SHENZHEN TUOZHU TECHNOLOGY CO., LTD. (Petitioner)
v.
STRATASYS, INC. (Patent Owner)

Petitioner Demonstratives

Case No. IPR2025-00311
U.S. Patent No. 8,562,324

Before Hon. Mitchell G. Weatherly, Christopher M. Kaiser, and Lilan Ren,
Administrative Patent Judges

Shenzhen Tuozhu 1034
Shenzhen Tuozhu v. Stratasys
IPR2025-00311

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Table of Contents

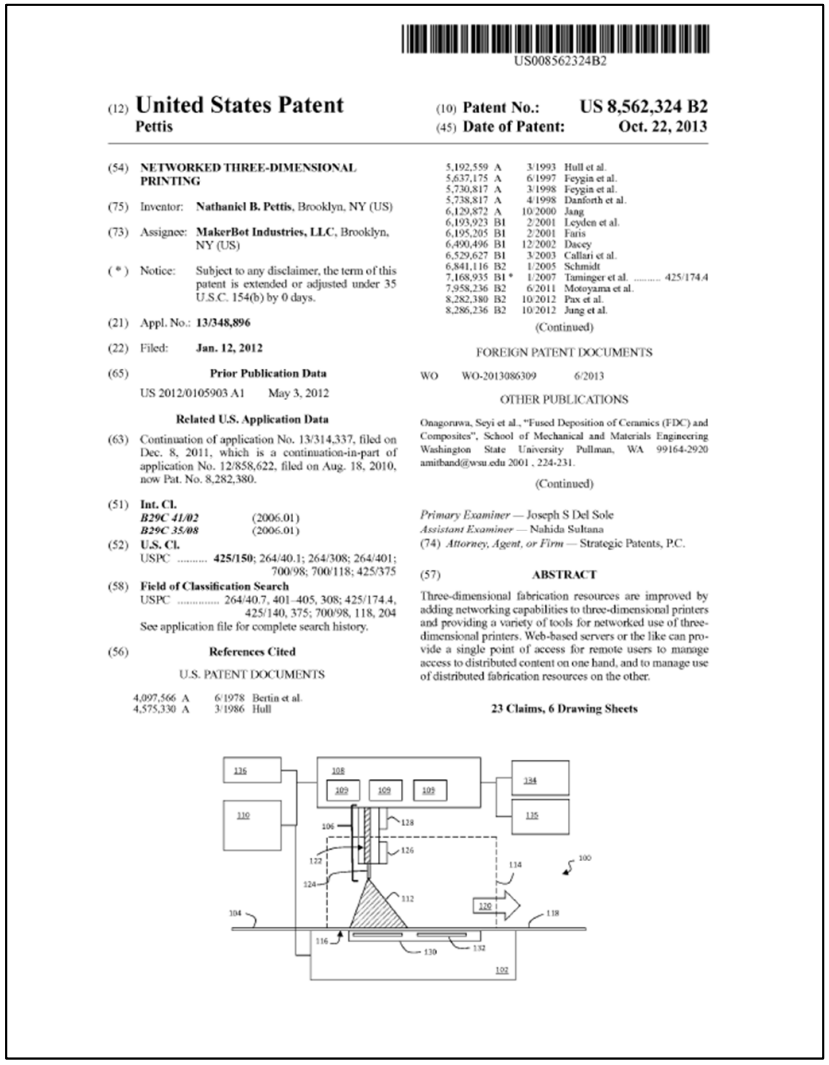
Section	Slide
’324 Patent Overview	3
Claim Construction	9
Mori and Henke are Analogous Art	24
’324 Patent Field of Endeavor and Problem Addressed	29
Mori is Analogous Art	32
Henke is Analogous Art	36
Ground 1A: Mazumder-Mori Provides Claims 1 and 19	40
Ground 1A: Mazumder-Mori Provides Claim 6	56
Ground 1A: Mazumder-Mori Provides Claim 5	64
Ground 1C: Mazumder-Mori-Hull Provides Claim 8	68
Ground 2A: Kritchman-Tay-Henke Provides Claims 1 and 19	70
Ground 2A: Kritchman-Tay-Henke Provides Claims 3 and 5	80
Ground 2A: Kritchman-Tay-Henke Provides Claim 6	85
Ground 2G: Kritchman-Tay-Henke-Anderson Provides Claim 5	92
Ground 2C: Kritchman-Tay-Henke-Hull Provides Claim 8	95

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

’324 Patent Overview

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Overview of the ’324 Patent



US008562324B2

(12) **United States Patent**
Pettis

(10) **Patent No.: US 8,562,324 B2**
(45) **Date of Patent: Oct. 22, 2013**

(54) **NETWORKED THREE-DIMENSIONAL PRINTING**

(75) Inventor: **Nathaniel B. Pettis**, Brooklyn, NY (US)

(73) Assignee: **MakerBot Industries, LLC**, Brooklyn, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/348,896**

(22) Filed: **Jan. 12, 2012**

(65) **Prior Publication Data**

US 2012/0105903 A1 May 3, 2012

Related U.S. Application Data

(63) Continuation of application No. 13/314,337, filed on Dec. 8, 2011, which is a continuation-in-part of application No. 12/858,622, filed on Aug. 18, 2010, now Pat. No. 8,282,380.

(51) **Int. Cl.**
B29C 41/02 (2006.01)
B29C 35/08 (2006.01)

(52) **U.S. Cl.**
USPC **425/150**; 264/40.1; 264/308; 264/401; 700/98; 700/118; 425/375

(58) **Field of Classification Search**
USPC 264/40.7, 401–405, 308; 425/174.4, 425/140, 375; 700/98, 118, 204
See application file for complete search history.

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(Continued)

Primary Examiner — Joseph S Del Sole
Assistant Examiner — Nahida Sultana
(74) *Attorney, Agent, or Firm* — Strategic Patents, P.C.

(57) **ABSTRACT**

Three-dimensional fabrication resources are improved by adding networking capabilities to three-dimensional printers and providing a variety of tools for networked use of three-dimensional printers. Web-based servers or the like can provide a single point of access for remote users to manage access to distributed content on one hand, and to manage use of distributed fabrication resources on the other.

23 Claims, 6 Drawing Sheets

- The ’324 Patent was filed Jan. 12, 2012, and its earliest claimed priority date is Aug. 18, 2010.
- The ’324 Patent includes 23 claims.
- The IPR2025-00311 Petition challenges claims 1, 3-11, and 17-22, of which claims 1 and 19 are independent.

EX1001 (’324 Patent), Cover Page.

FISH.
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Overview of the ’324 Patent

FIG. **3** depicts a networked three-dimensional printing environment. In general, the environment **300** may include a data network **302** interconnecting a plurality of participating devices in a communicating relationship. The participating devices may, for example, include any number of three-dimensional printers **304** (also referred to interchangeably herein as “printers”), client devices **306**, print servers **308**, content sources **310**, mobile devices **314**, and other resources **316**.

The sensor **134** may also or instead include at least one video camera. The video camera may generally capture images of the working volume **114**, the object **112**, or any other hardware associated with the printer **100**. The video camera may provide a remote video feed through the network interface **136**, which feed may be available to remote users through a user interface maintained by, e.g., remote hardware such as the print servers described below with reference to FIG. **3**, or within a web page provided by a web server hosted by the three-dimensional printer **100**. Thus in one aspect there is disclosed herein a user interface adapted to present a video feed from at least one video camera of a three-dimensional printer to a remote user through a user interface.

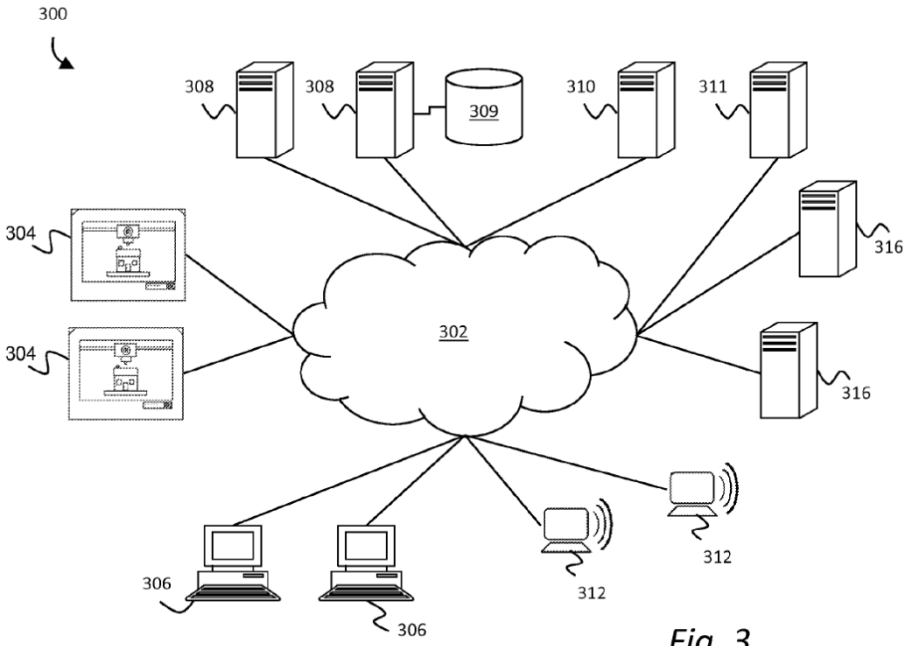


Fig. 3

EX1001 (‘324 patent), 8:7-15, 6:21-33, FIG. 3; Pet., 3-4.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Overview of the ’324 Patent

ticipate in the environment **300** as contemplated herein. Each client device **306** generally provides a user interface, which may include a graphical user interface and/or text or command line interface to control operation of remote three-dimensional printers **304**. The user interface may be main-

The fourth display area **506** may include a visualization area **510** that displays a visual representation of the print job. For example, the visualization area **510** may display a current tool path of the printer that is executing the print job, such as a two-dimensional layer of the object showing a path of a print head as it traverses that layer. The visualization area **510** may also or instead show a simulated print object, such as a rendering of a three-dimensional model depicting a current state of the completion of an object being fabricated according to a print job. The visualization area **510** may also or instead show an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job. This may, for example, include a digital still image (which may be updated periodically) or a video image captured from a video camera at the three-dimensional printer. Thus a user may visually monitor progress or status of a remote print job through the user interface **500**. A status area **512** may also be provided that shows current status information (e.g., percentage completion, time until start, time until completion, and so forth) for the active resource.

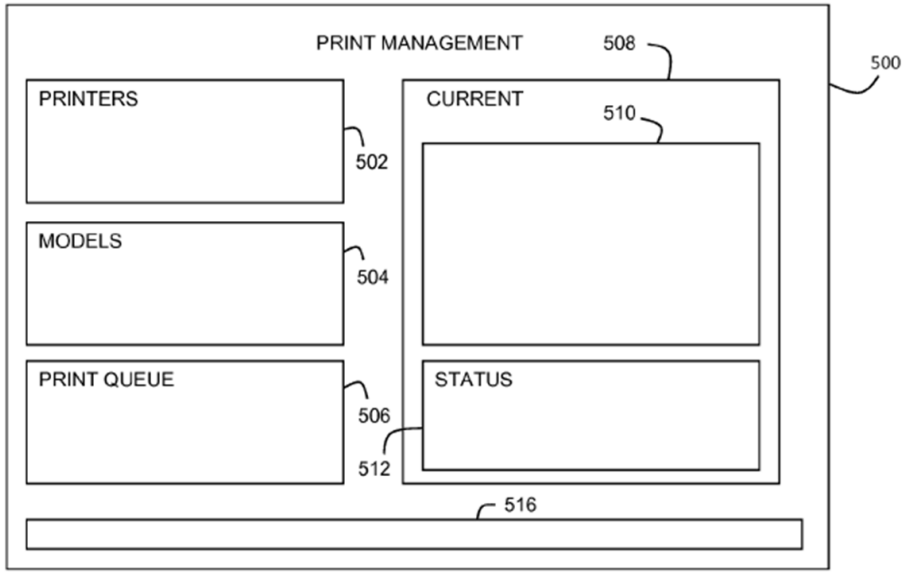


Fig. 5

FISH.

EX1001 (‘324 patent), 8:54-58, 22:41-60, FIG. 5; Pet., 4; Inst. Dec., 4; POR, 15. 6

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

'324 Patent Claims 1 and 19

1. A device comprising:
a three-dimensional printer including a build volume;
a network interface coupled to a data network;
a video camera positioned to capture video of the build volume from a point of view; and
a processor configured to receive a three-dimensional model through the network interface, and to control operation of the three-dimensional printer to fabricate the three-dimensional model as an object within the build volume of the three-dimensional printer, the processor further configured to provide a user interface to a remote user accessing the device through the network interface, and to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

19. A method comprising:
providing a three-dimensional printer including a build volume, a network interface coupled to a data network, and a video camera positioned to capture video of the build volume from a point of view;
receiving a three-dimensional model through the network interface;
fabricating the three-dimensional model as an object within the build volume of the three-dimensional printer; and
providing a user interface to a remote user accessing the device through the network interface, wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Overview of Grounds Instituted Against '324 Patent

Ground	Claims	Basis for Rejection (35 U.S.C. § 103)
1A	1, 3, 5-7, 9-10, and 19-22	Mazumder+Mori
1B	4	Mazumder+Mori+Tian
1C	8	Mazumder+Mori+Hull
1D	11	Mazumder+Mori+Seki
1E	17	Mazumder+Mori+Waehner
1F	18	Mazumder+Mori+Lan
1G	20-22	Mazumder+Mori+Anderson
2A	1, 3, 5-7, 9-10, and 19-22	Kritchman+Tay+Henke
2B	4	Kritchman+Tay+Henke+Tian
2C	8	Kritchman+Tay+Henke+Hull
2D	11	Kritchman+Tay+Henke+Seki
2E	17	Kritchman+Tay+Henke+Waehner
2F	18	Kritchman+Tay+Henke+Lan
2G	3, 5, 9-10, 20-22	Kritchman+Tay+Henke+Anderson

Pet., 1-2

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Element [1.d] (partial): …to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

Petition: "Furthermore, although not required by the claim language, it would have been obvious to display the actual image and the virtual image of the product simultaneously so as to achieve the advantages articulated above."

Pet., 23.

Institution Decision: "The plain language of the claim does not recite any requirement that the 'image of the build volume from the video camera and [the] two-dimensional projection of the three-dimensional model from the point of view of the video camera' be presented simultaneously, only that they both be presented. Ex. 1001, 27:29–35."

Inst. Dec., 24.

Petitioner's Reply: "The plain language of the claims does not state that the image and the projection are required to be displayed simultaneously, only that each is 'present[ed] in the user interface.'"

Pet. Rep., 2.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

- **Plain meaning of the claim language indicates no simultaneous display requirement (slides 12-14)**
- **No claim scope disclaimer in prosecution history (slides 15-17)**
- **Specification of ’324 patent does not describe simultaneous display of image of the build volume from the video camera and the two-dimensional projection of the three-dimensional model (slides 18-19)**
- **Dependent claims of ’324 patent indicate that simultaneous display is not required (slide 20)**
- **Patent Owner’s infringement contentions identify that Patent Owner has argued the district court proceeding that simultaneous display is not required in (slides 21-22)**
- **Patent Owner is attempting to nullify Congress's amendment process (slide 23)**

FISH.

Pet. Rep., 1-5.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

’324 Patent Claims 1 and 19

1. A device comprising:
a three-dimensional printer including a build volume;
a network interface coupled to a data network;
a video camera positioned to capture video of the build volume from a point of view; and
a processor configured to receive a three-dimensional model through the network interface, and to control operation of the three-dimensional printer to fabricate the three-dimensional model as an object within the build volume of the three-dimensional printer, the processor further configured to provide a user interface to a remote user accessing the device through the network interface, and to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

19. A method comprising:
providing a three-dimensional printer including a build volume, a network interface coupled to a data network, and a video camera positioned to capture video of the build volume from a point of view;
receiving a three-dimensional model through the network interface;
fabricating the three-dimensional model as an object within the build volume of the three-dimensional printer; and
providing a user interface to a remote user accessing the device through the network interface, wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Dr. Cormier (Patent Owner's Expert):

Q. Continuing with this hypothetical involving the graphical user interface 108 in figure 1, if this window remained open and a new job were added to the graphical user interface 108, would displaying that new job make this a new user interface or would you consider that the same user interface?

MR. KAPADIA: Objection. Incomplete hypothetical.

THE WITNESS: Again, I -- the hypothetical -- assuming that the window isn't closed and, you know, new windows aren't opened, I probably would describe that as the -- as the same user interface.

FISH.

EX1027 (Cormier Depo.), 19:1-20:3, 33:16-34:2; Pet. Rep., 2.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Dr. Wolfe (Petitioner's Expert):

7. The Patent Owner and Dr. Cormier are now attempting to read a simultaneous presentation requirement into the claims that is not part of the actual claim language, effectively rewriting the claim to recite:

> the processor further configured … to **simultaneously** present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

8. However, contrary to the assertions of Patent Owner and Dr. Cormier, the claims neither recite, nor require, that the presentation of the image of the build volume and the presentation of the two-dimensional projection of the three-dimensional model be at the same time, only that both are presented by the same user interface.

EX1022 (Second Wolfe Dec.), ¶¶7-8; Pet. Rep., 1-2.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Patent Owner (POR):

> But nothing in *Taminger* "specifically leads to the applicant's claimed user interface, which provides both video and model views from the same point of view in order to permit *side-by-side comparison* of model and results by a remote user." May 22, 2013 Amendment and Reply to Office Action at p. 7 (EX1002 at 161) (emphasis added).

POR, 17 (citing EX1002 (prosecution history), 161).

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Legal Standard

***CUPP Computing AS v. Trend Micro Inc.*, 53 F.4th 1376, 1383-84 (Fed. Cir. 2022):**

> "Thus, where the alleged disavowal is ambiguous, or even amenable to multiple reasonable interpretations, we have declined to find prosecution disclaimer."

> "Nullifying Congress's amendment process would be particularly perverse because Congress protected the public in ways that CUPP's disclaimer rule would not. Congress gave accused infringers 'intervening rights' protection for substantively amended claims, ensuring that such claims have only prospective effect."

***SuperGuide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 874-875 (Fed. Cir. 2004):**

> "'Although [it] is correct that the prosecution history is always relevant to claim construction, it is also true that the prosecution history may not be used to infer the intentional narrowing of a claim absent the applicant's clear disavowal of claim coverage.' *Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1327 (Fed. Cir. 2003). To be given effect, such a disclaimer must be made with 'reasonable clarity and deliberateness.' *N. Telecom Ltd. v. Samsung Elecs. Co.*, 215 F.3d 1281, 1294 (Fed. Cir. 2000)."

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Examiner During Prosecution:

DETAILED ACTION

Allowable Subject Matter

1. **Claims 1-23 are** allowed.

2. The following is an examiner's statement of reasons for allowance: the applicant argued that the closest prior art reference by Taminger (US 7,168,935) teaches all the limitation except having a device comprising: *presenting the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera* (see applicant's argument on page 7, lines 7 – 25).

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

EX1002 (prosecution history), 174; Pet. Rep., 4; Pet., 5.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

The fourth display area **506** may include a visualization area **510** that displays a visual representation of the print job. For example, the visualization area **510** may display a current tool path of the printer that is executing the print job, such as a two-dimensional layer of the object showing a path of a print head as it traverses that layer. The visualization area **510** may also or instead show a simulated print object, such as a rendering of a three-dimensional model depicting a current state of the completion of an object being fabricated according to a print job. The visualization area **510** may also or instead show an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job. This may, for example, include a digital still image (which may be updated periodically) or a video image captured from a video camera at the three-dimensional printer. Thus a user may visually monitor progress or status of a remote print job through the user interface **500**. A status area **512** may also be provided that shows current status information (e.g., percentage completion, time until start, time until completion, and so forth) for the active resource.

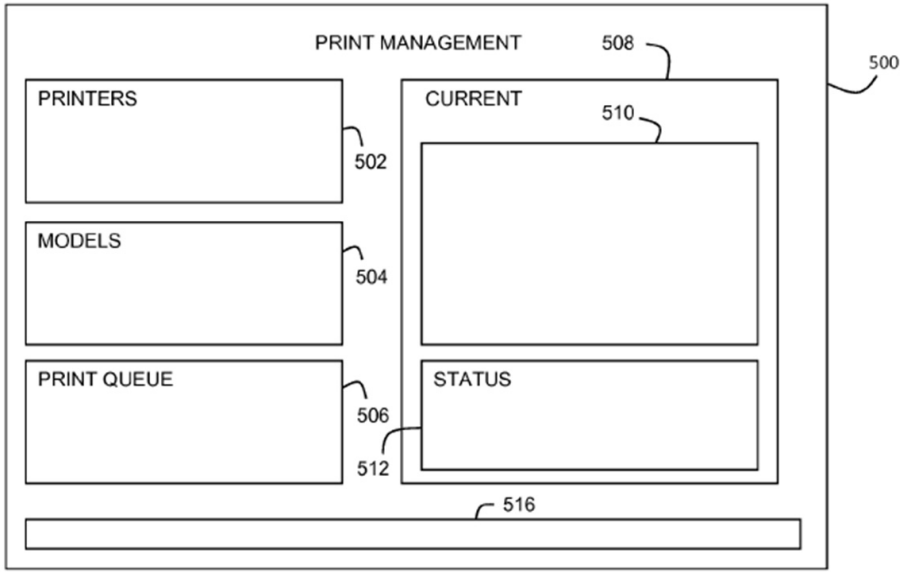


Fig. 5

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EX1001 ('324 patent), 22:41-60, 24:47-55, FIG. 5; Pet., 4; Pet. Rep., 2-3; Inst. Dec., 4; POR, 15.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Dr. Wolfe (Petitioner's Expert):

11. Figure 5 (reproduced above) does not show the three-dimensional model and the image of the working volume displayed simultaneously. Similarly, while the above quote from the '324 patent describes that various different types of information can be shown in the visualization area, it does not ever expressly describe these different types of information as being displayed at the same time,

12. Later on in the specification, the '324 patent describes that the user interface "may be any of the user interfaces described above, or any other suitable interface for conveying visual information such as a video image and/or model projection." EX1001, 24:47-55. This example once again describes that the video image and model projection can both be presented by the user interface but does not describe the image and model projection as being presented at the same time.

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

EX1022 (Second Wolfe Dec.), ¶¶11-12; Pet. Rep., 3

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

19. A method comprising:

providing a three-dimensional printer including a build volume, a network interface coupled to a data network, and a video camera positioned to capture video of the build volume from a point of view;

receiving a three-dimensional model through the network interface;

fabricating the three-dimensional model as an object within the build volume of the three-dimensional printer; and

providing a user interface to a remote user accessing the device through the network interface, wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

20. The method of claim **19** further comprising transmitting status information over the data network upon completion of the object.

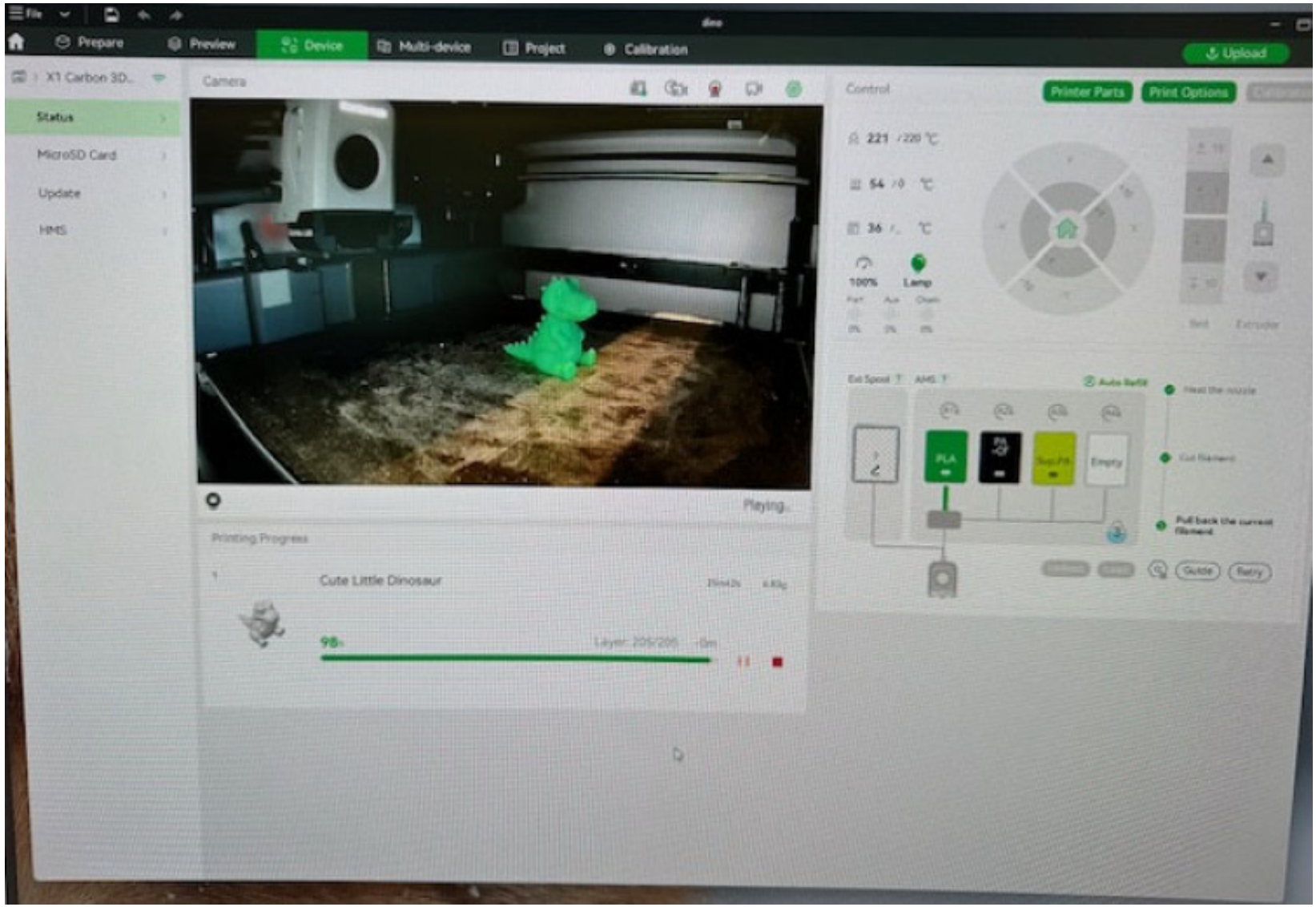
21. The method of claim **20** wherein the status information includes data presented through the user interface.

FISH.

EX1001 ('324 patent), 24:47-55, 25:6-10; Pet. Rep., 3.. 20

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]



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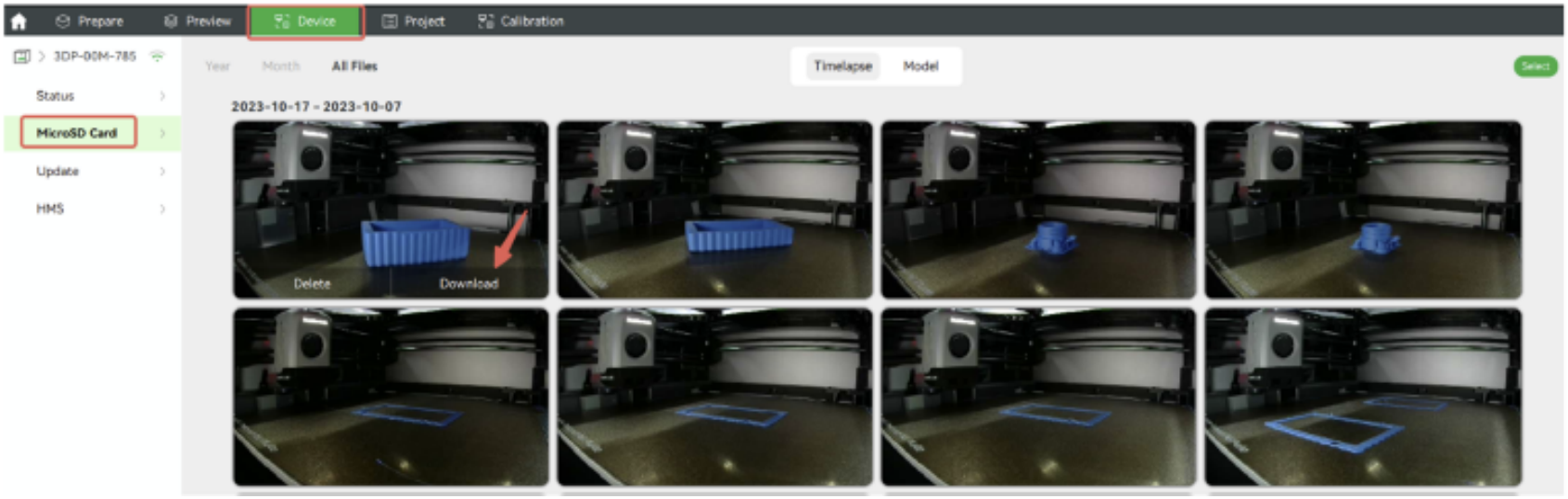
EX1016 (Stratasys Infringement Contentions), 43; Pet. Rep., 5. 21

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

Alternatively, a two-dimensional projection of the three-dimensional model is a video image from the video camera, as is shown above in Bambu Studio or Bambu Handy, and an image of the build volume from the video camera is a time lapse, as is shown below. These are shown in the Bambu Studio or Bambu Handy software running on a processor that alone or in combination with a processor on the printer is also configured to provide a user interface to a remote user.

In Bambu Studio, you can also download time-lapse video files from the "Device" - "MicroSD Card" page:



FISH.

EX1016 (Stratasys Infringement Contentions), 46, 53; Pet. Rep., 4-5. 22

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim Construction: Elements [1.d], [19.d]

***CUPP Computing AS v. Trend Micro Inc.*, 53 F.4th 1376, 1383-84 (Fed. Cir. 2022):**

> A rule permitting a patentee to tailor its claims in an IPR through argument alone would substantially undermine the IPR process. Congress designed inter partes review to "giv[e] the Patent Office significant power to revisit and revise earlier patent grants," thus "protect[ing] the public's paramount interest in seeing that patent monopolies are kept within their legitimate scope." *Cuozzo Speed Techs., LLC v. Lee*, 579 U.S. 261, 272, 279-80, 136 S. Ct. 2131, 195 L. Ed. 2d 423 (2016) (internal quotation marks, citation, ellipses, and alterations omitted). If patentees could shapeshift their claims through argument in an IPR, they would frustrate the Patent Office's power to "revisit" the claims it granted, and require focus on claims the patentee now wishes it had secured.

> Nullifying Congress's amendment process would be particularly perverse because Congress protected the public in ways that CUPP's disclaimer rule would not.
>
> ...
>
> In brief, if patent owners could freely modify their claims by argument in an IPR, they could avoid the public-protecting amendment process that Congress prescribed.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mori and Henke are Analogous Art

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: Legal Standard

***KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007):**

> "The principles underlying these cases are instructive when the question is whether a patent claiming the combination of elements of prior art is obvious. When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either ***in the same field or a different one***. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability."

FISH.

Pet., 12.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: Legal Standard

POR: To the extent Petitioner seeks to introduce or switch to belated arguments as to why Mori is analogous art, such as a reasonable-pertinence theory, doing so is improper.

POR, 30.

POR: Unlike the petitions in Corephotonics, Ltd. v. Apple Inc. that "were ambiguous" and "did not make clear whether" the prior art was in the same field as another or as the challenged patents,

POR, 30.

***Corephotonics, Ltd. v. Apple Inc.*, 84 F.4th 990, 1009 (Fed. Cir. 2023):**

"'[a] petitioner is not required to anticipate and raise analogous art arguments in its petition; instead a petitioner can use its reply' to respond to, for example, arguments raised in a patent owner response."

"[Petitioner] was not required to anticipate in its petition that [Patent Owner] would argue [the prior art references] were not in the same field of endeavor as the Challenged Patents. Once [Patent Owner] did so in its patent owner response, [Petitioner] was permitted to respond both by bolstering its field of endeavor argument and by adding that its prior art is pertinent to the problem faced by the inventors of the Challenged Patents."

Pet. Rep., 6.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: Legal Standard

PO Sur-Reply: These "contentions, not the Director's discretion, define the scope of the litigation all the way from institution through to conclusion." *SAS Inst.*, 138 S. Ct. at 1357 (2018). Petitioner's attempt to proceed "with a new approach" on analogous art "as compared to [prior] positions" is expressly prohibited by the Trial Practice Guide. Practice Guide at 74 (cannot proceed "with a new approach as compared to [prior] positions").

PO Sur-Reply, 4.

***Apple Inc. v. Andrea Elecs. Corp.*, 949 F.3d 697, 705-07 (Fed. Cir. 2020):**

"Apple's legal ground did not change in its reply—its reply still asserted that claims 6-9 would have been obvious over Hirsch and Martin. Moreover, Apple's reply relies on the same algorithm from the same prior art reference to support the same legal argument: that Martin discloses the 'current minimum' and 'future minimum' limitations of the asserted claims.

Indeed, Apple's reply arguments regarding Martin are not the types of arguments that we have previously found to raise a 'new theory of unpatentability.'"

Pet. Rep., 6.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: Legal Standard

***Donner Tech., LLC v. Pro Stage Gear, LLC*., 979 F.3d 1353 (Fed. Cir. 2020):**

> Such a PHOSITA—resigned to considering art outside her field of endeavor—would thus not identify the problems so narrowly so as to rule out all such art. The Board's characterization of the problem to which the claimed invention relates effectively collapses the field-of-endeavor and reasonable-pertinence inquiries and ignores that the reasonable-pertinence analysis must be carried out through the lens of a PHOSITA who is considering turning to art outside her field of endeavor.
>
> …
>
> [I]f the two references have "pertinent similarities" such that Mullen is reasonably pertinent to one or more of the problems to which the '023 patent pertains, then Mullen is analogous art.

***Netflix, Inc. v. DivX, LLC*, 80 F.4th 1352, 1359 (Fed. Cir., 2023):**

> We have affirmed findings of analogous art where the references shared a general field of endeavor. *See, e.g., Unwired Planet*, 841 F.3d at 1001-02 (affirming Board's finding of analogous art where the patent-in-dispute and prior art were both "in the field of interface design, with [the prior art] focusing on graphical user interfaces and the [patent-in-dispute] focusing on interfaces for location-based services,")

FISH.

Pet. Rep., 6-7.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

’324 Patent Field of Endeavor and Problem Addressed

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: ’324 Patent Field of Endeavor

’324 Patent:

The invention relates to three-dimensional fabrication using networked resources.

A variety of three-dimensional fabrication techniques have been devised to support rapid prototyping from computer models. These techniques have been refined over the years to

Described herein are devices and methods for using networked three-dimensional printers. It will be understood that while the exemplary embodiments below emphasize fabrication techniques using extrusion, the principles of the invention may be adapted to a wide variety of three-dimensional fabrication processes, and in particular additive fabrication processes including without limitation selective laser sintering, fused deposition modeling, three-dimensional printing, and the like. All such variations that can be adapted to use with a networked fabrication resource as described herein are intended to fall within the scope of this disclosure.

The three-dimensional printers **304** may be any computer-controlled devices for three-dimensional fabrication, including without limitation any of the three-dimensional printers or other fabrication or prototyping devices described above.

The visualization area **510** may also or instead show an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job.

(57) **ABSTRACT**

Three-dimensional fabrication resources are improved by adding networking capabilities to three-dimensional printers and providing a variety of tools for networked use of three-dimensional printers. Web-based servers or the like can provide a single point of access for remote users to manage access to distributed content on one hand, and to manage use of distributed fabrication resources on the other.

system may include a web server configured to provide a user interface over a data network, which user interface is adapted to receive user preferences from a user including a subscription to a plurality of sources of a plurality of three-dimensional models, a prioritization of content from the plurality of sources, and an identification of one or more fabrication resources coupled to the data network and suitable for fabricating objects from the plurality of three-dimensional models.

FISH.

EX1001, 1:14-18, 1:66-2:8, 22:50-53, 8:28-31, Abstract, 11:55-60, 14:33-42; Pet. Rep., 7-8

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: ’324 Problems Addressed

Dr. Wolfe (Petitioner’s Expert):

> One of the primary problems addressed by the ’324 patent is monitoring and control of an automated fabrication process.

EX1022 (Second Wolfe Dec.), ¶19; Pet. Rep., 8

> One of the primary problems addressed by the ’324 patent is monitoring and control of a remote automated process.

EX1022 (Second Wolfe Dec.), ¶23; Pet. Rep., 9

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

’324 Patent:

> In general as described above, the server may include a web-based user interface configured for a user to submit a new print job to the server and to monitor progress of the new print job. The web-based user interface may permit video monitoring of each one of the plurality of three-dimensional printers, or otherwise provide information useful to a remote user including image-based, simulation-based, textual-based or other information concerning status of a current print. Details of a suitable user interface are discussed in further detail with reference to FIG. **5**.

> In general, mobile devices **312** may be operated by users for a variety of user-oriented functions such as to locate printable objects, to submit objects for printing, to monitor a personally owned printer, and/or to monitor a pending print job.

> In one aspect, the conveyer **200** may support networked use of the printer **100** by permitting fabrication of multiple, consecutive parts under control by a remote computer without user intervention.

EX1001, 14:63-15:5, 8:49-51, 12:47-51; Pet. Rep., 8-10.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mori is Analogous Art

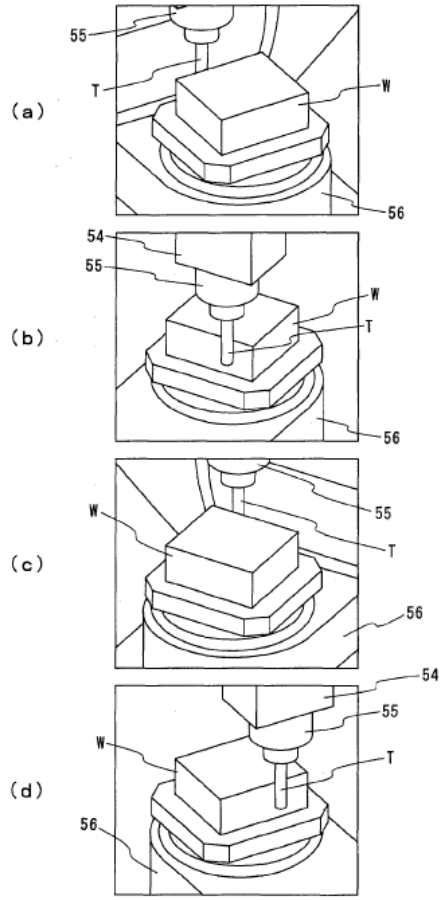
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mori (U.S. 2010/0063615)

A machining status monitoring apparatus is provided on a machine tool, and has a plurality of actual CCD cameras for imaging the tool and workpiece from different view points and generating actual two-dimensional image data thereof, a virtual image generating section having a plurality of virtual CCD cameras corresponding to the actual CCD cameras, in which the tool and workpiece of three-dimensional model are imaged by the virtual CCD cameras from each point and virtual two-dimensional image data thereof are generated, and a display control section for selecting one virtual CCD camera corresponding to the virtual two-dimensional image data in which the distal end of the tool is not hidden by the workpiece among the generated two-dimensional image data, and displaying the actual two-dimensional image data generated by the actual CCD camera corresponding to the selected virtual CCD camera on a display device.

[0005] The present invention has been achieved in view of the above-described circumstances and an object of the invention is to provide a machining status monitoring method and machining status monitoring apparatus with which it is possible to sufficiently monitor the machining status of a workpiece with images obtained from imaging means.

Fig. 4



FISH.

EX1005, Abstract, [0005], FIG. 4; Pet., 8-10; Pet. Rep., 7-8.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: ’324 Problems Addressed

Dr. Wolfe (Petitioner’s Expert):

17. Mori’s machining tool, which fabricates an object by removing material rather than adding material based on a model of the object to be fabricated, falls squarely within the field of endeavor of the ’324 patent of rapid prototyping or three-dimensional fabrication. Dr. Cormier agreed that Mori discloses a machining tool and that machining or destructive fabrication is a type of automated, rapid fabrication. EX2009, ¶111; EX1027, 22:19-23:12, 26:10-16. Dr. Cormier also confirmed that there is a great deal of overlap between students who study additive manufacturing and students who study machining or destructive manufacturing. EX1027, 26:12-23.

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

EX1022 (Second Wolfe Dec.), ¶17; Pet. Rep., 8

Dr. Cormier (Patent Owner’s Expert):

Q. So machining is a type of three-dimensional fabrication; is that correct?

THE WITNESS: I'm sorry. It -- I would call it one family under the umbrella term.

EX1027 (Cormier Depo.), 32:1-7; Pet. Rep., 8

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: ’324 Problems Addressed

Dr. Wolfe (Petitioner’s Expert):

> One of the primary problems addressed by the ’324 patent is monitoring and control of an automated fabrication process.

EX1022 (Second Wolfe Dec.), ¶19; Pet. Rep., 8

> 20. Mori is directly applicable to this monitoring functionality with which the ’324 patent is concerned. For example, Mori describes a “machining status monitoring apparatus” that provides images of “the tool and workpiece” and “virtual two-dimensional image data” of the tool and workpiece. EX1005, Abstract, [0043], [0049]-[0050], [0059]-[0065]. For example, “[a] machine status monitoring apparatus is provided on a machine tool, and has a plurality of actual CCD cameras for imaging the tool and workpiece from different view points and generating actual two-dimensional image data thereof, a virtual image generating section having a plurality of virtual CCD cameras corresponding to the actual CCD cameras, in which the tool and workpiece of three-dimensional model are imaged by the virtual CCD cameras from each point and virtual two-dimensional image data thereof are generated, and a display control section for selecting one virtual CCD camera corresponding to the virtual two-dimensional image data.” *Id.*, Abstract. patent is directed.

EX1022 (Second Wolfe Dec.), ¶20; Pet. Rep., 8

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

35

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke is Analogous Art

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke ("Rapid Prototyping Modules for Remote Engineering Applications")

***Abstract*—This contribution describes a concept for an integration of microcontroller- and FPGA- based Rapid Prototyping modules into a Remote Lab system and its implementation. The implementation enables a Web-based access to control electro-mechanical models. The electro-mechanical models can be controlled by different platforms (microcontroller or FPGA-based) Students have the possibility to test a designed control algorithm directly within a hardware environment by uploading a source file to the Remote Lab server. That way the students can compare**

As discussed in the beginning, it is furthermore necessary for students to test their design under real environmental conditions in the Remote Lab. For these purposes, we have developed a Web-interface to control the tools and models. By using this Web-interface (as shown in Figure 8), the student is able to

- download the synthesized hardware and/or software design algorithms - generated and already validated by the *REAL* environment - to test his control algorithm on the real hardware model in the lab room,
- handle the laboratory procedure (start, stop, reset),
- change environmental variables if necessary and
- watch the laboratory procedure by supervising the model and environmental variables inside an I/O monitor or by observing the hardware model directly via a Web-Cam.

REAL offers a Web-based environment including verification and simulation features to generate and execute a design within visual prototypes (e.g. the visual prototype of the Water level control, shown in Figure 7).

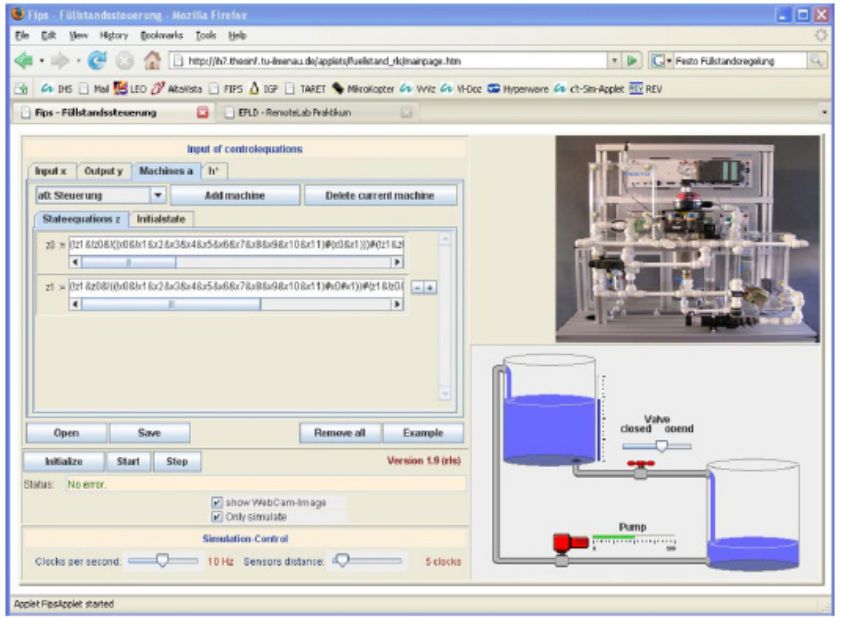


Figure 8. Online control of the Water level control - with Internet connectivity to the Remote Lab

FISH.

EX1014, 2, 5; Pet., 58-59; Pet. Rep., 8-9. 37

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: ’324 Problems Addressed

Dr. Wolfe (Petitioner’s Expert):

> In another example, the ’324 patent describes that it is directed toward “three-dimensional printers ***or other fabrication or prototyping devices***.” *Id.*, 8:28-31.

EX1022 (Second Wolfe Dec.), ¶21; Pet. Rep., 9

> 22. Henke is directed toward the same field of endeavor of rapid prototyping. Indeed, the title of the Henke paper is “Rapid prototyping modules for remote engineering applications.” EX1014, 2. Henke “describes concept for an integration of microcontroller- and FPGA- based Rapid Prototyping modules into a Remote Lab system and its implementation. The implementation enables a Web-based access to control electro-mechanical models.” *Id.* Henke describes that “[s]imulation and visual prototyping help to find functional errors.” *Id.*, 3. As with the ’324 patent, Henke describes using models which are tested using the rapid prototyping system. *Id.*

EX1022 (Second Wolfe Dec.), ¶22; Pet. Rep., 9

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

38

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Analogous Art: ’324 Problems Addressed

Dr. Wolfe (Petitioner’s Expert):

> One of the primary problems addressed by the ’324 patent is monitoring and control of a remote automated process.

EX1022 (Second Wolfe Dec.), ¶23; Pet. Rep., 9

> 24. Henke is directly applicable to this remote monitoring and control functionality with which the ’324 patent is concerned. For example, Henke’s system provides “Web-based access to control electro-mechanical models.” EX1014, 2. Henke is directly relevant to the problem of remote monitoring and control of an automated process, describing that a user interface is provided at a remote computer to allow the remote user to “handle laboratory procedure (start, stop, reset), change environmental variables if necessary and watch the laboratory procedure by supervising the model and environmental variables inside an I/O monitor or by observing the hardware model directly via a Web-Cam.” EX1014, 5. These disclosures of Henke regarding control and monitoring of an automated process at a remote computer are reasonably pertinent to the problem addressed by the ’324 Patent.

EX1022 (Second Wolfe Dec.), ¶24; Pet. Rep., 9

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

39

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 1A: Mazumder-Mori Provides Claims 1 and 19

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 1A: Mazumder-Mori

- **Motivation to combine Mazumder and Mori (slides 42-43)**
- **The Mazumder-Mori combination provides Elements [1.d] and [19.d] (slides 44-50)**
- **Patent Owner's district court arguments regarding display of different images taken from the same camera with respect to Elements [1.d] and [19.d] (slides 51-53)**
- **Patent Owner's expert testified that displaying two different images from the same camera would satisfy Elements [1.d] and [19.d] (slides 54-55)**

FISH.

Pet., 10-13, 16-25, 29; Pet. Rep., 10-14.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori: Motivation to Combine

- "…easily visually compare 'visual images of the product being fabricated' with virtual images of 'three-dimensional models of the…workpiece W'"
- "…monitor the progress of the object even when the actual view of the object is partially or totally obscured."
- "…sectional images showing cross sectional representations of the object…cannot be obtained from a video camera alone…allow the user to observe progress of inner or rear portions of the object that may not be visible from the angle of the actual camera."
- "…application of known techniques to a known system ready for improvement to yield predictable results."

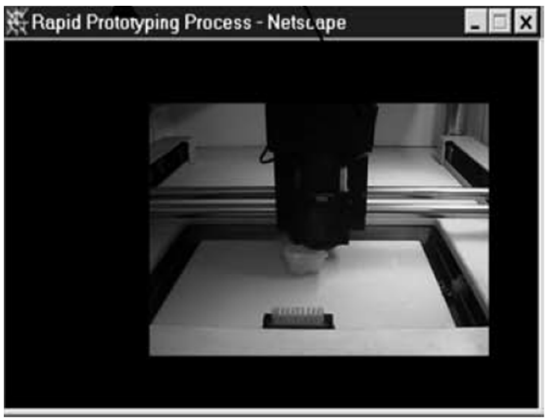
Pet., 10-13.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori: Motivation to Combine

Dr. Wolfe:

86. *As a second reason* to apply the suggestions of Mori to Mazumder to display virtual images generated from the three-dimensional model along with actual images of the fabrication process captured by the camera(s), such inclusion of both actual and virtual images of the fabrication process in the user interface would have allowed the user to of the remote computer to monitor the progress of the object even when the actual view of the object is partially or totally obscured. EX1005, [0073], [0082]. For example, a POSITA would have recognized that in some cases, based on the angle of the camera, the material deposition head/extruder or another part of the rapid fabrication device may temporarily partially or completely obscure the camera's view of the object being fabricated in the build volume. As another example, a support structure or other material involved in the manufacturing process that is not part of the intended finished object being manufactured may obscure the view of some or all of the object.



EX1003, ¶86; EX1013, 5; Pet., 11-12, 68.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori: Disputed Elements

Element [1.d] (partial): …to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

Element [19.d] (partial): "…wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera."

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder's Remote Computer displays an image of the build volume from the video camera

Mazumder:

> In addition to the sensor systems **40**, **50**, **60**, a video or TV camera **65** records the laser-aided DMD process and transmits the images to the local computer **70**, which then sends the images together with the associated temperature, strain and stress data to the remote computer **95** to be displayed preferably on a TV screen or shown on the remote computer monitor as streaming video (display screens not shown in FIG. **1**).

FISH.

EX1004 (Mazumder), 6:36-43; Pet., 20.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mori discloses displaying actual images of build volume and two-dimensional projection of model

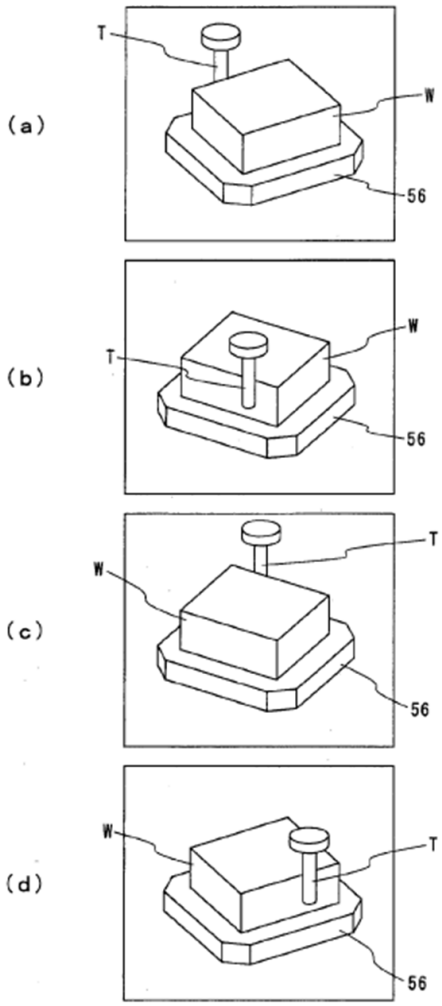
Mori:

> The actual CCD cameras **11**, **12**, **13** and **14** each image the tool T mounted to the spindle **55** and the workpiece W on the table **56** at a certain time interval, and in turn generate two-dimensional image data (actual image data) thereof, and output the generated two-dimensional image data to the display control section **23**.

> Since the virtual CCD cameras **19**, **20**, **21** and **22** are respectively arranged at the same positions and in the same orientations as the actual CCD cameras **11**, **12**, **13** and **14** based on the read extrinsic parameters, the view points of the virtual CCD cameras **19**, **20**, **21** and **22** match the view points of the actual CCD cameras **11**, **12**, **13** and **14**, respectively.

> **[0063]** Thereafter, the virtual image generating section **18** in turn generates two-dimensional image data which is assumed to be obtained when the tool T, workpiece W and a part of the table **56** which are represented by three-dimensional model are imaged at a certain time interval by the virtual CCD cameras **19**, **20**, **21** and **22**, and transmits the generated two-dimensional image data to the display control section **23** (step S25).

Fig. 7



EX1005 (Mori), [0049], [0062], [0063], FIG. 7; Pet., 8-10, 21-23.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Combination

Dr. Wolfe:

84. A POSITA would have recognized that the teachings of Mori would have been readily applied to the system of Mazumder for multiple reasons to achieve predictable benefits. Specifically, a POSITA would have recognized multiple benefits that would have predictably been provided by modifying Mazumder's system based on Mori's teachings to include actual images of the object being fabricated as captured by one or more cameras (as described by both Mazumder and Mori) in the user interface displayed at Mazumder's remote computer 95 along with virtual images of the object generated from stored model data shown from the perspective of one or more virtual cameras (as suggested by Mori).

47

FISH.

EX1003 (Wolfe Dec.), ¶84; Pet., 10-11. 47

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Combination

Dr. Wolfe:

> 85. *As a first reason* to apply the suggestions of Mori to Mazumder to include in the user interface at the remote computer, a display of the virtual images of the object being fabricated along with, and from the same perspective as, the images of the real images as captured by one or more video cameras at the rapid fabrication system, a POSITA would have recognized that including both the real images of the fabrication process and the virtual images of the model of how the intended object should look during that particular phase of fabrication, from the same perspective, would have advantageously allowed the user to easily visually compare the "visual images of the product being fabricated" to the virtual images of "three-dimensional models of the…workpiece W" and to easily determine whether the fabrication process is proceeding as planned. EX1004, 7:27-28;

EX1003 (Wolfe Dec.), ¶85; Pet., 11.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder's Remote Computer displays an image of the build volume from the video camera

Mazumder:

the laser-aided direct material deposition process. The display preferably includes zoom and rotation capabilities to enable detailed and accurate view from various angles of the product undergoing fabrication.

When the designer perceives a defect, an abnormality or some other undesirable characteristic affecting the final quality of the product, or when it seems desirable to improve the design, the designer may pause or abort the fabrication process by sending a command to the controller of the DMD system at the "local", i.e. the manufacturing, site. The

FISH.

EX1004 (Mazumder), 2:27-39; Pet., 7-8, 31; Pet. Rep., 12-13.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Combination

Dr. Wolfe:

> 113. A POSITA would have additionally recognized that, in the predictable combination of Mazumder with Mori, it would have been obvious to display the actual image and the virtual image of the product simultaneously, which would have helped further achieve the advantages that I discussed above. For example, the presentation of the actual images captured by the camera and the virtual images simultaneously within the user interface would have beneficially aided the remote user to more easily visually compare the actual image and virtual image to quickly identify any defects or problems with the fabrication process. Indeed, this is consistent with both Mazumder's goals and Mori's suggested benefits.

FISH.

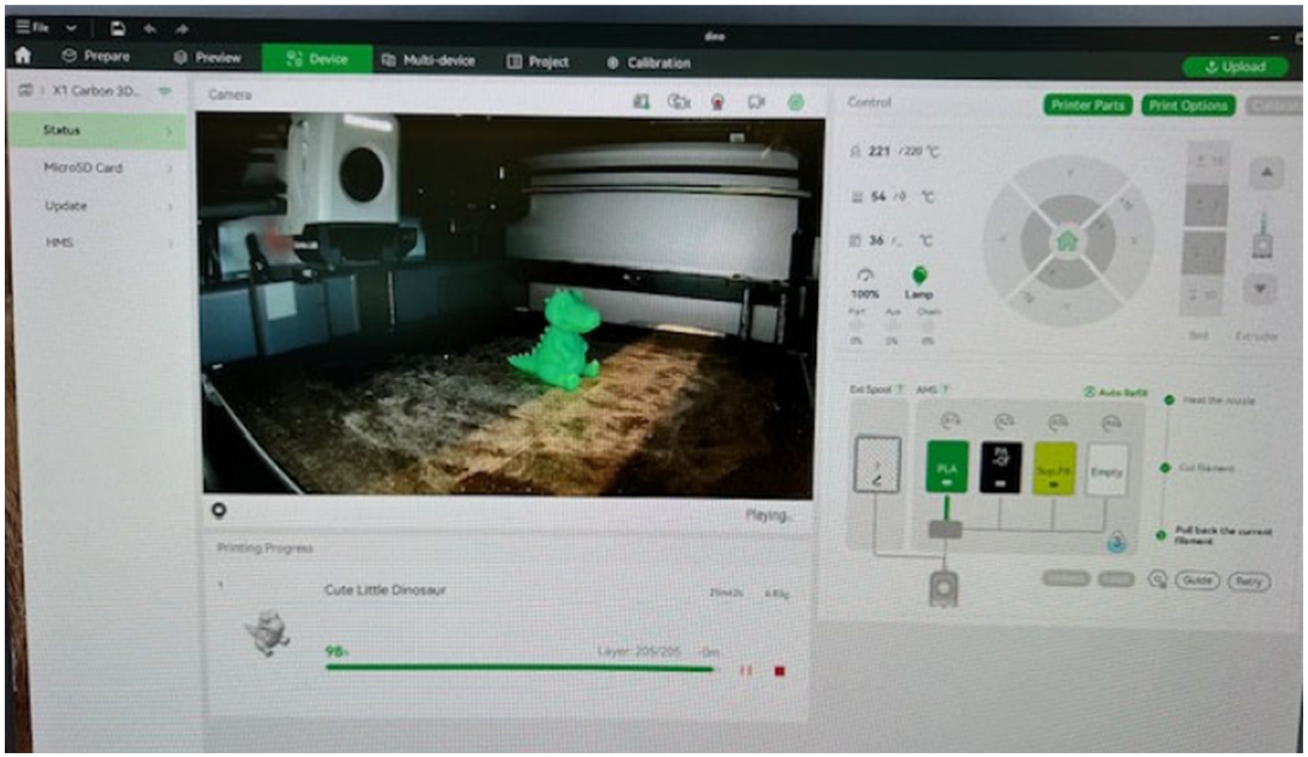
EX1003 (Wolfe Dec.), ¶113; Pet., 23-24.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

Alternatively, a two-dimensional projection of the three-dimensional model is a video image from the video camera, as is shown above in Bambu Studio or Bambu Handy, and an image of the build volume from the video camera is a time lapse, as is shown below. These are shown in the Bambu Studio or Bambu Handy software running on a processor that alone or in combination with a processor on the printer is also configured to provide a user interface to a remote user.



FISH.

EX1016 (Infringement Contentions), 46, 43; Pet. Rep., 13.

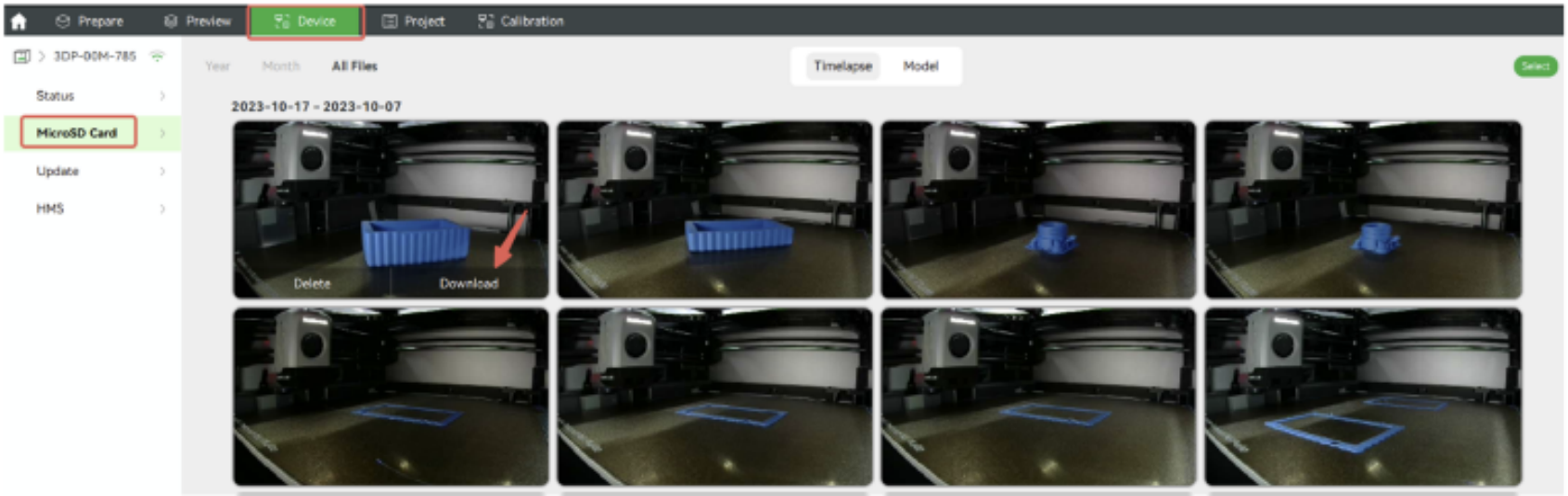
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

Alternatively, a two-dimensional projection of the three-dimensional model is a video image from the video camera, as is shown above in Bambu Studio or Bambu Handy, and an image of the build volume from the video camera is a time lapse, as is shown below. These are shown in the Bambu Studio or Bambu Handy software running on a processor that alone or in combination with a processor on the printer is also configured to provide a user interface to a remote user.

In Bambu Studio, you can also download time-lapse video files from the "Device" - "MicroSD Card" page:



FISH.

EX1016 (Stratasys Infringement Contentions), 46, 53; Pet. Rep., 13. 52

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

> Bambu asks the Court to improperly redraft the claims to introduce an unwarranted limitation that excludes *claimed* embodiments of the '324 Patent, which demonstrate that "the two-dimensional projection may be obtained from a three-dimensional scanner or other data acquisition device," such as a video camera. Ex. A3 at 24:61-25:5; *see also id.* cls. 2, 6.

FISH.

EX1023 (Stratasys Claim Construction Brief), 14; Pet. Rep., 13. 53

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys's Expert:

> So that would be an instance where the same camera was used to generate both images that are displayed for those two different purposes that you mentioned where the images were taken at different point in time.
>
> Q. BY MR. BISENIUS: And that example you just described would satisfy this claim language; is that correct?
>
> MR. KAPADIA: Objection. Form.
>
> THE WITNESS: So that would be one instance, yes.

EX1027 (Deposition of Dr. Cormier), 61:13-23; Pet. Rep., 14.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Mazumder:

> The remote host computer is preferably equipped with two monitors, one with a graphical user interface and the other for image and video observation of the laser-aided direct material deposition process. The display preferably includes zoom and rotation capabilities to enable detailed and accurate view from various angles of the product undergoing fabrication.

FISH.

EX1004 (Mazumder), 2:27-33; Pet., 7-8; Pet. Rep., 14.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 1A: Mazumder-Mori Provides Claim 6

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Provides Claim 6

6. The device of claim 1 wherein the two-dimensional projection is a video image from the video camera.

1. A device comprising:
a three-dimensional printer including a build volume;
a network interface coupled to a data network;
a video camera positioned to capture video of the build volume from a point of view; and
a processor configured to receive a three-dimensional model through the network interface, and to control operation of the three-dimensional printer to fabricate the three-dimensional model as an object within the build volume of the three-dimensional printer, the processor further configured to provide a user interface to a remote user accessing the device through the network interface, and to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

FISH.

EX1001 ('324 Patent), Claims 6 and 1

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder Provides Multiple Images

Mazumder:

> The remote host computer is preferably equipped with two monitors, one with a graphical user interface and the other for image and video observation of the laser-aided direct material deposition process. The display preferably includes zoom and rotation capabilities to enable detailed and accurate view from various angles of the product undergoing fabrication.

> In addition to the sensor systems **40**, **50**, **60**, a video or TV camera **65** records the laser-aided DMD process and transmits the images to the local computer **70**, which then sends the images together with the associated temperature, strain and stress data to the remote computer **95** to be displayed preferably on a TV screen or shown on the remote computer monitor as streaming video (display screens not shown in FIG. **1**).
>
> The temperature, strain and stress data, visual images or metrological information collected at the local manufacturing site **205** are all processed through the local computer **70**,

FISH.

EX1004 (Mazumder), 2:27-33, 6:36-48; Pet., 7-8, 26; Pet. Rep., 14, 19-20.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder's disclosure is just as detailed as that of the '324 patent

The '324 Patent:

The sensor **134** may also or instead include at least one video camera. The video camera may generally capture images of the working volume **114**, the object **112**, or any other hardware associated with the printer **100**. The video

print job. The visualization area **510** may also or instead show an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job. This may, for example, include a digital still image (which may be updated periodically) or a video image captured from a video camera at the three-dimensional printer.

As shown in step **708**, the method **700** may include providing a user interface to a remote user accessing the device through the network interface, wherein the user interface presents an image of the build volume from the camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera. This may be any of the user interfaces described above, or any other suitable interface for conveying visual information such as a video image and/or model projection. It will be understood that a

As shown in step **710**, the method **700** may include transmitting status information over the data network upon completion of the object. This may, for example, include data presented through the user interface, or any other status information or summary thereof. For example, the status information may include a digital image from the video camera, which may be transmitted with an electronic mail communication confirming completion of the object. More generally,

FISH.

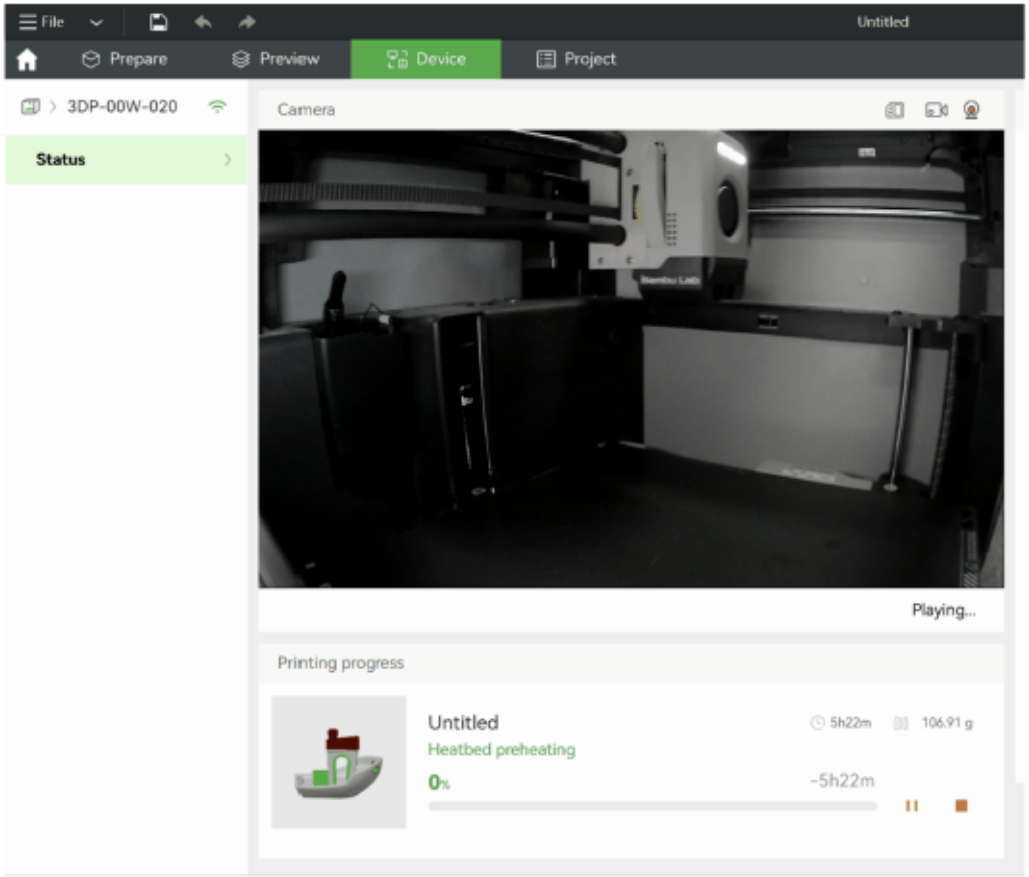
EX1001 (The '324 patent), 6:22-24, 22:50-55, 24:47-55, 25:8-13; Pet. Rep., 19-20.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

6. The device of claim 1 wherein the two-dimensional projection is a video image from the video camera.	For each of the Accused Instrumentalities, the two-dimensional projection is a video image from the video camera. For example, a two-dimensional projection of the three-dimensional model is a video image from the video camera, such as the LiveView feature in Bambu Studio or Bambu Handy.

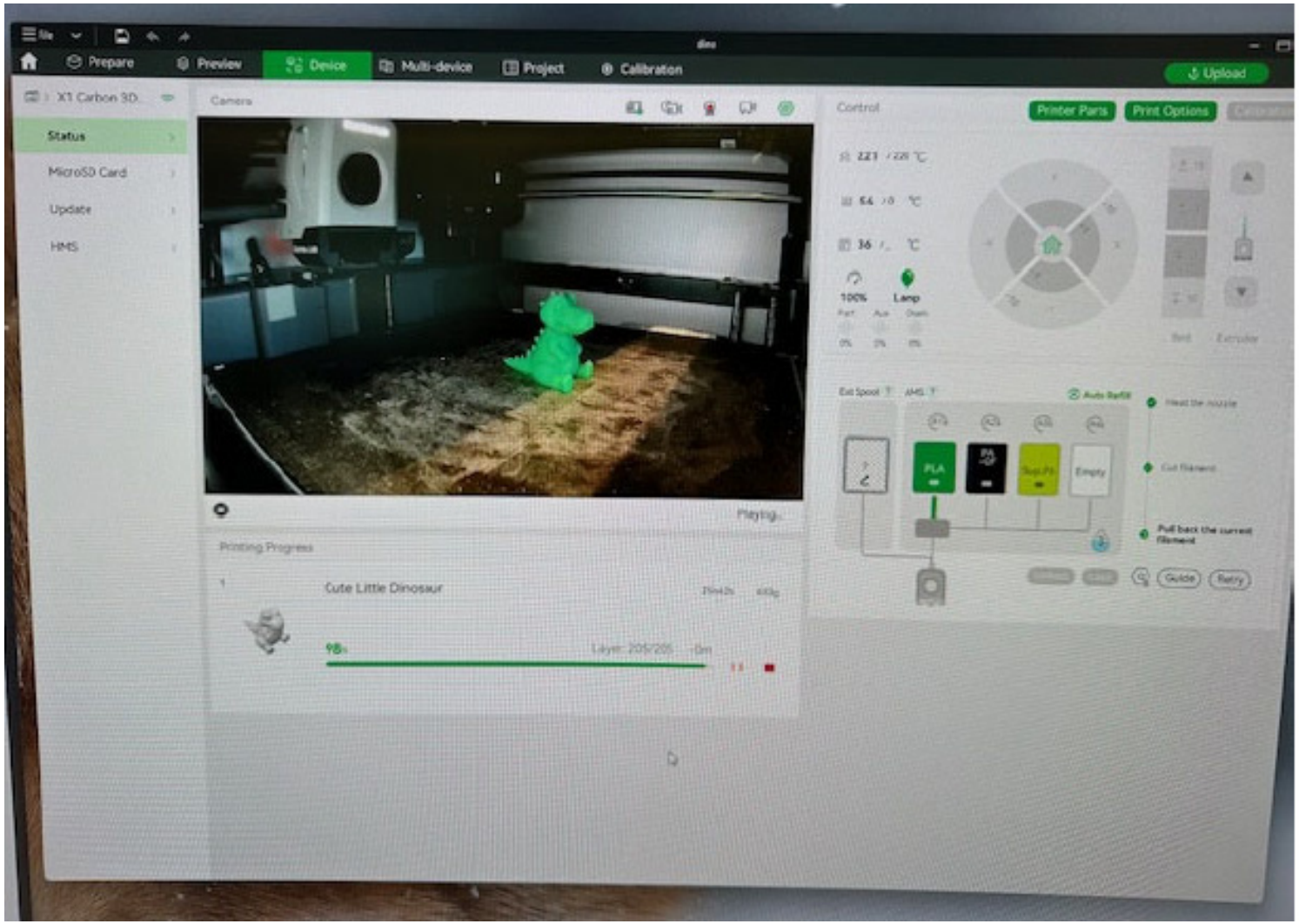


EX1016 (Infringement Contentions), 91, 42, 102; Pet. 26, 22 fn. 3; Pet. Rep., 15-16, 18.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:



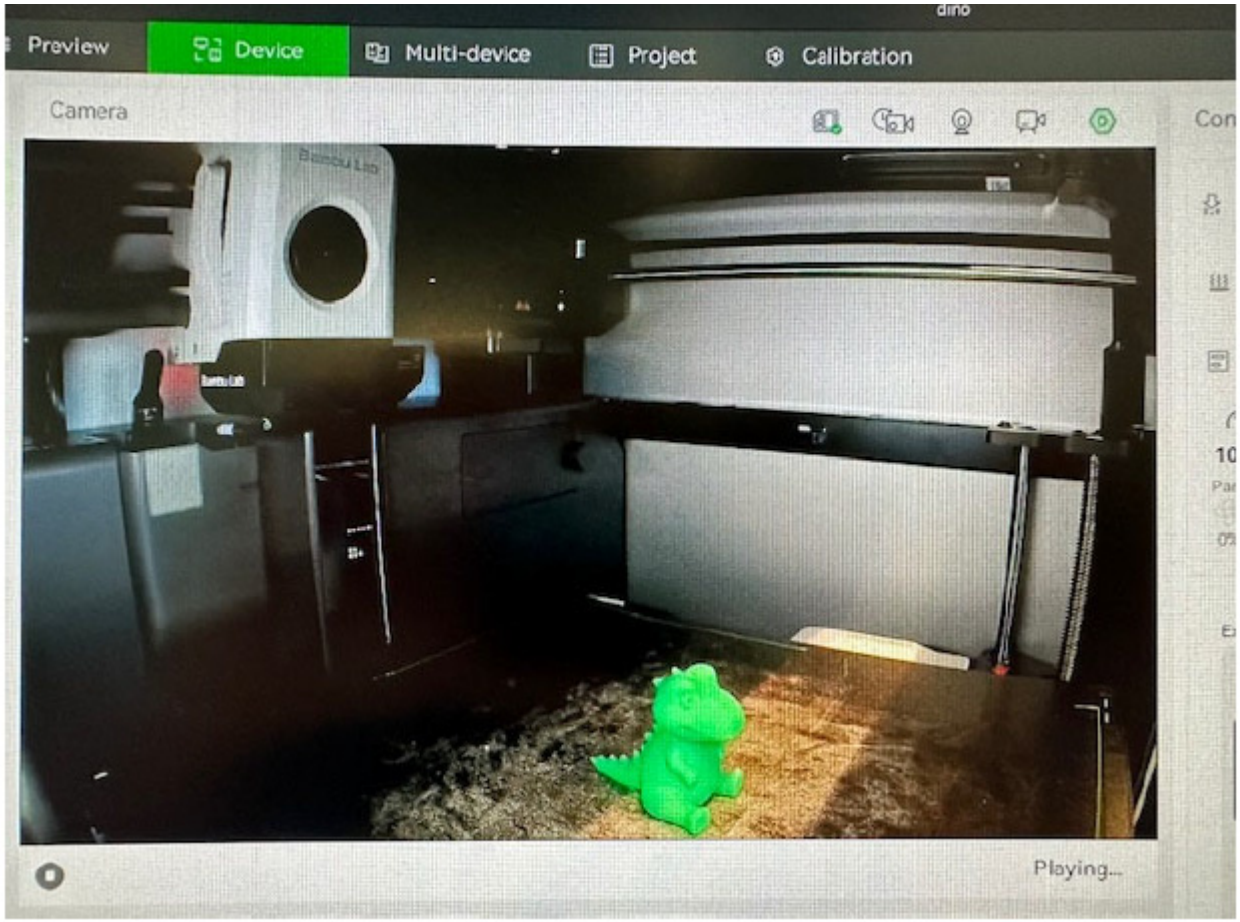
FISH.

EX1016 (Infringement Contentions), 43, 103; Pet. 26, 22 fn. 3; Pet. Rep., 17-18.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:



FISH.

EX1016 (Infringement Contentions), 44, 104; Pet. 26, 22 fn. 3; Pet. Rep., 18

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder Provides Multiple Images

Mazumder:

> The remote host computer is preferably equipped with two monitors, one with a graphical user interface and the other for image and video observation of the laser-aided direct material deposition process. The display preferably includes zoom and rotation capabilities to enable detailed and accurate view from various angles of the product undergoing fabrication.

> In addition to the sensor systems **40**, **50**, **60**, a video or TV camera **65** records the laser-aided DMD process and transmits the images to the local computer **70**, which then sends the images together with the associated temperature, strain and stress data to the remote computer **95** to be displayed preferably on a TV screen or shown on the remote computer monitor as streaming video (display screens not shown in FIG. **1**).
>
> The temperature, strain and stress data, visual images or metrological information collected at the local manufacturing site **205** are all processed through the local computer **70**,

FISH.

EX1004 (Mazumder), 2:27-33, 6:36-48; Pet., 7-8, 26; Pet. Rep., 14, 19-20. 63

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 1A: Mazumder-Mori Provides Claim 5

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Provides Claim 5

Mori:

[0078] When the feed mechanisms **57**, **58** and **59** are driven by the control device **62**, the model data of the entire machine tool **50** in the model data storage section **16** is updated by the model data updating section **17** synchronically with the actual operations of the first saddle **52**, second saddle **53** and spindle head **54**, based on the operation command obtained from the control device **62**. It is noted that, in the machine tool **50**, coolant is supplied to the contact portion of the tool T and the workpiece W depending on the contents of machining during the machining of the workpiece W.

[0074] When receiving the sectional image generation signal transmitted from the camera selection section **24**, the sectional image generating section **26** generates virtual two-dimensional image data as sectional image data by a computer process, based on the parameters stored in the camera parameter storage section **15** and the model data updated by the model data updating section **17**, the virtual two-dimensional image data including, for example, a part of the table **56**, the tool T, a sectional shape appearing when at least the workpiece W is cut along a predetermined cutting plane, and the shape of the workpiece W which is located behind the predetermined cutting plane. And the generated sectional

FISH.

EX1005 (Mori), [0078], [0074]; Pet. 12, 23; Pet. Rep., 14.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Provides Claim 5

- **Anderson corroborates that a POSITA would have known how to implement Mori's suggestion in an additive manufacturing rapid fabrication system:**

[0015] The present invention pertains to a user interface, method and apparatus for providing three-dimensional object fabrication status in the form of a progressively filled-in wireframe model representation of the three-dimensional object. In various embodiments of the present invention, data pertaining to the fabrication of one or more three-dimensional objects is received and used to control a graphical user interface to provide a visual representation of the three-dimensional object(s) fabrication progress in the form of one or more progressively filled-in wireframe model representations of the three-dimensional object(s).

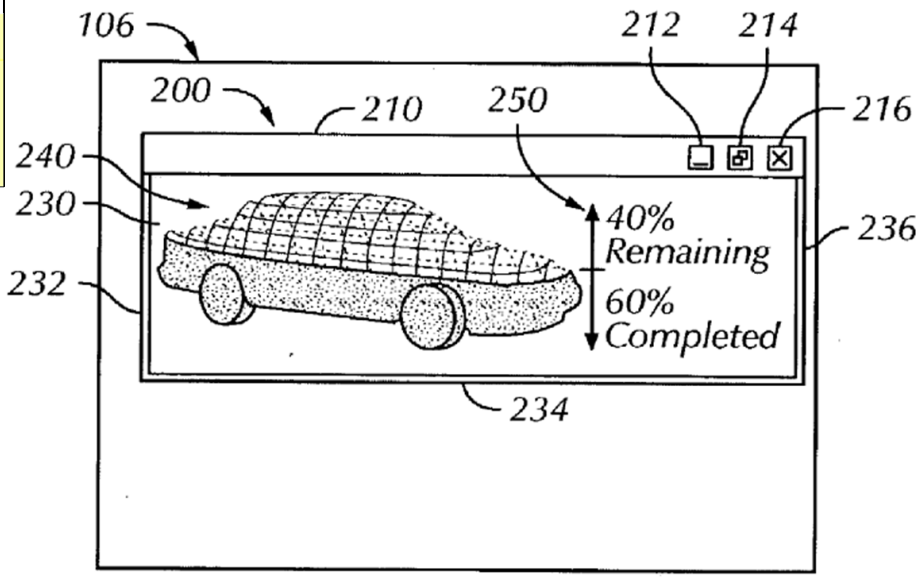


FIG. 2A

EX1012 (Anderson), [0015], FIG. 2A; Pet. Rep., 15.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori Provides Claim 5

Dr. Wolfe (Petitioner's Expert):

33. To be clear, a POSITA would have known how to dynamically update the virtual images to correspond to a state of physical completion of the object because such processes were known in the prior art. For example, Anderson demonstrates that a POSITA had the ability to apply Mori's teachings to Mazumder in such a manner. For example, Anderson discloses the user interface includes "progress information" that is updated as the three-dimensional printer operates such that "[a]fter each pass of the printheads, the printer updates a status register" to accurately track "the number of passes completed by the printhead." EX1012, [0018]. Anderson teaches that "the server polls the printer for the pass number" and updates the displayed model "to show the completed portion as a filled-in (e.g., solid colored) area." *Id.*

Patent Owner elected to not cross-examine Dr. Wolfe after his reply testimony.

EX1022 (Second Wolfe Dec.), ¶33; Pet. Rep., 15.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 1C: Mazumder-Mori-Hull Provides Claim 8

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Mazumder-Mori-Hull Provides Claim 8

Hull:

8.2 How to Transfer Files from Slice Computer to Process Computer

This procedure shows how to transfer the sliced object and support files from the slice computer to the process computer (Wyse PC 286) in the SLA-1.

a. Press ENTER - MAIN MENU is displayed.
b. Select option 1 (Data Transfer).
c. In response to (data transfer) prompt, type 2 (FTP) (file transfer program) and press ENTER.
d. In response to (ftp) prompt, type OPEN and press ENTER.
e. In response to (to) prompt, type address of slice computer and press ENTER.
f. In response to Remote user prompt, type the name of your directory and press ENTER.
g. In response to Password prompt, type your password and press ENTER.
h. In response to (ftp) prompt, type GET and press ENTER.
i. In response to (remote-file) prompt, type name of desired file usually followed by .sli (example - test.sli) and press ENTER.
j. In response to (local-fill test .sli in default) prompt, press ENTER (unless you want to change name). (The FTP routine will now transfer the file to the process computer. It will prompt when the transfer is complete.)
k. To exit from FTP, in response to (ftp) prompt, type BYE and press ENTER. (The sliced files have now been transferred to the SLA-1 process computer.)
l. MAIN MENU is displayed after transfer is completed.

REMOTE USER A Network Menu option used to remotely operate the Slice Computer from the Control Computer keyboard.

FISH.

EX1008 (Hull), [0157], [0499]; Pet. 33; Pet. Rep., 21-22.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 2A: Kritchman-Tay-Henke Provides Claims 1 and 19

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Kritchman-Tay-Henke: Disputed Elements

Element [1.d] (partial): …to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

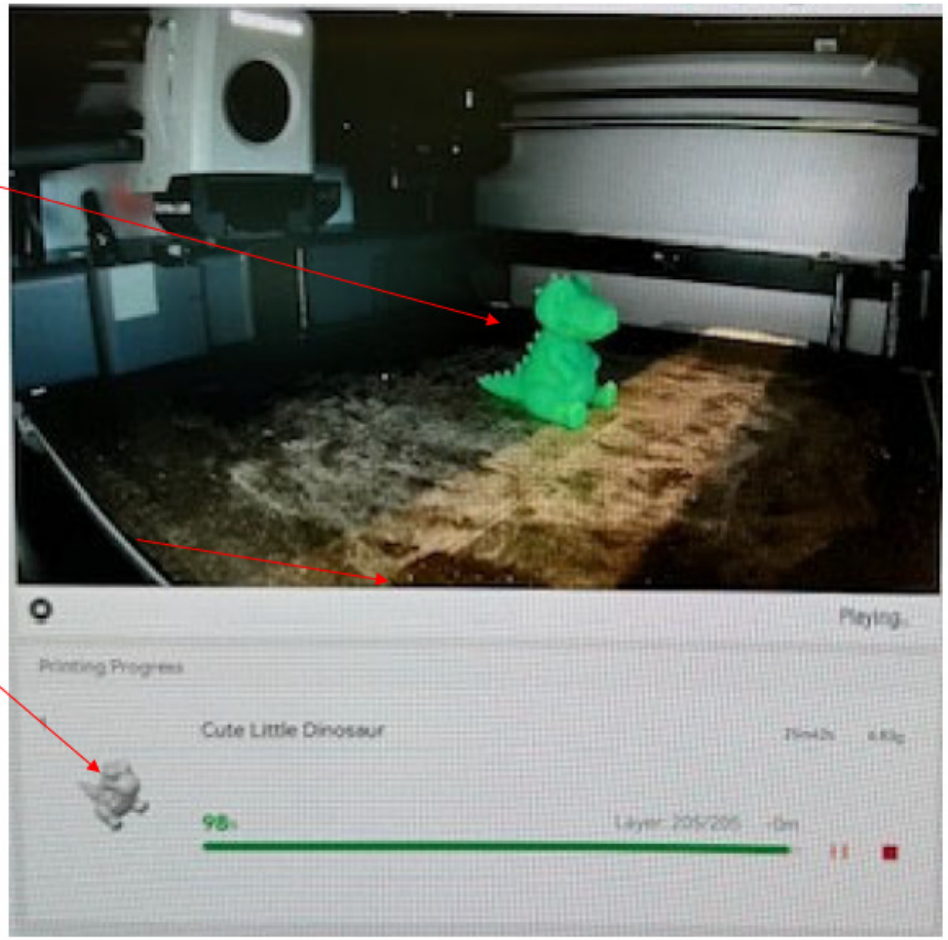
Element [19.d] (partial): "…wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera."

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:



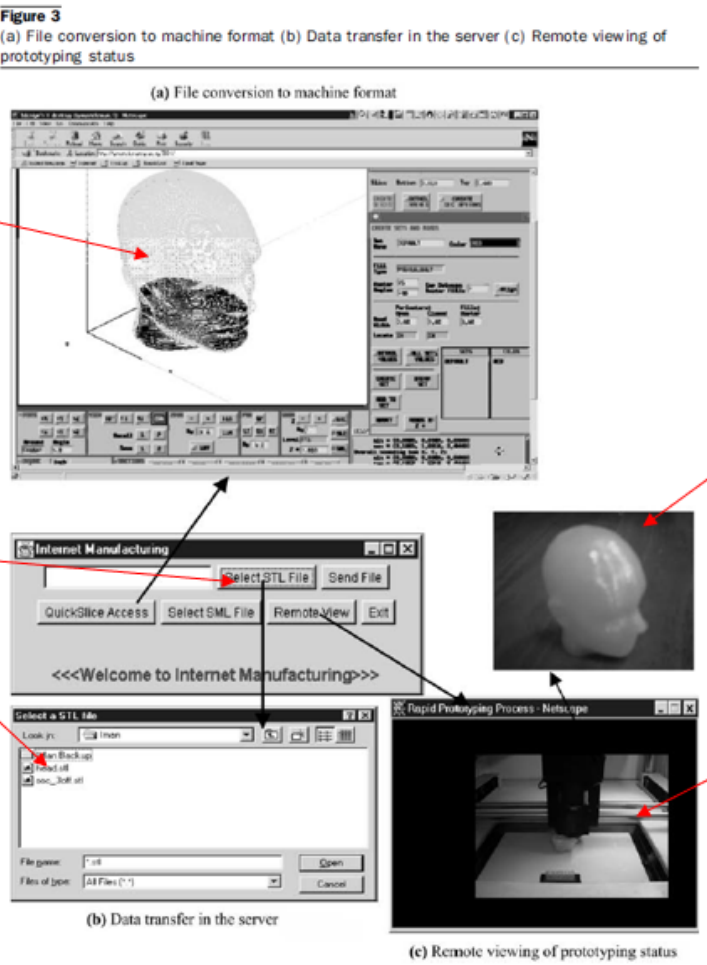
FISH.

EX1016 (Infringement Contentions), 43, 39; Pet. 26, 22 fn. 3; Pet. Rep., 25.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Tay Displays Actual and Model Images

Tay:



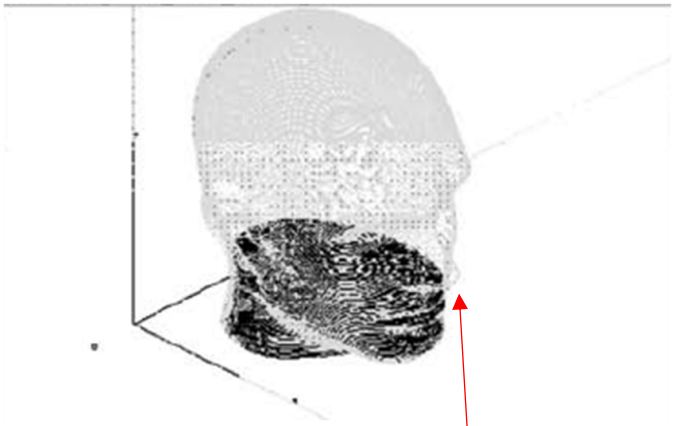
FISH.

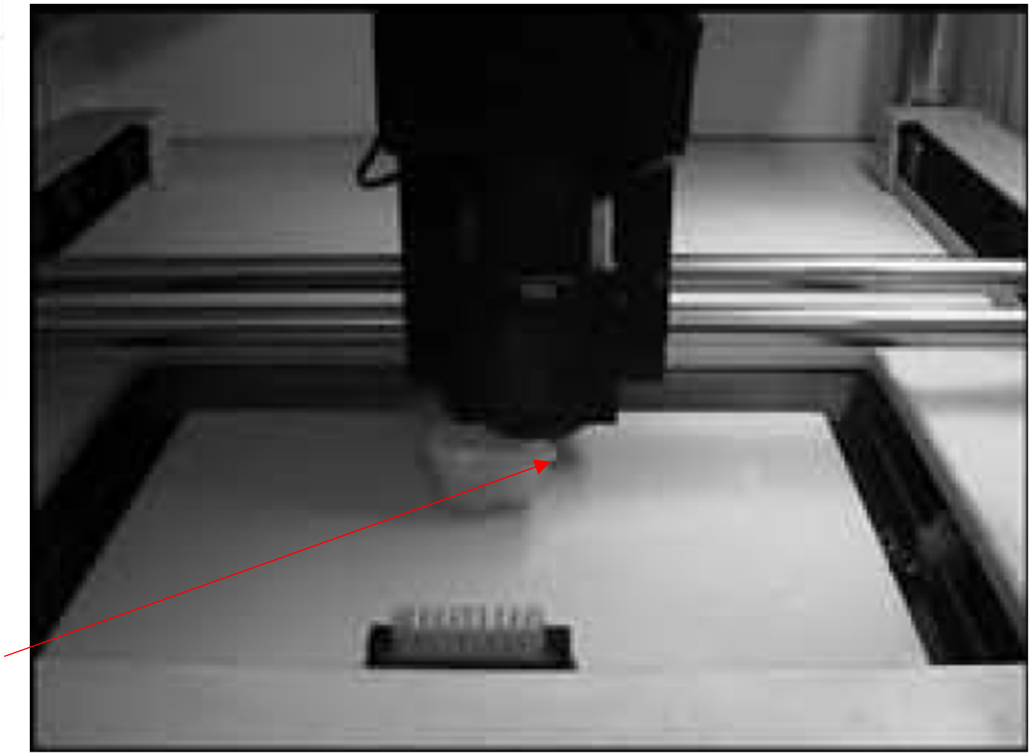
EX1013 (Tay), 5; Pet., 57, 68, 70-71; Pet. Rep., 23-24. 73

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Tay Displays Actual and Model Images From Relatively The Same Angle

Tay:





Nose pointing to right and slightly down

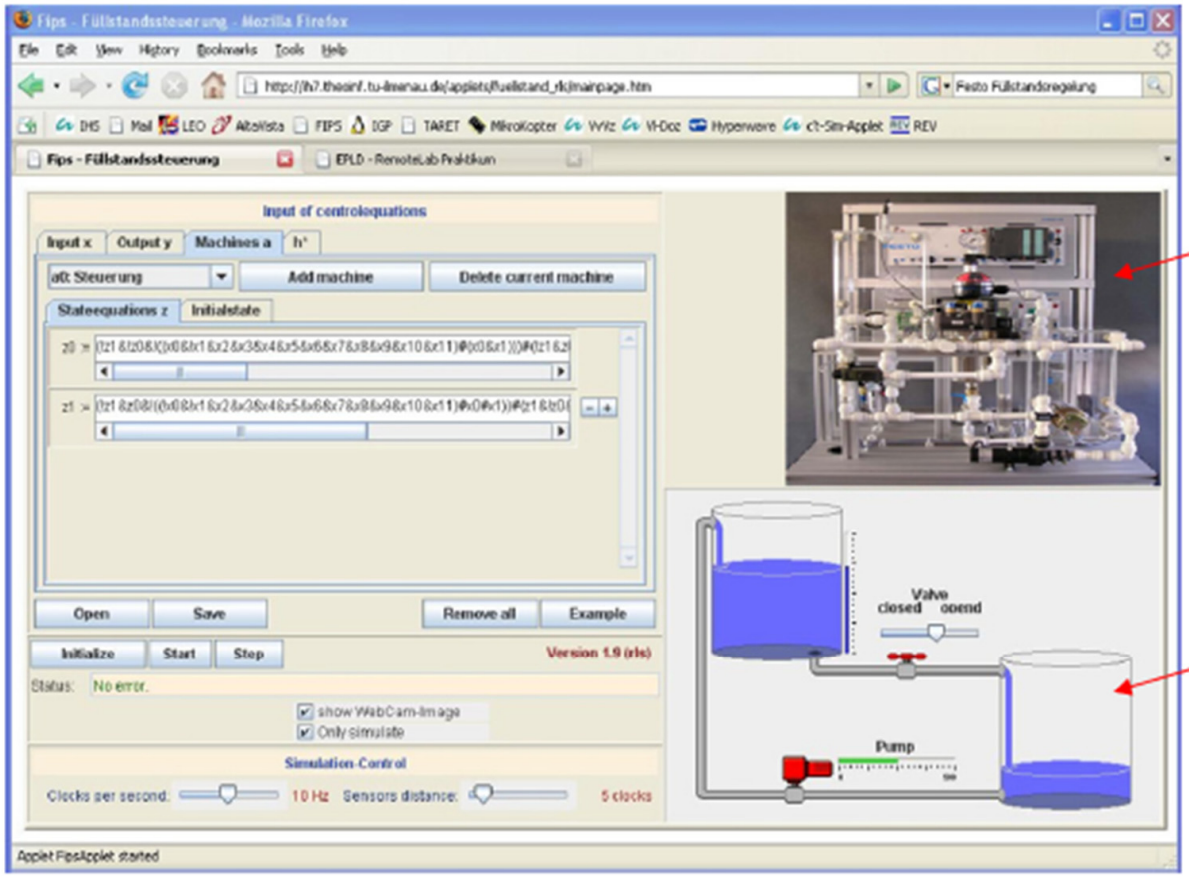
FISH.

EX1013 (Tay), 5; Pet., 57, 68, 70-71; Pet. Rep., 24-26. 74

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke Displays Actual Image and Simulation from Same Angle

Henke:



Front view of actual system

Front view of model

Figure 8. Online control of the Water level control - with Internet connectivity to the Remote Lab

FISH.

EX1014 (Henke), 5; Pet., 72-73; Pet. Rep., 26-27. 75

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Motivation to Apply Henke to Kritchman-Tay

- "…simultaneously displaying actual images of the fabrication process and the visual representation of the model (and from the same perspective) on the client device beneficially allowed an onscreen comparison to quickly identify whether the fabrication process is proceeding correctly and that the object matches the model"

- "…more easily assess the progress of the fabrication process, such as in instances where the actual images of the process may be partially or completely obscured, such as by a portion of the fabrication system or a support structure."

- "…provided more full information to the remote user to allow the user to better monitor all aspects of the fabrication process."

Pet., 61-62.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke Displays Actual Image and Simulation from Same Angle

Henke:

Abstract—This contribution describes a concept for an integration of microcontroller- and FPGA- based Rapid Prototyping modules into a Remote Lab system and its implementation. The implementation enables a Web-based access to control electro-mechanical models. The electro-mechanical models can be controlled by different platforms (microcontroller or FPGA-based) Students have the possibility to test a designed control algorithm directly within a hardware environment by uploading a source file to the Remote Lab server. That way the students can compare architectures of different control-platforms as well as different design approaches to control electro-mechanical models. The paper starts with an introduction into the design process and describes the tool set, which is provided to the students. After that the different platforms and their integration in the Web-server are introduced. Finally we would like to give examples of such complex design tasks and show, how the students can use different tools during several design steps.

The possibilities of the *REAL* system (as shown in Figure 10) we present here exemplarily. Some examples of the Student's design will be discussed in the following.

FISH.

EX1014 (Henke), 2, 7; Pet. Rep., 27. 77

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke Displays Actual Image and Simulation from Same Angle

Henke:

As discussed in the beginning, it is furthermore necessary for students to test their design under real environmental conditions in the Remote Lab. For these purposes, we have developed a Web-interface to control the tools and models. By using this Web-interface (as shown in Figure 8), the student is able to

- download the synthesized hardware and/or software design algorithms - generated and already validated by the *REAL* environment - to test his control algorithm on the real hardware model in the lab room,
- handle the laboratory procedure (start, stop, reset),
- change environmental variables if necessary and
- watch the laboratory procedure by supervising the model and environmental variables inside an I/O monitor or by observing the hardware model directly via a Web-Cam.

FISH.

EX1014 (Henke), 5; Pet., 72-73; Pet. Rep., 9, 26-27. 78

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke Displays Actual Image and Simulation from Same Angle

Henke:

To check the functionality of the whole design, some special simulation and validation features are included as integral part of the *REAL* system. This offers various possibilities for the execution of simulations, e. g.:

- generation of executable visual prototypes from the general design and parts of it as well,
- properties for step by step and parallel execution of these prototypes,
- visualization of the simulation process with the tools, used for specification as well,
- features for test pattern generation,
- possibilities for analysing the simulation process offline afterwards,
- code generation for hardware and software synthesis as a result of the partitioning process.

REAL offers a Web-based environment including verification and simulation features to generate and execute a design within visual prototypes (e.g. the visual prototype of the Water level control, shown in Figure 7).

FISH.

EX1014 (Henke), 5; Pet., 72-73; Pet. Rep., 9, 26-27. 79

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 2A: Kritchman-Tay-Henke Provides Claims 3 and 5

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claims 3 & 5

Claim 3: The device of claim 1 wherein the two-dimensional projection is simulated based upon operation of the three-dimensional printer.

Claim 5: The device of claim 1 wherein the two-dimensional projection is dynamically updated to correspond to a state of physical completion of the object.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke Displays Actual Image and Simulation from Same Angle

Henke:

To check the functionality of the whole design, some special simulation and validation features are included as integral part of the *REAL* system. This offers various possibilities for the execution of simulations, e. g.:

- generation of executable visual prototypes from the general design and parts of it as well,
- properties for step by step and parallel execution of these prototypes,
- visualization of the simulation process with the tools, used for specification as well,
- features for test pattern generation,
- possibilities for analysing the simulation process offline afterwards,
- code generation for hardware and software synthesis as a result of the partitioning process.

REAL offers a Web-based environment including verification and simulation features to generate and execute a design within visual prototypes (e.g. the visual prototype of the Water level control, shown in Figure 7).

FISH.

EX1014 (Henke), 5; Pet., 72-75; Pet. Rep., 9, 26-29. 82

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Henke Displays Actual Image and Simulation from Same Angle

Henke:

Simulation and visual prototyping help to find functional errors. Run-up to the practical, simulations and animations in "virtual worlds" are often used to verify the developed solutions. The physical behaviour of the actual model, and its environment as well, will be emulated (e. g. as simulation model). The user can influence his "virtual world" and analyse the caused reaction of his control algorithm. Dynamic activities will be animated and in some cases supported by corresponding engine sounds. Figure 2 shows an example of such a visual model - a Water level control, used for a design task.

FISH.

EX1014 (Henke), 3; Pet., 72-73; Pet. Rep., 28-29. 83

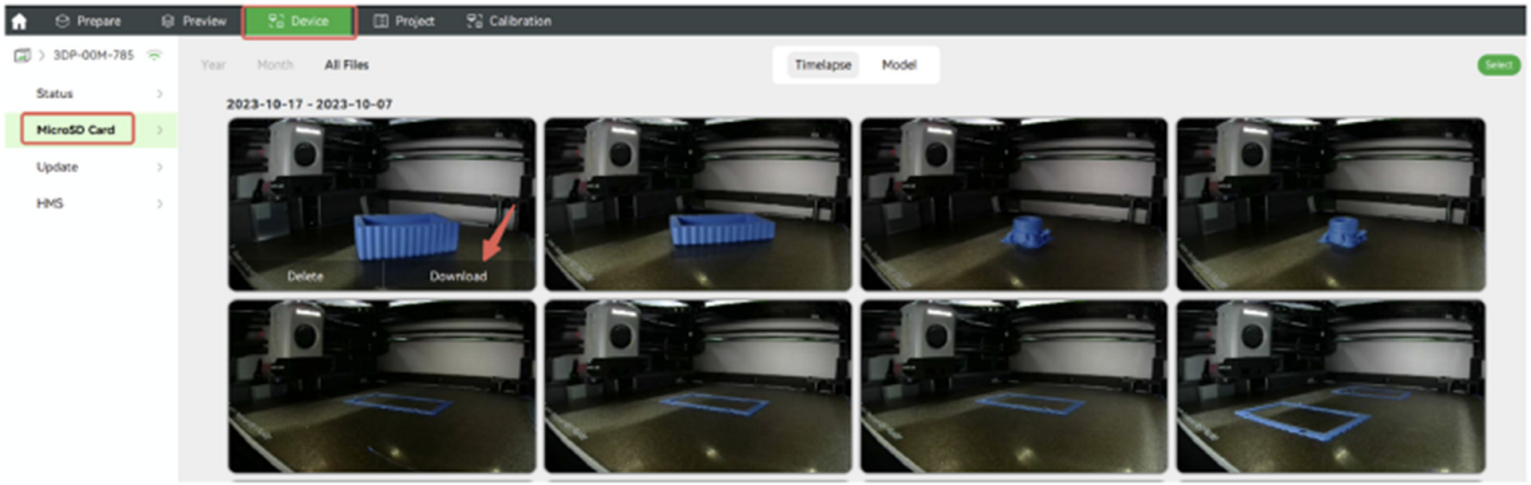
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

> For example, the two-dimensional projection is simulated as a time lapse based on the operation of the three-dimensional printer printing the object one layer at a time.

In Bambu Studio, you can also download time-lapse video files from the "Device" - "MicroSD Card" page:



FISH.

EX1016 (Infringement Contentions), 57, 64; Pet. 75-76.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 2A: Kritchman-Tay-Henke Provides Claim 6

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Tay's disclosure is just as detailed as that of the '324 patent

The '324 Patent:

The sensor **134** may also or instead include at least one video camera. The video camera may generally capture images of the working volume **114**, the object **112**, or any other hardware associated with the printer **100**. The video

print job. The visualization area **510** may also or instead show an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job. This may, for example, include a digital still image (which may be updated periodically) or a video image captured from a video camera at the three-dimensional printer.

As shown in step **708**, the method **700** may include providing a user interface to a remote user accessing the device through the network interface, wherein the user interface presents an image of the build volume from the camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera. This may be any of the user interfaces described above, or any other suitable interface for conveying visual information such as a video image and/or model projection. It will be understood that a

As shown in step **710**, the method **700** may include transmitting status information over the data network upon completion of the object. This may, for example, include data presented through the user interface, or any other status information or summary thereof. For example, the status information may include a digital image from the video camera, which may be transmitted with an electronic mail communication confirming completion of the object. More generally,

98

FISH.

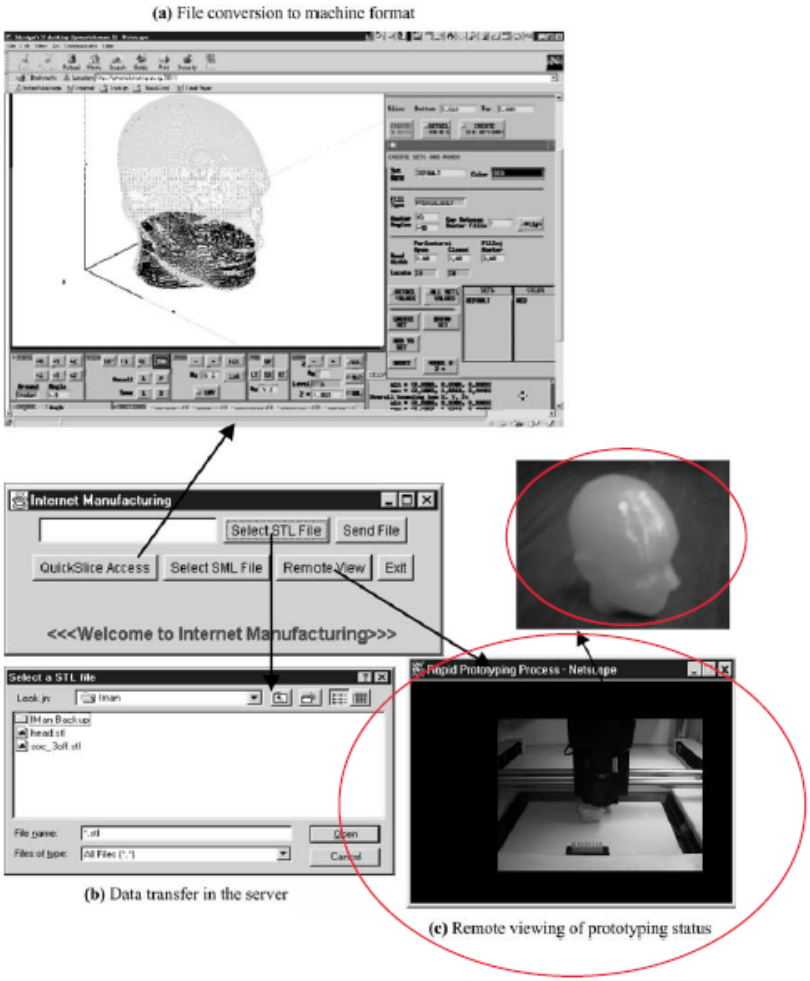
EX1001 (The '324 patent), 6:22-24, 22:50-55, 24:47-55, 25:8-13; Pet. Rep., 19-20, 30. 86

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Tay Displays Multiple Images

Tay:

Figure 3
(a) File conversion to machine format (b) Data transfer in the server (c) Remote viewing of prototyping status



From the viewpoint of the client application, the socket connection is active only for data transfer and invocation of the rapid prototyping hardware. Other audio and visual feedback from the remote location where the server and rapid prototyping hardware are resided can be obtained by the use of Web cam and video conferencing (see Figure 3). Normally, only one single client

FISH.

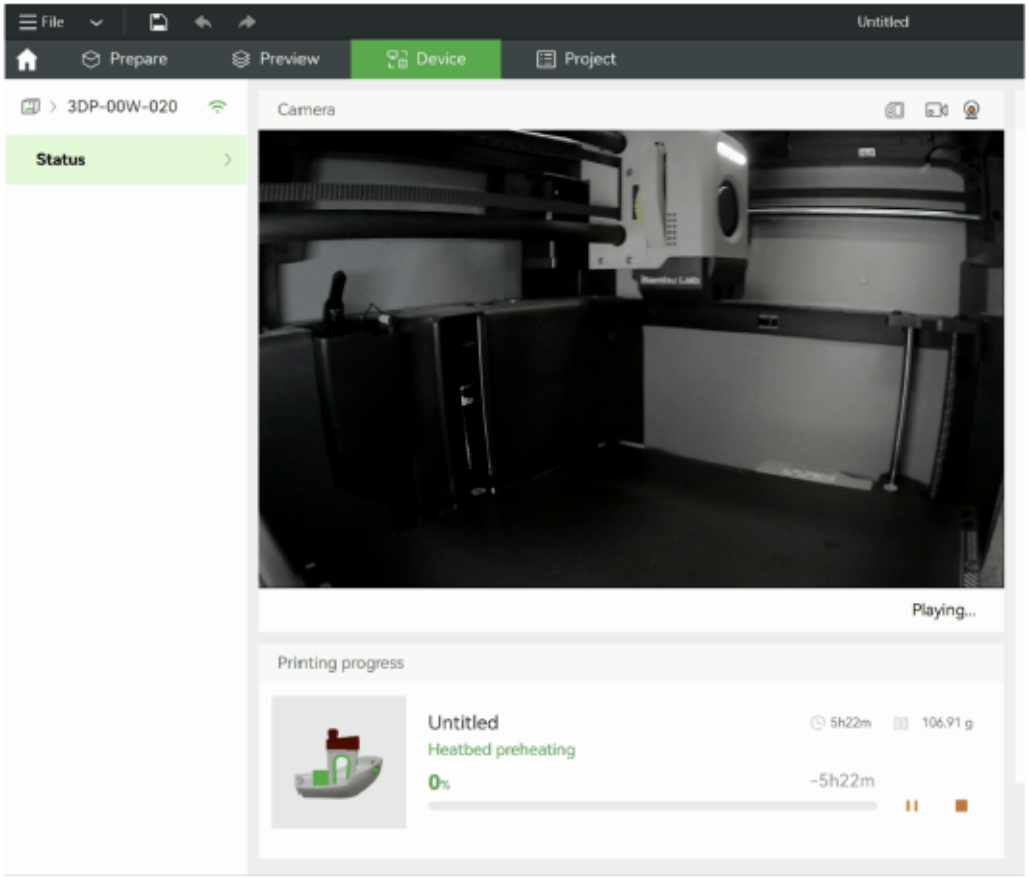
EX1013 (Tay), 4-5; Pet., 76-77; Pet. Rep., 23-24, 30.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

6. The device of claim 1 wherein the two-dimensional projection is a video image from the video camera.	For each of the Accused Instrumentalities, the two-dimensional projection is a video image from the video camera. For example, a two-dimensional projection of the three-dimensional model is a video image from the video camera, such as the LiveView feature in Bambu Studio or Bambu Handy.



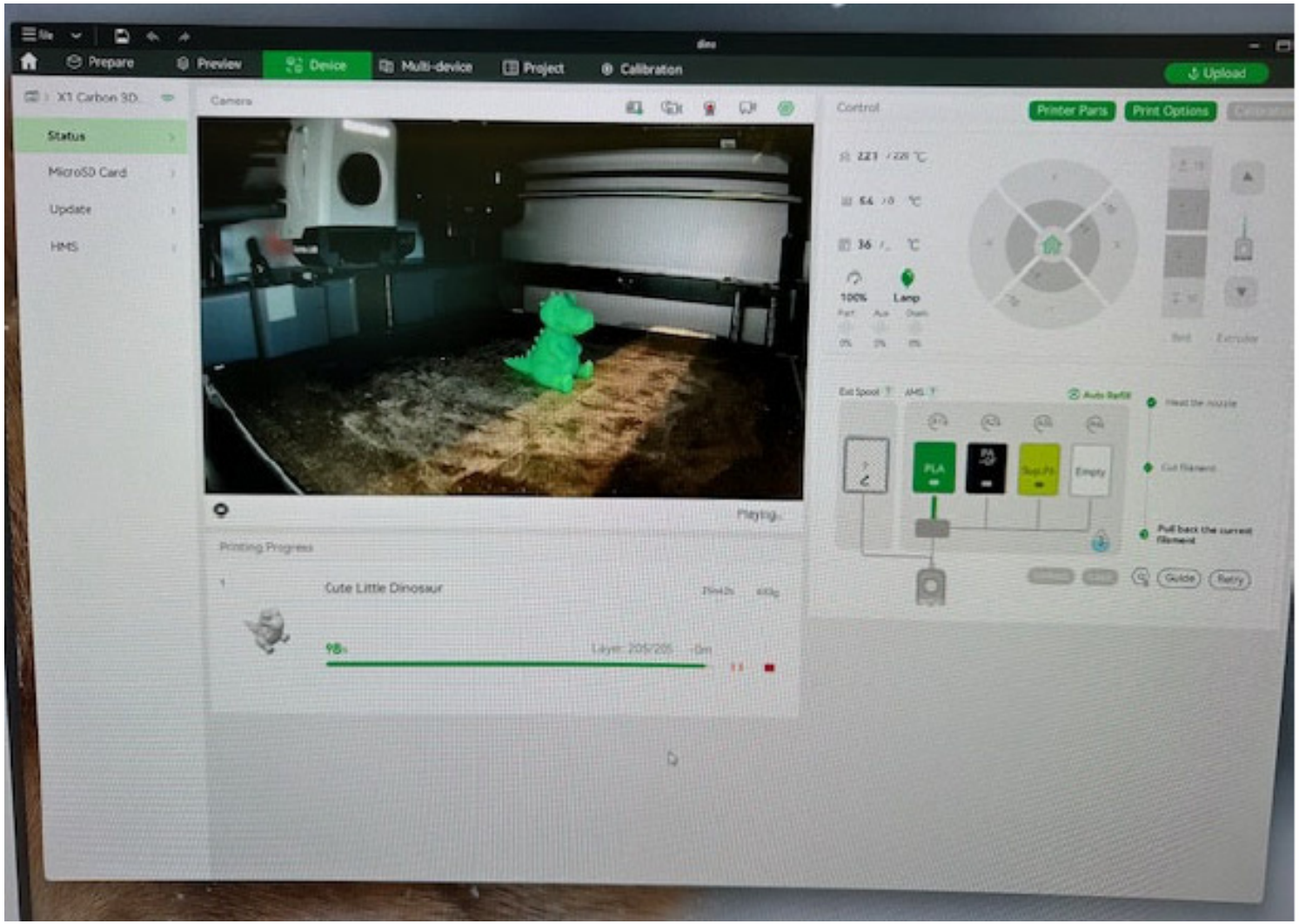
FISH.

EX1016 (Infringement Contentions), 102; Pet. 78; Pet. Rep., 30.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

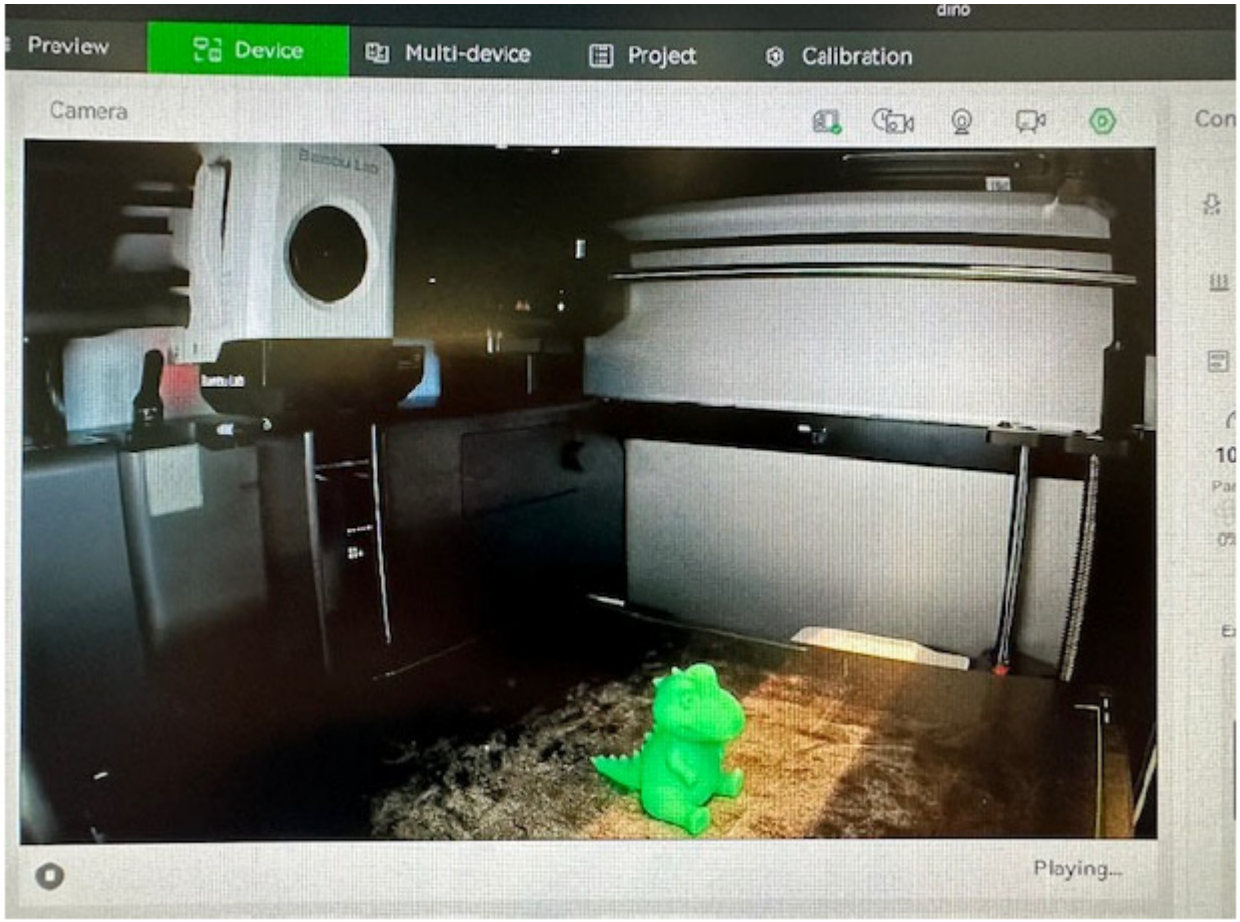


EX1016 (Infringement Contentions), 103; Pet. 78; Pet. Rep., 30.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Broad District Court Interpretation

Stratasys:

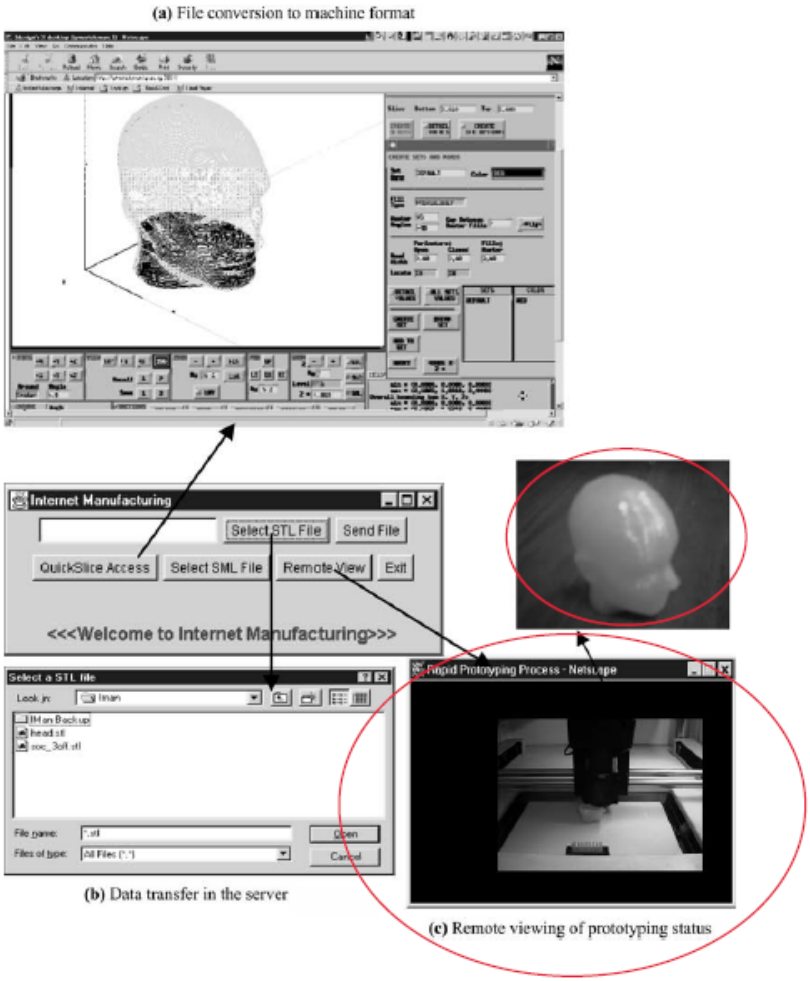


DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Tay Displays Multiple Images

Tay:

Figure 3
(a) File conversion to machine format (b) Data transfer in the server (c) Remote viewing of prototyping status



From the viewpoint of the client application, the socket connection is active only for data transfer and invocation of the rapid prototyping hardware. Other audio and visual feedback from the remote location where the server and rapid prototyping hardware are resided can be obtained by the use of Web cam and video conferencing (see Figure 3). Normally, only one single client

FISH.

EX1013 (Tay), 4-5; Pet., 76-77; Pet. Rep., 23-24, 30.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 2G: Kritchman-Tay-Henke-Anderson Provides Claim 5

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Kritchman-Tay-Henke-Anderson Provides Claim 5

Anderson:

[0015] The present invention pertains to a user interface, method and apparatus for providing three-dimensional object fabrication status in the form of a progressively filled-in wireframe model representation of the three-dimensional object. In various embodiments of the present invention, data pertaining to the fabrication of one or more three-dimensional objects is received and used to control a graphical user interface to provide a visual representation of the three-dimensional object(s) fabrication progress in the form of one or more progressively filled-in wireframe model representations of the three-dimensional object(s).

The print server (and/or driver), which preferably has already rendered a 3D wireframe model representation of the 3D object being printed, calculates how many passes are required to complete the job. At a specified interval, the server polls the printer for the pass number. After each polling, the 3D wireframe model representation is re-rendered to show the completed portion as a filled-in (e.g., solid colored) area. It should be noted that the printer can "push" the pass information to the server, as well as having the server "pull" it. Alternatively, the above-described functionality can be implemented via the printer driver (i.e., the print server is not used to perform these functions).

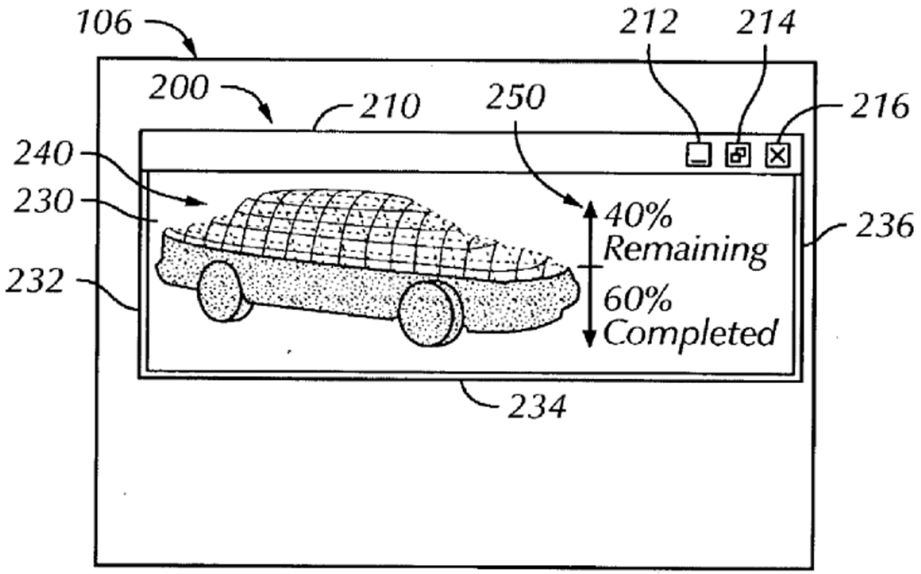


FIG. 2A

EX1012 (Anderson), [0015], [0018], FIG. 2A; Pet. 93-94; Pet. Rep., 15, 30-31.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Kritchman-Tay-Henke-Anderson Provides Claim 5

Anderson:

[0028] In another embodiment of the present invention, an apparatus for providing three-dimensional object fabrication status includes: a data interface configured to receive, from one or more solid freeform fabrication (SFF) systems, data pertaining to a three-dimensional object(s) fabrication task; and a mechanism for processing the data to generate output signals that cause a display to generate a visual representation of progress of the three-dimensional object(s) fabrication task in the form of one or more wireframe model representations of the three-dimensional object(s) which are progressively filled to visually indicate fabrication task progress for each three-dimensional object. The data inter-

It would also be helpful to be able to provide operators of such systems with a real time indication of job progress.

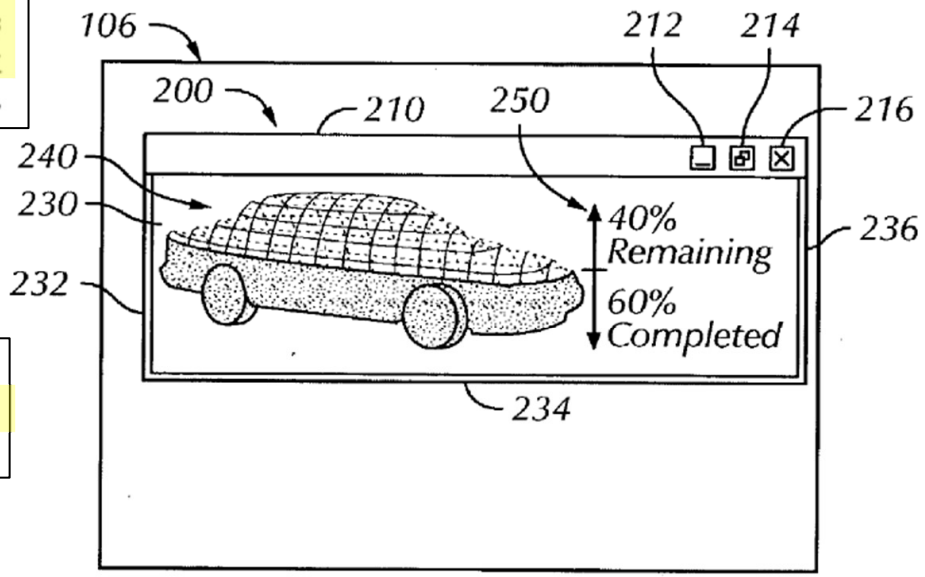


FIG. 2A

EX1012 (Anderson),[0028] [0005], FIG. 2A; Pet. Rep., 31.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 2C: Kritchman-Tay-Henke-Hull Provides Claim 8

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Kritchman-Tay-Henke-Hull Provides Claim 8

Hull:

8.2 How to Transfer Files from Slice Computer to Process Computer

This procedure shows how to transfer the sliced object and support files from the slice computer to the process computer (Wyse PC 286) in the SLA-1.

a. Press ENTER - MAIN MENU is displayed.
b. Select option 1 (Data Transfer).
c. In response to (data transfer) prompt, type 2 (FTP) (file transfer program) and press ENTER.
d. In response to (ftp) prompt, type OPEN and press ENTER.
e. In response to (to) prompt, type address of slice computer and press ENTER.
f. In response to Remote user prompt, type the name of your directory and press ENTER.
g. In response to Password prompt, type your password and press ENTER.
h. In response to (ftp) prompt, type GET and press ENTER.
i. In response to (remote-file) prompt, type name of desired file usually followed by .sli (example - test.sli) and press ENTER.
j. In response to (local-fill test .sli in default) prompt, press ENTER (unless you want to change name). (The FTP routine will now transfer the file to the process computer. It will prompt when the transfer is complete.)
k. To exit from FTP, in response to (ftp) prompt, type BYE and press ENTER. (The sliced files have now been transferred to the SLA-1 process computer.)
l. MAIN MENU is displayed after transfer is completed.

REMOTE USER A Network Menu option used to remotely operate the Slice Computer from the Control Computer keyboard.

FISH.

EX1008 (Hull), [0157], [0499]; Pet. 33; Pet. Rep., 21-22.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

THANK YOU

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE