledge?

A. I don't -- I'm not -- I don't know.

Q. How about a workstation?

A. I don't know.

Q. Paragraph (c) of your declaration states that "In fact...every imaging project to which I have contributed, including the nearly 200 listed in my CV, has employed a processor, such as, for example, within a computer or workstation." Do you see that?

A. Yeah.

Q. How many of those 200 imaging projects involved the generation of stereo panoramic images?

A. Stereo panoramic images, I believe I've already testified that I don't recall any. So --

Q. Paragraph (d) of your declaration in the '284 case states that "A person of ordinary skill in the art...would understand that it would be preferable to miniaturize the image generation components disclosed by Kawakita so that they would all fit within a single

housing including the imager, processor, and display." Do you regard that still as your opinion?

A. I have not changed my opinion.

Q. How would a person of skill in the art understand to miniaturize the display arrangement disclosed in the field test of Kawakita into a housing including the imager, processor, and display, so that the required adjustments can be accomplished?

A. I'm sorry. Could you please repeat? I lost the verb in there.

Q. How would a person of skill in the art understand how to miniaturize the display arrangement disclosed in the field test of Kawakita into a housing that also includes the imager and the processor, such that the required adjustments disclosed by Kawakita could be accomplished?

A. I --

MR. HANLEY: Objection; lacks foundation.

THE WITNESS: Right. I don't know. Nor did I say that in that paragraph -- in that sentence.

BY MR. NELSON:

Q. Your sole opinion with respect to the miniaturization, then, is that a person of skill in the art would find it preferable to do so?

A. For paragraph 10(d), yes.

Q. You do not opine, for instance, that Kawakita discloses how to do so, correct?

A. Correct.

Q. Is it your opinion, apart from what you've stated here, that one of skill in the art reading Kawakita would know how to miniaturize --

A. I haven't --

Q. -- that display arrangement?

A. -- formed an opinion on that question.

Q. Do you agree with me that your recitation in 10(e) in Sony-1013 is the same recitation you provide in Sony-1010 at 10(b)?

A. It appears to be. Yes.

Q. Would you please turn to Sony-1040. This is your second declaration in connection with the '284 patent. Will you let me know when you're there. And I'm going to direct your attention to paragraph 10(d).

Are you there?

A. Yep.

Q. Here you offer an opinion about what one of ordinary skill in the art reading the "Field Test" section of Kawakita would understand, correct?

A. Sorry. Could you repeat the question?

Q. Sure.

A. I was reading my text.

Q. Yeah. Here you offer an opinion about one "of ordinary skill in the art reading the 'Field Test' section of Kawakita would understand," correct?

A. Yes.

Q. Okay. And you state halfway through that "Even if the report of stereoscopic viewing of the panoramic mosaic images were not included in Kawakita, a person" of "ordinary skill in the art reading the remainder of Kawakita would understand that stereoscopic display of the panoramic mosaic images to be disclosed or, at least, obvious." Do you see that?

A. Yes.

Q. Without the field test report, which of the two possibilities is your actual opinion, that stereoscopic display of the panoramic mosaic images is disclosed or that it would be obvious to do so?

A. It's both.

Q. It's both?

A. Yeah.

Q. Is it disclosed?

A. Yes.

Q. Absent the field test?

A. Yes.

Q. Where?

A. The fact that it talks about stereoscopic

viewing in the section -- header of section 6 is disclosing that. The whole section, as we've discussed in this deposition, is about stereoscopic viewing.

Q. What mechanism for display is disclosed in section 6?

A. There's no --

MR. HANLEY: Objection; asked and answered.

THE WITNESS: There's no specific mechanism that I see disclosed, just the general mechanism.

If you don't mind, I'm going to get a bottle of water.

BY MR. NELSON:

Q. That's fine.

A. No, I'm not.

Q. Oh. Let's --

A. It's not necessary.

MR. NELSON: Let's take one minute, and I'll get some more bottles of water. All right? I don't mind.

(Recess taken.)

BY MR. NELSON:

Q. I'm handing you what Sony has marked as Sony Exhibit Sony-1004. Have you seen this exhibit before?

A. Yes, I have.

Q. What is it?

A. It's the reference that we've been referring to as Ishiguro.

Q. Could you tell me, if you can, from a 50,000-foot level, what does Ishiguro describe?

A. Ishiguro describes "Acquiring Omnidirectional Range Information," is the title of the -- of the paper, and in so doing the collection of omnidirectional stereoscopic panoramas and images using a imaging apparatus that's most clearly shown in figure 4, where there's a camera rotating about an -- about a axis of rotation, but shifted from that rotation axis by some amount, and a mechanism of using a pair of slits to composite together two panoramas is described.

Q. What do you understand the purpose of the image acquisition technique described in Ishiguro to be?

A. The purpose is to acquire stereoscopic panoramic images, which are then used for estimation of depth and robotic applications of various forms.

Q. So when you testified that your understanding is that the purpose of the technique as described in Ishiguro is to acquire stereoscopic panoramic images, it's your testimony that the purpose of Ishiguro is to generate stereoscopic panoramic images for human viewing for a perception of depth?

A. I didn't testify that that was his purpose.

But I would testify that those panoramas could be viewed by a human. So they would fit the definition of "stereoscopic panorama" we've been working with and agreeing to today.

Q. So if I've missed your testimony about what the purpose of -- of the image acquisition technique was, could I ask you to tell me again what it is?

A. Do you want me to repeat what I just testified to?

Q. Well, I missed it, because I asked you to confirm that your testimony was that the purpose was to acquire stereoscopic panoramic images, and you said I had it wrong. What is the purpose of the image acquisition technique of Ishiguro?

A. I'm sorry. I'm lost. I don't recall where I said you had it wrong. Could you just -- can we start over and ask me a question?

Q. What do you understand the purpose of the image acquisition technique described in Ishiguro to be?

A. To acquire stereoscopic panoramic images for the purpose -- for the use by robotic vision algorithms, for depth estimation and navigation, and other purposes.

Q. Are stereoscopic panoramic images, which by definition provide a perception of depth to a human, necessary, in Ishiguro, to provide for depth estimation

and navigation using robotic vision algorithms?

A. I'm not sure if they're necessary, but they are used.

Q. Do you agree with me that Ishiguro -- Ishiguro describes the use of this image acquisition technique to provide depth calculation to aid a robot in navigating a space?

A. Yeah. I just testified to that effect.

Q. Directing your attention to page 48 of Ishiguro, Sony-1004, the first full paragraph describes that "Feature (3) can be used for stereo vision."

A. Unfortunately, I'm lost. Could you help me find where I'm supposed to be?

Q. Sure. The first full paragraph -- sorry, on the second column --

A. Okay.

Q. -- of page 48. I apologize. Are you with me there?

A. Yeah.

Q. There's a description -- there's a statement that says, "Feature (3) can be used for stereo vision by using two omnidirectional images taken at different locations in an environment."

A. Okay.

Q. What does stereo vision mean in Ishiguro?

A. I think here he's referring to stereo vision by a robotic algorithm, by a -- by a machine algorithm that will be used to compute depth.

However, that's what he means. It could also be used for human viewing. I don't think he was thinking of that as he wrote that word. So you asked me the question what did he mean when he wrote the word. And that is -- that was my testimony.

Q. Can I ask you to describe the technique Ishiguro discloses for image acquisition?

A. Sure. Do you mean the -- what I've described in figure 4?

Q. Is that what you understand to be the image acquisition arrangement, the camera arrangement?

A. It's the imaging method.

Q. This camera in Ishiguro is mounted on a robot, in your understanding?

A. Could be.

Q. Does Ishiguro describe that the camera is mounted on a robot?

A. I -- he certainly describes that the camera moves around so as to do these maps in different locations. And I can't remember whether he specifically says a robot or not.

Q. And the camera has two slits; is that correct?

A. It has several slits. It's not clear. Figure -- if you look at figure 4, it -- three -- three slits are drawn there.

Q. Well, let me direct your attention to just above figure 4. If you read it, it says, "We set two vertical slits with a 1-pixel width symmetrically to the image center." Does that clear it up?

A. That clears up that there are two slits that are set symmetric to the image center. It doesn't state that he doesn't additionally set another slit.

Q. Do you see another slit anywhere in this disclosure?

A. Only in figure 4.

Q. You think that's a slit, rather than the image center that he just referred to?

A. I'm not sure. It could be either.

Q. To the extent you detect slits in the disclosure of Ishiguro, are they one pixel wide?

A. In this paragraph they certainly are.

Q. Is there ever a description in Ishiguro of the slits for the camera being wider than one pixel?

A. I don't recall.

Q. What freedom of movement does the camera arrangement disclosed in Ishiguro have during image acquisition?

A. Rotation around the axis.

Q. Anything else?

A. Not that I recall.

Q. Is there any description of horizontal movement of the camera during image acquisition?

A. I have to say I -- not that I recall. I haven't reread this in the last -- in -- recently, so -- not that I recall.

Q. How does Ishiguro describe that images are created using the camera arrangement disclosed?

A. Well, I'm sure images are collected by the camera and stored as images, as a sequences of images. I don't recall where he describes that in the text.

Q. Do you understand -- do you have an understanding of how the omnidirectional images, such as those presented in figure 5, are generated from the acquired images --

A. Yes.

Q. -- in Ishiguro?

A. Yes.

Q. How does that occur?

A. By compositing together the slits, the images taken from the slits.

Q. With respect to the camera arrangement of Ishiguro, which you've pointed me to in figure 4, what

does Ishiguro describe about the distance between the slits?

A. In figure 4?

Q. Anywhere in Ishiguro. What does -- what is disclosed about the distance between the slits?

A. There's a relationship between the -- equation 1 certainly governs the relationship of the depth of a point involving the angle of the slits used in the imaging geometry.

Q. You're referring to equation 1 at the top of the second column of page 50?

A. Yeah.

Q. And does that equation 1, to your understanding, describe how the distance between the slits should be set so as to provide perception of depth to a human viewer of the resulting images?

A. Well, in concert with figure 9, it would help -- it would help if one had a desired error -- target error to know what -- and work space in terms of distance. Ishiguro has analyzed the relationship between the intraocular radius R and the error that results. And so if one had a work space that one wanted to have high-fidelity depth perception, there would be some guidance provided by that figure.

Q. Is it your understanding that figure 9, when it

discusses "Relationship between radius R and error," "R" refers to the intraocular radius of a human being?

A. Oh, no, it's the rotation axis of -- of the camera. My apologies.

Q. Well, I'm just trying to understand the testimony just previous to that, where you say, I believe, "Ishiguro has analyzed the relationship between the intraocular radius R and the error that results."

A. Yes. And I misspoke in that testimony, and I should have said the camera rotation radius R.

Q. Okay. Where does Ishiguro discuss any relationship between the intraocular radius of a human being and the separation between slits of the camera in Ishiguro?

A. Well, there is a relationship between the rotation axis of the camera and the intraocular distance. I'm not sure if it's explicitly described in Ishiguro, but -- I don't remember where it is.

Q. Okay. I know you're going to feel like you answered this question, but I need to ask you. Do you know one way or the other whether that relationship is explicitly described in Ishiguro?

A. I'm not -- I don't recall if it's explicitly described.

Q. Thank you.

A. That was a fair question.

Q. How many omnidirectional images does the process of Ishiguro create following this process of image capture and slit compositing?

A. One stereoscopic panoramic image or image pair, depending on how we define these terms.

Q. How does Ishiguro describe that the omnidirectional image pair that's created are used?

A. He describes the use of that stereoscopic panorama for depth estimation in a robotic vision system and map make -- making a map of a scene and thereby having an understanding of the structure of an environment that a robot might want to navigate in.

Q. So in that use, just to make sure I understand, I -- if I understand it correctly, the robot, or, rather, some computer, can take those two images and from the relative separation of objects detected in them can derive an estimate of depth, how far this object is away from the point of image capture, correct?

A. Yes.

Q. Does Ishiguro describe showing these omnidirectional images to a person, to a human?

A. Not that I recall.

Q. Does Ishiguro describe displaying these images to a human in a manner that would provide a perception

of depth to a human?

A. Isn't that redundant from the previous question?

Q. You can solve it by saying it doesn't.

A. And I'll amend my previous answer in saying except insofar as, by publishing this image, they're showing these images to people who read their paper. But no.

Q. Does -- with respect to the composition process for these image pairs disclosed by Ishiguro, after the omnidirectional images are created, does Ishiguro disclose any technique for further modifications to those resultant images or adjustments to those resultant images?

A. I -- I don't recall. He discloses -- however, he certainly does disclose various forms of further processing towards the goals that we just discussed that he has.

Q. Can I ask you to look at figure 5, on page 50.

A. Yes.

Q. Is it your understanding that figure 5 is an example of the output of the technique described in Ishiguro?

A. Of an intermediate component of the technique, yes.

Q. Put another way, then, figure 5, to your understanding, is an example of the image pairs that are generated by the Ishiguro technique and then later used for --

A. Yes.

Q. -- depth calculation?

Yes?

A. Used in the Ishiguro technique, yes.

Q. Do you see that figure 5 has a description below it that says "Two omnidirectional views for stereo method"?

A. Yeah.

Q. What do you understand the authors to have meant by the term "stereo method"?

A. Same as the question you asked me earlier when you asked for the definition of "stereo vision." That's referring to the process of automatically determining the range. That's their intent when they use the term, is my -- that's my -- that would be my understanding of their intent. That wouldn't preclude, however, using these images for human stereo viewing.

Q. I understand.

You may feel as if you've answered this question, too, but it would help me to understand what you believe or what you understand Ishiguro to describe

in terms of what the system of Ishiguro does with these images to estimate or calculate depth. How are these images taken, in the disclosure of Ishiguro, and used to calculate depth of objects in a scene?

A. I don't -- I haven't memorized that part of the document, but I can slightly speculate that you can -- it's apparent that you can just run traditional stereo -- machine stereo perception on these algorithms to find corresponding scene elements, estimate disparity, and from disparity get depth. I don't, frankly, recall the specific paragraph that discloses that right now.

Q. Does that process, as disclosed in Ishiguro, require the further display of these images in a manner that could be viewed by a human being?

A. It doesn't require it, no.

Q. The computer system's not going to composite it red and blue and put on glasses?

A. It would be a cool computer that did that.

Q. But it's not disclosed in Ishiguro as doing that?

A. One shouldn't make jokes on the record.

So no.

Q. Thank you.

A. But I have a good one for later.

Q. If it's a computer vision joke, I can tell you from my discussions with Professor Essa, they are generally lost on me. But I'm happy to try.

Is figure 5 of Ishiguro a stereoscopic panoramic image?

A. Yes.

Q. How do you know?

A. Because it is apparent to me that if you took a viewport corresponding to a human viewer of a region of this panorama and took the corresponding scene region from the left eye and the right eye and showed it to human eyes, there -- pardon the pun -- there would be varying disparities of corresponding elements in the scene, which would provide a sense of depth to a human observer.

Q. And you know this because you tested it?

A. No. I know this because it's obvious to me.

And, again, I will say not only is it apparent to me for this image, but in general the kinds of images the apparatus disclosed would acquire would have that characteristic.

Q. Is it necessary, for a depth calculation process for robotic navigation, that the disparity between the images be such that the resultant image is appropriate for human perception of depth?

A. It's not necessary. The computer could be searching a much larger range of disparities than a individual human would.

Q. Does Ishiguro disclose a disparity that's appropriate for human perception of depth?

A. The images that Ishiguro collects and the scenes that he shows would have ranges of disparities that would be fusible by human observers.

Q. Well, so let me ask you. Where in Ishiguro do you see a description of how the method they disclosed that leads to figure 5 is designed so that it will provide a perception of depth to humans?

A. I don't recall any discussion of that. I would just state, in response to that question, that they designed a method to create omnidirectional views that would have a sense of depth to a machine algorithm. The machine algorithm senses depth in ways that are not dissimilar from how humans sense depth. And so the human would also end up sensing depth from these images, even though it wasn't their purpose in designing these images per se.

Q. Is it your understanding of Ishiguro that the fact that in your opinion the resultant images are suitable for human perception of depth is happenstance?

A. Meaning luck or --

Q. It's -- it's not an intentional aim of Ishiguro?

A. It's a correlate aim. You really -- it's hard to design something that would work for the robotic case and not work for the human case. It's not impossible, but --

Q. Is it disclosed anywhere in Ishiguro, that is to say "it" meaning human perception of depth of the resultant images disclosed as a corollary aim or a correlate aim anywhere in Ishiguro?

A. I didn't see it, to my recollection.

Q. If I could ask you to turn to tab -- sorry, not tab 5, Sony-1010, which is your first declaration in connection with the '003 patent. And will you let me know when you're there.

A. 1010. Is that what I'm looking for?

Q. Uh-huh. It -- it should be a declaration that will have on the front of it "Sony-1010."

A. I don't have that one.

Do -- oh, sorry. I must be missing it. Where did it go?

Q. You know, I bet it's under here somewhere.

A. There it is. Thank you.

Q. Paragraph 11(a) is where I'd like to direct your attention. That's on page 4. Are you there?

A. Sure.

Q. You state that "Ishiguro discloses a method for generating a stereoscopic omnidirectional image pair." Do you see that?

A. Yes.

Q. What do you mean by "omnidirectional"? Same thing as panoramic?

A. Yeah. Yeah. It's maybe even stronger than panoramic. It's really all the way around.

Q. But otherwise, the definition of a stereoscopic image pair that we've talked about today is what you meant to convey?

A. Sure. Yes.

Q. Paragraph 11(b) states, "It would have been obvious to a person of ordinary skill in the art to combine the embodiments depicted in figure 1 and figure 4 in Ishiguro by including a center slit in the figure 4 system." Do you understand figure 1 to disclose a center slit?

A. Yes.

Q. Okay. And just so I understand, where in figure 1 is there -- let me just make sure I'm looking at the right thing. It may be obvious.

I'll withdraw that question.

Can I ask you to turn to Exhibit Sony-1013.

This is, I believe, your first declaration in the '284 patent. And I'm going to ask you to turn to page 6, paragraph 11(b). You state there, "It would have been commonplace, if not necessary, for scientists such as Ishiguro and his colleagues to stereoscopically view the images generated by the technique disclosed by Ishiguro on a stereoscopic display in order to confirm that the mosaic images accurately" present "relative depths of objects in the scene."

That's your opinion?

A. Yes.

Q. What is the basis for your statement that it would have been commonplace, if not necessary, to do so?

A. My general understanding of the field and its practice and just the, you know, clear understanding I have that as you built a system like this, you would want to check if it worked, and one of the ways you would check if it worked would be to look at the images that are coming out of the system.

Q. And that's based on all of your experience up until today?

A. Correct, and also the fact that they even publish a figure illustrating it. You know, to convince the reader of their method, they found it useful to show figure 5. I think that they would have found it useful

themselves to have looked at such a display when they were building the system.

Q. Do you cite any evidence in your declaration as to or supporting your statement that it would have been commonplace, if not necessary, to stereoscopically view those resultant images?

A. I did not cite any documents in that paragraph.

Q. Anyplace else in your declaration where you cite any evidence to that regard?

A. No, not regarding that paragraph.

Q. You write that "It would have been commonplace, if not necessary." I want to make sure I understand what you mean by that. There's two ways of reading that phrase. It could be that you're trying to suggest that it's pretty close to necessary to do it. The other way of reading it is that, well, it would have been commonplace but really not necessary. Which is it?

A. Well, I think the former is the grammatical way to read that. It's pretty commonplace.

Q. Do you also, then, think it's necessary?

A. Not strictly necessary. Very commonplace. Not strictly necessary. So it's hard to imagine they wouldn't have looked at the images at some point when they built the system. But if you had given them a million dollars to build it without looking at the

images, they would have found a way.

Q. And the reason your opinion is that they'd need to view the images stereoscopically is in order to confirm that the mosaic images accurately present relative depths?

A. Yeah.

Q. Why is confirmation that the mosaic images themselves accurately present to a human the relative depths of objects in the scene necessary for calculating depths for these images for a robot?

A. I didn't testify it was necessary.

Q. Commonplace, if not necessary?

A. Because it's the best way to just check to see if you have a stimulus that has depth that -- that is apparent. Humans are the best depth -- well, not -- humans are always generally the best vision systems we have. So when one is trying to build a machine vision system, you often want to -- if a human couldn't do it, it would be hard for a machine to do it. So it would be an easy way to check that things were working, at least for the first -- for the acquisition part of the system.

Q. Wouldn't it -- wouldn't it just be easier to measure the actual distances and compare them to the depth map?

A. Well, let's say you were building a system and

the system wasn't working and you had complete garbage as your depth map. You have no idea why. You might want to look -- you would want to visualize the omnidirectional panoramas, so as to see whether -- is it this part of my algorithm that's broken or that part?

Q. In the situation you just described, wouldn't you just need to look at the images side by side, rather than stereoscopically?

A. You wouldn't get a sense of depth if you looked at them just side by side, so you might not get all the information from them. So it would be preferable to view them stereoscopically.

Q. Your opinion, as I understand it, is that it would be commonplace to view these stereoscopically in order to confirm that the mosaic images accurately present relative depths. But doesn't figure 13 of Ishiguro show how Ishiguro measured the accuracy of the estimates of relative depths of objects in the scene?

A. And what page is figure 13, now?

Q. 55, with the description beginning on page 54.

A. Figure 13 shows, as I recall -- I haven't reviewed this figure recently -- the positions of points in a scene. I'm not sure it's actually doing an error analysis. But even if it were, it would be a nice way to analyze the error of the complete system once it's

functioning. I don't think it would really address the scenario that I testified to earlier.

Q. In the Ishiguro technique for estimating depth of objects in the images, do the omnidirectional image pair that's been acquired need to be aligned against each other in any way to estimate depth?

A. I have to say I don't recall where that's disclosed in this document, since I don't think I relied on that for my testimony. But I -- if you draw my attention to it, I can look at it.

Q. Well, doesn't Ishiguro just disclose that you need to determine the correspondence between two objects in the images?

A. He probably does, since that's the basis of stereo -- stereo -- robotic stereo vision.

Q. I'd like to draw your attention back to Exhibit Sony-1013, page 6. And I'm going to ask you to look at paragraph 11(d).

A. Page 6?

Q. I'm sorry. Your declaration, sir.

A. 10 --

Q. 1013.

A. 1013 --

Q. Yeah.

A. -- is where I am. Great. Page --

Q. Yeah, it should be the same one. And it's page 6, paragraph 11(d).

A. It was right where I was. I apologize. All over the world to come back to where I was. Thank you.

Q. Uh-huh.

It states that "A person of ordinary skill in the art reading Ishiguro would also understand that Ishiguro discloses an experimental arrangement for laboratory use and that" in "order to implement Ishiguro's arrangement as a transportable unit for field use or as a commercial product, it would be necessary and normal to miniaturize and package the image generation components disclosed by Ishiguro so that they would all fit within a single housing including the imager," the "processor, and display." Do you see that?

A. Yes.

Q. What's the basis for your opinion?

A. My knowledge of the person of ordinary skill in the art as of the time of these inventions, and just common sense about my understanding of the field.

Q. Just so I understand, when you're talking about a transportable unit for field use or as a commercial product, you're talking about a robot, right?

A. No.

Q. No? What are you talking about?

A. If you -- it could be a robot, or it could be a commercial product for depth sensing that wasn't necessarily on a robot, but just for other measurement applications, like architecture, or -- I'm not sure this -- my testimony is limited only to Ishiguro's applications of his methods. So if one wanted to apply Ishiguro's methods to other applications and one wanted to make a field use or commercial mobile, handheld version of it, if you had that goal, I think it would be necessary and normal to use all the ideas and tools and directions from the development of technology to make everything smaller and package them into a single housing.

Q. Does Ishiguro anywhere disclose its arrangement for creating and analyzing these images, other than in connection with robot navigation?

A. No.

Q. Why would a robot of the sort described in Ishiguro need a display included in its housing?

A. If the robot was going to show the map to a user or ask for navigation assistance to be drawn upon the map or if the robot were a telepresence robot and were to convey the appearance of the scene to a remote viewer, or any number of ideas like that.

MR. NELSON: It's time for a short break.

(Recess taken.)

BY MR. NELSON:

Q. Okay. I'm going to hand you what Sony has marked as Sony-1006. I'm going to ask you to tell me if you recognize what it is.

A. I do not.

Q. Are you familiar with an Asahi article in this case?

MR. HANLEY: Objection; beyond the scope of the direct.

THE WITNESS: I've heard Asahi discussed, but I've not seen this -- but I do not recall seeing this document.

BY MR. NELSON:

Q. Okay. Do any of your declarations offer an opinion regarding Sony-1006, the Asahi reference?

A. I do not believe so.

Q. Were you asked to provide an opinion regarding Sony-1006, the Asahi reference?

A. I haven't seen this reference before, so no.

Q. Were you asked to provide any evidence necessary to make out a case of invalidity as to the '003 or '284 patents in view of Sony-1006, the Asahi reference?

A. I haven't seen this specific document before.

I remember a long time ago having some discussions of some -- some version of Asahi, but I was not asked to make any opinions, nor have I formed any opinions.

MR. NELSON: Okay. That concludes the deposition.

MR. HANLEY: Okay. No redirect.

(Whereupon, the deposition was adjourned at 3:24 p.m.)

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AFFIDAVIT

I, the undersigned, declare under penalty of perjury that I have read the foregoing transcript and that it is a true and correct transcript of my testimony contained therein.

Subscribed at _____, California, this _____ day of _____, 2013.

_____

TREVOR J. DARRELL, Ph.D.

CERTIFICATE OF REPORTER

I, JOHN WISSENBACH, hereby certify that the witness was duly sworn by me, before commencement of testimony by the witness, to testify the truth, the whole truth, and nothing but the truth in the within-entitled cause; that said deposition was taken at the time and place therein stated, in the presence of the above-noted people; that the testimony of said witness was reported by me, a Certified Shorthand Reporter and disinterested person, and was thereafter transcribed into typewriting and is a true record of the testimony given by the witness, and that the pertinent provisions of the applicable code or rules of civil procedure relating to the notification of the witness and counsel for the parties hereto of the availability of the transcript of the deposition for reading and signing have been met.

And I further certify that I am not a relative or employee of a party or of an employee of an attorney or agent of a party, or interested, directly or indirectly, in the proceeding either as counsel, attorney, agent, or otherwise.

DATED: 11/6/13

JOHN WISSENBACH, CSR No. 6862