



(19) **United States**

(12) **Patent Application Publication**
Attia

(10) **Pub. No.: US 2015/0239270 A1**

(43) **Pub. Date: Aug. 27, 2015**

(54) **ADDING STRENGTH, COLOR, AND FINISH TO 3D PRINTED OBJECTS**

Publication Classification

(71) Applicant: **Sedny Attia**, Santa Cruz, CA (US)

(51) **Int. Cl.**
B41J 29/38 (2006.01)

(72) Inventor: **Sedny Attia**, Santa Cruz, CA (US)

(52) **U.S. Cl.**
CPC **B41J 29/38** (2013.01)

(21) Appl. No.: **14/264,882**

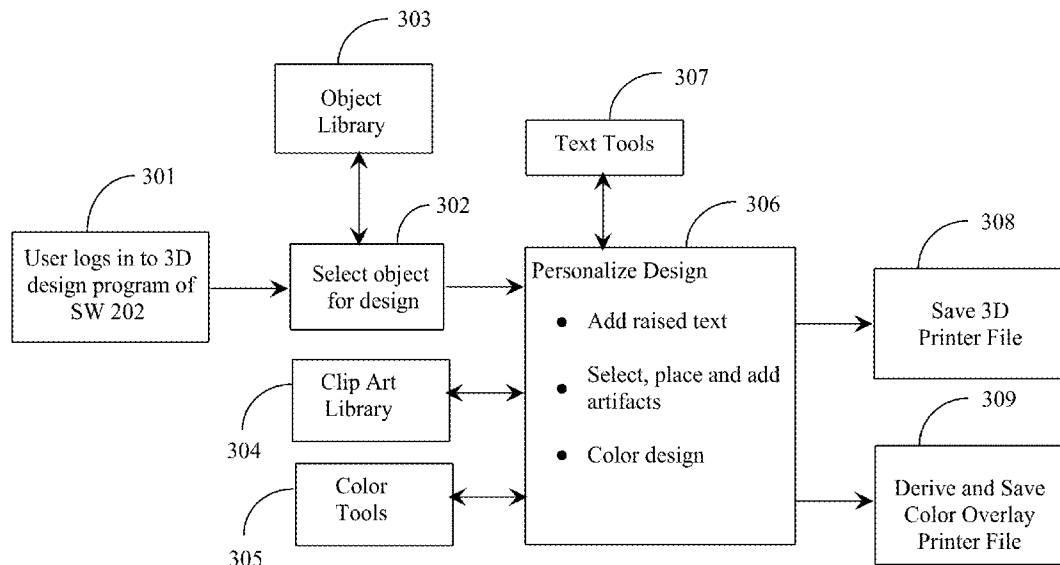
(57) **ABSTRACT**

(22) Filed: **Apr. 29, 2014**

A method comprises steps for (a) printing a 3D object using a 3D printer, the 3D object comprising a surface having one or both of one or more raised artifacts and one or more instances of raised text; and (b) printing an overlay to the surface with a printer using UV-curable ink and curing the ink with ultra-violet light, providing thereby one or more of increased strength, improved texture, and enhanced color effects or the 3D object.

Related U.S. Application Data

(60) Provisional application No. 61/945,040, filed on Feb. 26, 2014.



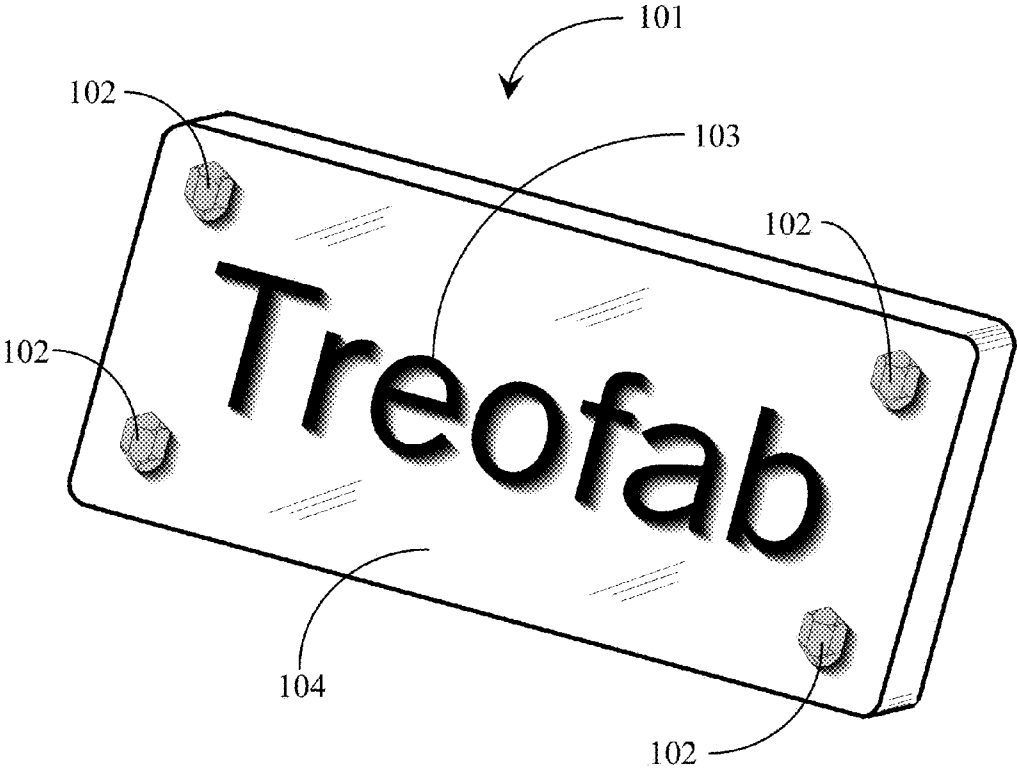


Fig. 1 (prior Art)

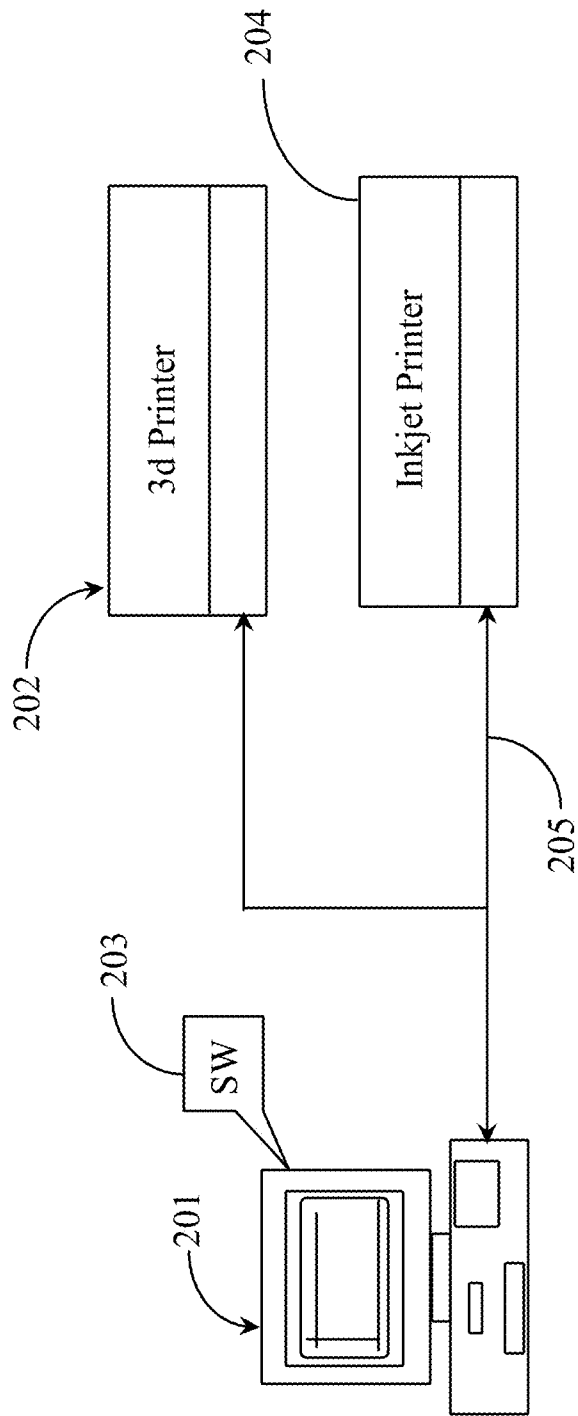


Fig. 2

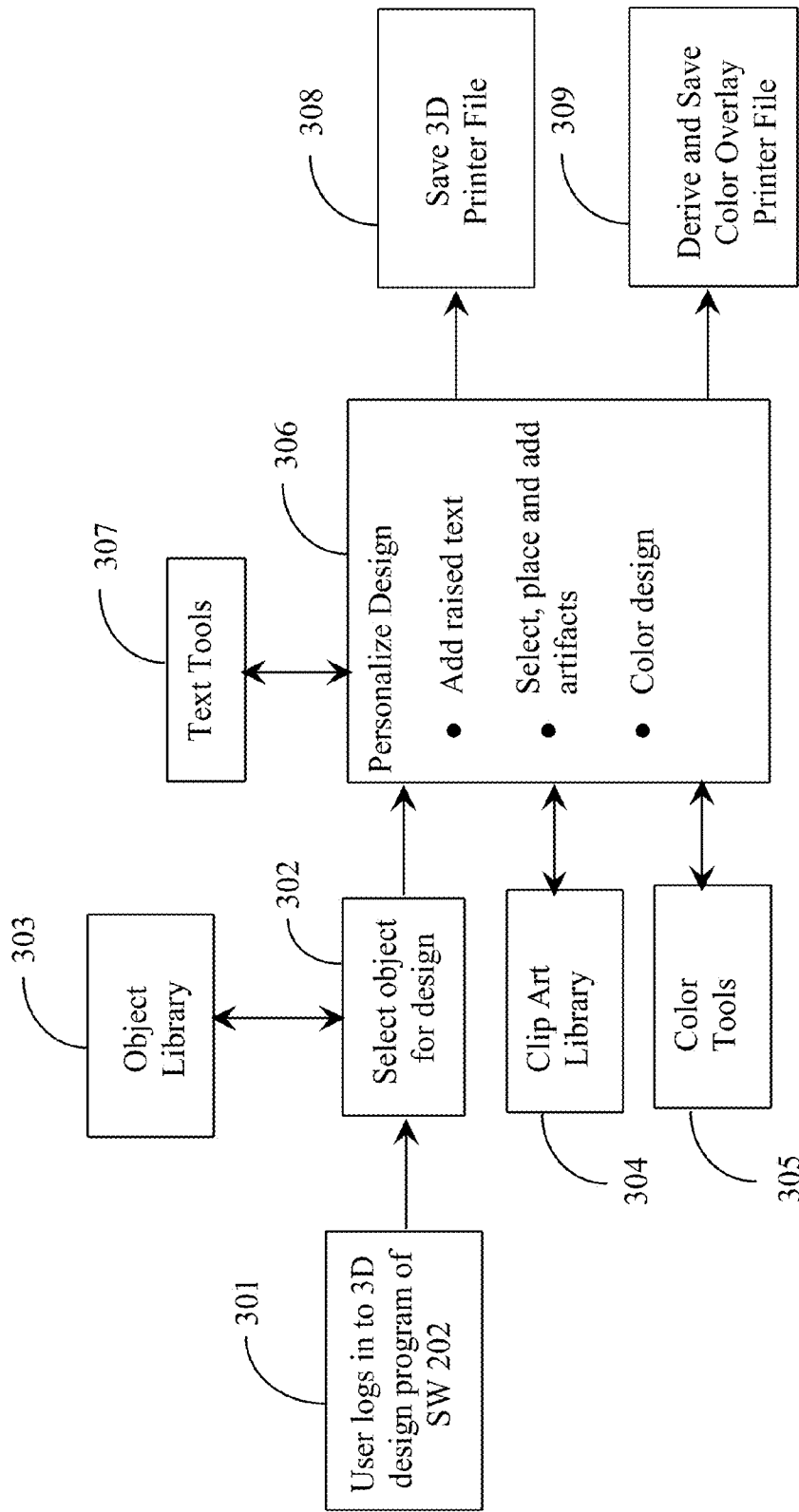


Fig. 3

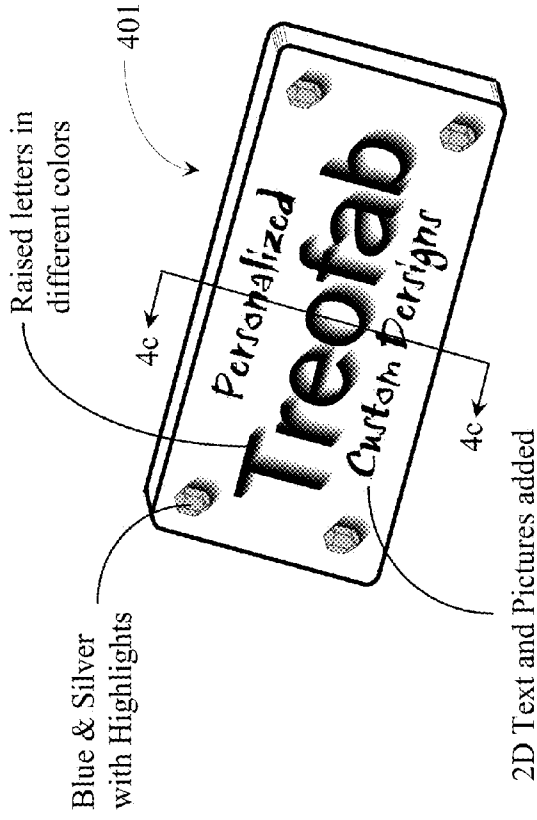


Fig. 4a

2D Text and Pictures added

Fig. 4b

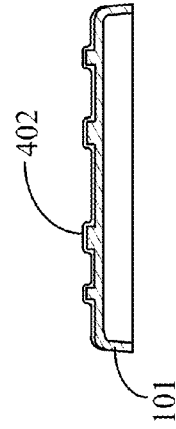


Fig. 4c

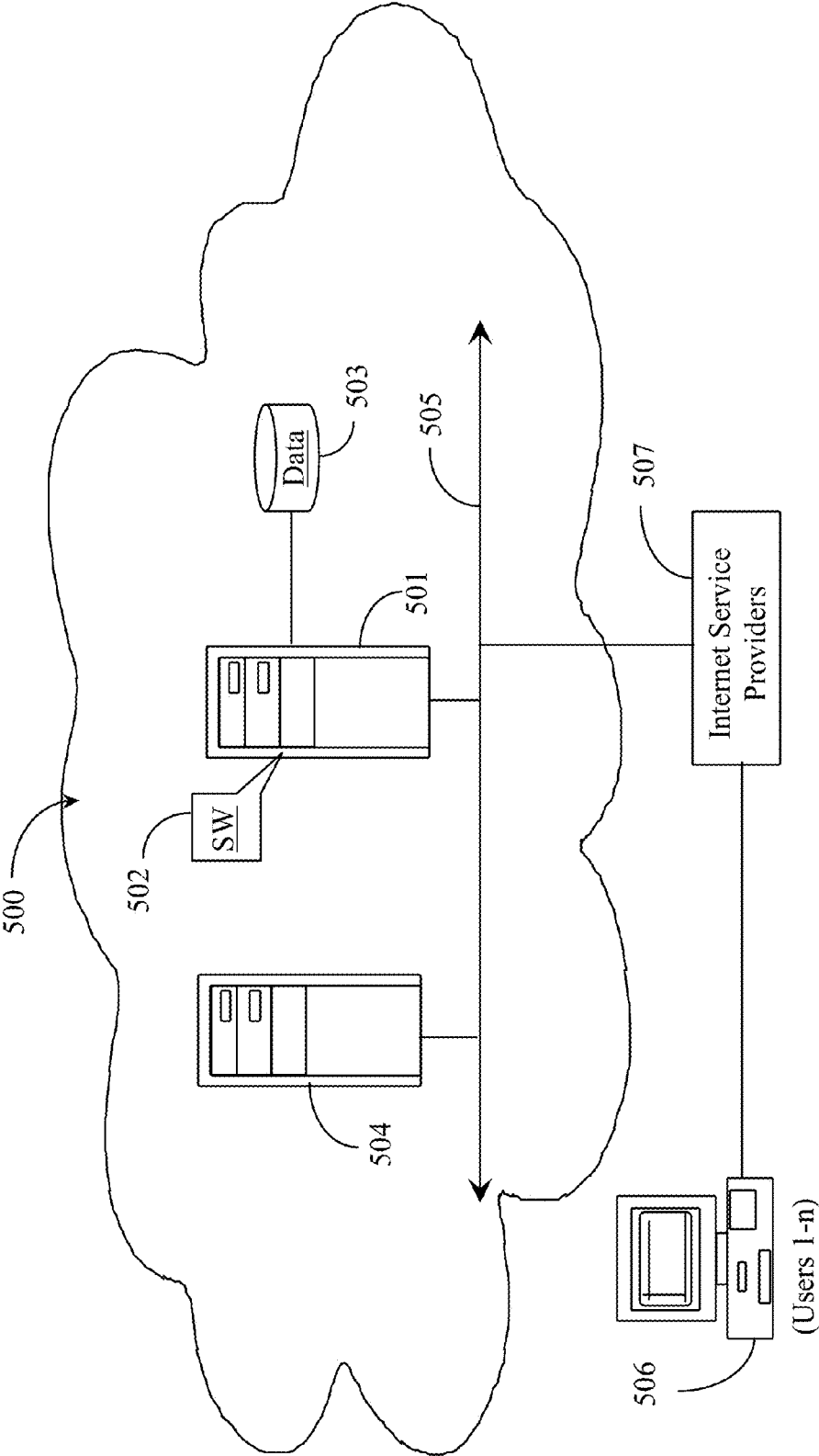


Fig. 5

ADDING STRENGTH, COLOR, AND FINISH TO 3D PRINTED OBJECTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application Ser. No. 61/945,040, filed on Feb. 26, 2014, the disclosure of which is hereby incorporated in its entirety at least by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention is in the technical field of 3D printed objects. More particularly, the present invention relates to a method for adding strength, color, and finish to 3D printed objects.

[0004] 2. Description of Related Art

[0005] In the art of 3D printing many different techniques and processes of 3D printing are available, as well as different 3D printing materials. One problem and disadvantage with existing 3D printing processes is strength of the 3D printed object.

[0006] One known 3D printing method includes printing 3D objects using a sandstone material and a Z-Corp™ 3D printer. However, a sandstone 3D printed object is very brittle and unable to withstand the stress of general use and everyday handling.

[0007] Another known 3D printing method includes printing 3D objects using a paper material and a MCOR™ 3D printer. Likewise, a paper 3D printed object has many similar disadvantages, including brittleness and subject to damage during the stress, wear, and tear of everyday use and handling.

[0008] Another limitation and disadvantage with known 3D printing methods includes the inability to provide a full-color finish. For instance, other known 3D printing processes such as selective laser sintering (SLS) and Stereolithography (SLA), provide 3D objects that are durable for everyday handling, but fail to provide a full-color finish. Painting, dyeing, and other known color techniques are not unsuccessful.

[0009] Another disadvantage to the aforementioned 3D printing methods is that the texture of the 3D printed object is typically limited to the texture of the material used, consequently, there is a need for a 3D printing method for adding strength, color, and finish to 3D printed objects.

BRIEF SUMMARY OF THE INVENTION

[0010] In one embodiment of the present invention a method is provided, comprising steps (a) printing a 3D object using a 3D printer, the 3D object comprising a surface having one or both of one or more raised artifacts and one or more instances of raised text; and (b) printing an overlay to the surface with a printer using UV-curable ink and curing the ink with ultraviolet light, providing thereby one or more of increased strength, improved texture, and enhanced color effects or the 3D object.

[0011] In one embodiment, in step (a), the surface includes a plurality of raised artifacts and a plurality of instances of raised text. In one embodiment, in step (a), the 3D object is formed from an ultraviolet-curable polymer, paper, or sandstone. Also in one embodiment, in step (b), the overlay is printed using an inkjet printer. Still in one embodiment, in step (b) color images are added to the surface. Also in one

embodiment there is further a step wherein a file for driving the 3D printer to produce the 3D object is created by a user through an interactive interface to a CAD program, and a file to drive the printer using UV-curable ink is derived from the first file.

[0012] In one embodiment the CAD program and interactive interface is provided through a web page. Further in one embodiment the CAD program provides access to libraries enabling users to select 3D objects to print, clip art to be added to the 3D object, text tools to add text to the 3D object and color tools to add color and color images to the 3D object. Still in one embodiment the users are enabled to download a first file to drive a 3D printer to create the 3D object, and a second file derived from the first file to print the overlay on the printed 3D object.

[0013] In another aspect of the invention a system is provided, comprising a computerized appliance having a processor and coupled to a data repository, the processor executing software from a non-transitory medium, the software providing an interactive interface to a design program, the design program enabling a user to, select from storage an individual one of a plurality of objects that may be printed on a 3D printer; select text to add to the 3D object and add the text to the object; select artifacts to add to surfaces of the 3D object, and add the artifacts to the object, enhance surfaces of the 3D object with color and images; create a first file to run a 3D printer to print the 3D object; create a second file to run a printer with UV-curable ink to overlay the 3D object with color and images; and download the two files.

[0014] In one embodiment the system comprises a 3D printer and an inkjet printer, wherein the user downloads the two files, sends the first to a 3D printer creating the 3D object, mounts the created 3D object in the second printer, and sends the second file to the second printer providing a UV-curable overlay to the 3D printed object, the overlay file then cured by UV light, providing one or more of enhanced strength, enhanced texture, and color and images to the 3D object. Also in one embodiment the computerized appliance is an Internet-connected appliance providing a web page enabling users to access and use the design program.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0015] FIG. 1 is a perspective view of an object that may be 3D printed, and is representative of the prior art.

[0016] FIG. 2 is a block diagram of a computer network according to an embodiment of the present invention.

[0017] FIG. 3 is a flow diagram illustrating steps to create a 3D printed object according to an embodiment of the present invention.

[0018] FIG. 4a is a perspective view of the 3D printed object of FIG. 1 according to prior art.

[0019] FIG. 4b is a perspective view of the 3D printed object of FIG. 4a after a derived overlay printer file is applied and printed according to an embodiment of the present invention.

[0020] FIG. 4c is a cross-sectional view taken along section line 4c-4c of FIG. 4b.

[0021] FIG. 5 is an architectural diagram of an Internet computer network system according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] FIG. 1 is a perspective view of an object 101 that may be 3D printed according to prior art. Referring to FIG. 1, the 3D printed object 101 has a desired length, width, and thickness of a 3D printing material printed by methods well known in the art. The 3D printing material is described in greater detail below. Object 101 comprises a plurality of raised artifacts 102 and raised lettering 103 against a flat surface 104. Although diamond shaped artifacts 102 are shown, many different artifacts in a variety of different shapes may be 3D printed. The raised lettering 103 may be provided in a variety of different fonts and text constraints, including but not limited to height, width, and orientation. The process of adding and printing the raised artifacts 102 and raised lettering 103 is described in greater detail below.

[0023] Many different techniques of 3D printing are available, including different 3D printer models and different 3D printing materials. For example, a Z-Corp™ 3D printer may print an object, such as object 101, using a sandstone material. There are many disadvantages of a sandstone 3D printed object, such as object strength and photo degradation. Specifically, a sandstone 3D printed object is very brittle and unable to withstand the stress of general use and everyday handling. Further, a sandstone 3D printed object is subject to photo degradation when exposed to sunlight, causing the object's color and appearance to quickly fade. A MCOR™ 3D printer may print an object, such as object 101, using a paper material. Likewise, a paper 3D printed object has many similar disadvantages, including brittleness and being subject to damage during the stress, wear, and tear of everyday use and handling. A further limitation for a paper or sandstone 3D printed object is the object's texture. Specifically, the texture is limited to the texture of the material used. For instance, a sandstone 3D printed object, such as object 101, will have a relatively rough, grainy surface texture.

[0024] In one embodiment the 3D printed object 101 will be printed from a process using UV-curable liquid polymers, printed perhaps on a PolyJet™ 3D printer. In this process an object is created one layer at a time by curing layers of printed liquid polymers with a UV light source. 3D objects printed with UV-curable liquid polymers are more durable than 3D objects printed using a sandstone or paper material. Still, if more strength or support is needed, the 3D printed object may be produced using a 3D printing process known as selective laser sintering (SLS) using a powder resin material. However, much like the sandstone and paper material, there is a limitation in the color and texture using this method. Painting, dyeing, and other known coloring techniques have proven to be unsuccessful. Accordingly, the present inventor has discovered and developed a method of printing a full-color overlay on 3D printed objects with an inkjet printer using UV-curable ink. The full-color overlay is cured using a UV light source creating a structural and chemical bond to a 3D object printed with UV-curable polymer, which strengthens the 3D printed object while providing a full-color design. Conceivably, since the 3D printed object was first printed and cured with UV curable liquid polymers, a structural and chemical bond occurs when the UV printed ink overlay is printed and cured with a UV light source on the original 3D object. The details of this process are described in greater detail herein below.

[0025] FIG. 2 is a block diagram of a computer network and software according to an embodiment of the present invention. Referring to FIG. 2, the computer network 205 com-

prises general purpose computer 201 executing software 203. The computer network 205 further comprises a 3D printer 202 and an inkjet printer 204. The inkjet printer 204 is a UV inkjet printer, capable of printing and curing UV curable inks. 3D objects, such as object 101 illustrated in FIG. 1, may be designed on computer 201 by executing software 203. The software 203 may be any computer aided design (CAD) software known in the art that may be adapted to create files for running a 3D printer. After designed objects are completed, files may be derived from the software 203 capable of running the 3D printer, and separate files for running the inkjet printer, and sent to the 3D printer and/or the inkjet printer 204 for processing. This process is described in greater detail below.

[0026] FIG. 3 is a flow diagram illustrating steps to create a 3D printed object according to an embodiment of the present invention. At step 301 a user logs in to a 3D design program provided by software 203, the user may select an object for design. Software 203 accesses an object library 303 of a variety of objects that may be selected. For example, the object may be a nameplate, such as the object 101 illustrated in FIG. 1. Likewise, the object may be a back plate for a cellphone enclosure, or any number of objects that may be 3D printed, including but not limited to a business card holder or plaque, and many other objects.

[0027] Next, in step 306 the user has access to tools to personalize the design. For instance, the user may add raised text using text tools 307, illustrated as raised lettering 103 in FIG. 1. The text tools 307 include ability to change a variety of options, including but not limited to size, font, and orientation. The size constraints include the height of the text, which is the amount the text extends from the object, as well as length and width. The orientation constraint includes the ability to change the rotation of the text, such as orientating the text at an angle in relation to the object.

[0028] The user may select, place, and add artifacts from a clip art library 304. Examples of clip art include the diamond artifacts 102 illustrated in FIG. 1, as well as a variety of other symbols, shapes, and art. The artifacts may be 2D clip art that is rendered in 3D space as a raised object, or a true 3D clip art, such as a face or sculpture.

[0029] Still referring to FIG. 3, the user may further personalize the object by utilizing color tools 305 to add color to the design. Using color tools 305 the user may customize the color of any selected artifact, text, or object surface. Multiple colors may be provided creating a full-color design. Further, images may be added.

[0030] After completing the personalization of the design 306 the user may save a 3D printer file 308. Printer file 308 may be used to drive a 3D printer to produce a 3D printed object. For example, the printer file 308 may be used to drive the 3D printer 202, as shown in FIG. 2, to create a 3D printed object 101, as illustrated in FIG. 1. It will be understood that many CAD file formats may be used in alternative embodiments. Next the user may also derive and save a color overlay printer file 309, which may be derived from the same design parameters that produces the 3D printer file. Color overlay printer file 309 may be used to drive an inkjet printer, using UV-curable ink, and provide an overlay for the 3D printed object. For example, the color overlay printer file 309 may be used to drive the inkjet printer 204, as shown in FIG. 2. The color overlay printer file may be a Portable Network Graphics (PNG) file format, to prevent any data loss from file compression. Other lossless data file formats may be used in alternate embodiments, including but not limited to TIFF, BMP, or

JPEG-L.S. In an alternative embodiment, an independent texture file can be derived and saved for processing and printing. It should be understood that the color overlay printer file may include the texture. Likewise, when referencing color inkjet printing, texturing is implied.

[0031] FIG. 4a is a perspective view of 3D printed object 101 of FIG. 1 . . . 3D printed object 101 represents a 3D object printed from a 3D printer file, such as 3D printer file 308 as shown in FIG. 3. In this example, the 3D printed object 101 is printed having no color, or limited to the color of the materials used in printing the object.

[0032] FIG. 4b is a perspective view of the 3D printed object 101 of FIG. 4a after a derived color overlay printer file is sent to an inkjet printer, in which object 101 may be mounted, to create a full-color overlay on the 3D printed object 101, providing object 401. Specifically, the derived color overlay file, such as printer file 309 shown in FIG. 3, is sent to an inkjet printer, such as inkjet printer 204 shown in FIG. 2. The inkjet printer prints the color overlay printer file on the surface of the 3D printed object 101 of FIG. 4a, using UV-curable inks. After printing, the full-color overlay is cured using a UV light source creating a structural and chemical bond, which strengthens the 3D printed object while providing a full-color design.

[0033] As described above, a user may customize their object design using customization tools shown in FIG. 3. A full-color overlay printed on the 3D printed object 101 comprises diamond artifacts, such as diamond artifacts 102 shown in FIG. 1, printed with blue and silver highlights in this example. Object 401 with color overlay further comprises the raised lettering printed with a plurality of colors or a single color. The overlay may include full-color personalized custom designs, including but not limited to, 2D text, backgrounds, and images. The 2D text may be added and printed to the flat surface of the 3D object. Similarly, different color backgrounds and pictures may be added and printed to the flat surface of the 3D object. The color backgrounds and pictures may be printed in a variety of different designs, including but not limited to a plurality of colors, a single color, or color gradients.

[0034] FIG. 4c is a cross-sectional view taken along section line 4c-4c of FIG. 4b which shows 3D printed object 101 with full-color overlay 402, providing object 401. As described above, the full-color overlay 402 is printed with UV curable ink. Overlay 402 may change the texture and thickness of the original material, while strengthening and providing a full-color surface overlay as described for FIG. 4b.

[0035] FIG. 5 is an architectural diagram of an Internet-connected system according to an embodiment of the present invention. Referring to FIG. 5, the Internet-connected system comprises an Internet server 501 executing software 502. Server 501 is connected to a data repository 503, which may be any sort of data storage known in the art. The system further comprises a third party Internet server 504 connected to Internet backbone 505. Although one third party Internet server 504 is shown, it is understood that potentially millions of other similar servers are connected to the Internet 500 via Internet backbone 505. Through Internet server 501, a website is provided; wherein the operating software 502 is accessible on the Internet. A number of users (1-n) 506 are connected to the Internet server 501 via an Internet service provider (ISP) 507. This allows users 506 to access the website and corresponding operating software 502, which provides the design service and steps illustrated in FIG. 3.

[0036] In this embodiment the software delivery model is software as a service (SAAS), wherein users 506 may access the website and corresponding operating software 502, to create 3D printer files for a plurality of 3D printers that operate with a plurality of 3D print material.

[0037] Users 506 may be a variety of entities, including but not limited to individuals, small businesses, or large businesses. Users 506 accessing software 502 may also derive color overlay printer files for operation with inkjet printers. Specifically, overlay printer files for UV inkjet printers which can print and cure UV ink on 3D objects, as seen in FIGS. 4a-c, to provide all the advantages of UV printing on 3D objects as discussed herein.

[0038] In various embodiments of the invention 3D printed objects may have engraving, depressions and holes as well as raised lettering and artifacts without departing from the scope of the invention. In many embodiments 3D printed objects may also be other than flat-aspect objects as shown in embodiments above, such as cylindrical, round and other shapes. UV printing equipment may be adapted to manipulate one or both of print heads and fixtured objects to be printed so such objects may be efficiently coated in embodiments of the invention.

[0039] It will be apparent to the skilled person that there may be many alterations in the embodiments described without departing from the scope of the invention. For example, although the embodiments described above include printing a 3D object using UV curable liquid polymers, other printed 3D object materials and printing applications may be used before the UV inkjet printing process, while still providing the advantages discussed herein, such as Fused Deposition Modeling (FDM) thermoplastic and Selective Laser Sintering (SLS) plastic or metal, as well as the aforementioned sandstone and paper.

What is claimed is:

1. A method comprising steps:

- (a) printing a 3D object using a 3D printer, the 3D object comprising a surface having one or both of one or more raised artifacts and one or more instances of raised text; and
- (b) printing an overlay to the surface with a printer using UV-curable ink and curing the ink with ultraviolet light, providing thereby one or more of increased strength, improved texture, and enhanced color effects on the 3D object.

2. The method of claim 1 wherein in step (a), the surface includes a plurality of raised artifacts and a plurality of instances of raised text.

3. The method of claim 1 wherein in step (a), the 3D object is formed from an ultraviolet-curable polymer, paper, or sandstone.

4. The method of claim 1 wherein in step (b), the overlay is printed using an inkjet printer.

5. The method of claim 4, wherein in step (b) color images are added to the surface.

6. The method of claim 1 further providing a step wherein a file for driving the 3D printer to produce the 3D object is created by a user through an interactive interface to a CAD program, and a file to drive the printer using UV-curable ink is derived from the first file.

7. The method of claim 6 wherein the CAD program and interactive interface is provided through a web page.

8. The method of claim 7 wherein the CAD program provides access to libraries enabling users to select 3D objects to

print, clip art to be added to the 3D object, text tools to add text to the 3D object and color tools to add color and color images to the 3D object.

9. The method of claim **8** wherein the users are enabled to download a first file to drive a 3D printer to create the 3D object, and a second file derived from the first file to print the overlay on the printed 3D object.

10. A system comprising:

a computerized appliance having a processor and coupled to a data repository, the processor executing software from a non-transitory medium, the software providing an interactive interface to a design program, the design program enabling a user to:

select from storage an individual one of a plurality of objects that may be printed on a 3D printer;

select text to add to the 3D object and add the text to the object;

select artifacts to add to surfaces of the 3D object, and add the artifacts to the object;

enhance surfaces of the 3D object with color and images;
create a first file to run a 3D printer to print the 3D object;
create a second file to run a printer with UV-curable ink to overlay the 3D object with color and images; and
download the two files.

11. The system of claim **10** comprising a 3D printer and an inkjet printer, wherein the user downloads the two files, sends the first to a 3D printer creating the 3D object, mounts the created 3D object in the second printer, and sends the second file to the second printer providing a UV-curable overlay to the 3D printed object, the overlay file then cured by UV light, providing one or more of enhanced strength, enhanced texture, and color and images to the 3D object.

12. The system of claim **10** wherein the computerized appliance is an Internet-connected appliance providing a web page enabling users to access and use the design program.

* * * * *