

Three Dimensional Printing

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Introduction

When thinking of a printer, the first thing that comes to mind is probably a flat sheet of paper with images or text from a document on it. However, imagine what it would be like have more than just a flat image of a necklace but to have the ability to make a necklace that is in three dimensions, tangible, and good for everyday use with the use of only a printer. At first thought, it probably sounds impossible and too good to be true, but it is something feasible. Three dimensional printing is a modern type of growing technology that contains many benefits but also requires for some extra precautions to be taken as it has legal, ethical, social, and security problems attached to it.

Background

Three dimensional printing is much different from regular everyday printing done with a printer in people's homes. The book *What is the Future of 3D Printing?* states that 3D printing is “the process that creates an object using a device connected to a computer” (Marcovitz, 2017, p.10). 3D printers are similar to the traditional printer that prints documents or photographs but prints in three dimensions, producing objects that can be of use every day (Marcovitz, 2017, p. 10). According to *3D Printing* by Steven Otfinoski, three dimensional printing creates new objects from raw materials (Otfinoski, 2016, p. 7).

Manufacturing was called a “subtractive” process before 3D printers were developed. The “subtractive” process indicates that “the finished product is made from raw materials that are subtracted from the process as the product moves down an assembly line” (Markovitz, 2017, p. 11). Products are traditionally made by either using molds or cutting them from raw materials (Markovitz, 2017, p. 12). 3D printing is known as “additive manufacturing”. An additive is the material that is put into the printer to allow for the object to be made. Traditional printers such as

ink-jet printers and 3D printers are similar in terms of their process. With traditional printers, a nozzle sprays the ink on top of a piece of paper to replicate what is on the computer screen. 3D printing is also a process that uses a nozzle to design the object. However, with 3D printing, the additive must be added to the nozzle prior to the creation of the object (Markovitz, 2017, 13-14). 3D printing seems to be an efficient and useful way to print desirable objects; however, there are some aspects that make 3D printing a questionable printing option.

Legal and Ethical Aspects

Even though 3D printing sounds like a very reasonable investment, there are some aspects of 3D printers that need to be examined. The first major aspect of 3D printers are the legal aspects. With the traditional printers, images obtained from the internet are usually printed without a problem as long as the images are properly cited to give credit to the owner of the image. However, it is different with 3D printing. Since 3D printing is a more advanced form of technology that creates original objects, using other photos is not permitted and leads to many legal problems. With 3D printing, “it is easier to make a copy of a patented product and therefore easier to infringe a patent” (Ebrahim, 2016, p. 46). It is hard to prohibit crime associated with 3D printing as it is very easy to download designs from the internet at any location which can be done without pay, affecting the 3D printing industry (Ebrahim, 2016, p. 46). A common legal issue that comes along with 3D printing is infringement, specifically creating a computer aided design which is a “virtual blueprint model that is used to produce 3D printed objects” (Ebrahim, 2016, p. 39). The computer aided designs are often times made for an item that has already been created before and are shared publically, so online users can get access to the files.

Another legal issue associated with 3D printing is intellectual property law. The intellectual property law protection consists of “copyright law, patent law, trademark, and trade

dress law: Copyright law is a form of protection sought for original, creative works, patent law is used for useful works, trademark law protection is used to identify goods by each of the consumers in a marketplace, and the trade dress law refers to the type of product packaging and the object's design" (Ebrahim, 2016, p. 42). The creation of objects mostly occurs easily in factories. However, it becomes difficult to try to recreate objects made in factories (Neely, 2015). As mentioned in the scholarly journal article, "companies are most likely to face a threat of unauthorized reproduction from other companies" (Neely, 2015).

Digital infringement is a specific form of infringement that is a legal issue associated with 3D printing. With digital infringement, "anyone who uses a 3D printer to print a patented object directly infringes when the object is made without authorization or without a license from the patent owner" (Ebrahim, 2016, p. 46). A consequence of the infringement is suing by the patent owner. However, a problem arises when the patent owner cannot identify who the direct infringer is due to the immense amount of their personal and business technology use being combined. Another legal issue associated with 3D printing is intellectual property law. It is noted that the intellectual property issues are related to "the ability to quickly create, reproduce, modify, copy, transfer, share, post, and download computer aided design files" (Ebrahim, 2016, p. 48).

There are also ethical issues attached to these advanced printers. Due to items being produced in homes by 3D printers, questions of safety arise. In a scholarly journal article called *The Risks of Revolution: Ethical Dilemmas in 3D Printing from a US Perspective*, the safety of the 3D printed objects is an ethical issue. The safety of products is dependent upon centralized manufacturing and are tested and certified as being safe. The products undergo safety checks on a regular basis (Neely, 2015). However, this is not necessarily the case with 3D printers as they

are used in homes often. Each printer tends to be different; therefore, the quality of each printer is not the same. Since it is difficult to improve the safety of the physical object itself, the software of the 3D printer can be improved through the limitation of shared plans (Neely, 2015).

Security Aspects

Along with 3D printing comes security concerns. The main focus of security with 3D printing is cybersecurity. It was noted in an article titled *NYU Researchers Report Cybersecurity Risks in 3D Printing* that there are two cybersecurity implications associated with 3D printing: “printing orientation and insertion of fine defects” (NYU Polytechnic Institute Tandon School of Engineering, 2016). With the 3D printers, a computer aided design file is sent. The computer assisted design gets broken into pieces and positions of the printer head. As stated in the article, “the orientation of the product during printing could make as much as a 25 percent difference in its strength” (NYU Polytechnic Institute Tandon School of Engineering, 2016). Those who often commit crimes can purposely change the instructions for a computer aided design. If the 3D printer is connected to the internet, people can hack into the printer and create defects in the product being created by the 3D printer (NYU Polytechnic Institute Tandon School of Engineering, 2016). Although 3D printing raises many concerns due to problems in its security, it is used to create an endless amount of objects in three dimensions.

Application of 3D Printers

3D printers are used to create a variety of objects. They can be used to build things such as homes and bridges. 3D printers are used by food companies to make food in three dimensions. Lynette Kucsma, the cofounder of a food company called Natural Machines, stated that their “big vision is that [they] actually do see that the 3D food printer will become a common appliance in every kitchen” (Otfinoski, 2017, p. 31). 3D printing is even applicable to fashion. It

has specifically been used to produce customized shoes based on a customer's measurements (Otfinoski, 2017, p. 30). 3D printers can also be useful in the biological and anatomical sense. Skin can be produced through the use of 3D printers. It is done by the growth of cells which are squirted from a printing head. They are also used in the health care industry through the production of customized hearing aids, prosthetic limbs, false teeth, and skulls (Otfinoski, 2017, p. 23).

Benefits and Problems of 3D Printing

With all the varied applications of 3D printing come a lot of benefits associated with the printer. A lot of countries worldwide that have struggled to obtain resources necessary to survive no longer have to obtain resources from other countries. With 3D printing, those countries are able to produce the resources they need without the help from other countries. 3D printers also make products locally with a minimal amount of wasted materials (Otfinoski, 2017, 58). Although there are a multitude of beneficial uses of 3D printers, there are also problems associated with the 3D printers. One of the problems is not having knowledge of what the limitation is in terms of what can and cannot be printed. Illegal devices, such as weapons, can be created by anyone and is dangerous because any individual can get a hold of 3D printers to make potentially dangerous or hazardous items (Otfinoski, 2017, p. 30).

Conclusion

3D printers are an exceptional form of new technology that is like no other. They are beneficial and can be used to create a variety of things from jewelry to appliances. However, 3D printers also have many negative aspects as well such as security, legal, and ethical concerns. With the new 3D printer technology, the future can be changed for the better but with some setbacks.

References

Is 3D Printing the Future of Manufacturing?. (2016, April 29). Retrieved from

https://www.washingtonpost.com/video/sponsored-video/is-3d-printing-the-future-of-manufacturing/2016/05/02/b455e9b2-0e27-11e6-bc53-db634ca94a2a_video.html.

Accessed 14 February 2017.

This video obtained from the *Washington Post* explains what 3D printing is and how it is used. It also mentions why 3D printers are used and its significance. In the video, the experienced speakers explain how 3D printers are beneficial and what the expected future looks like in the presence of 3D printers. The information seems reliable as the video was recently published within the past year. The speakers in the video are those with a title such as the US Managing Director or Partner Support Engineer. Even though the video is short, it was clear and concise. It was helpful for the research paper as it allowed for the determination of what 3D printers are while the printer was being shown directly with an explanation which helped provide a better understanding of 3D printers and allowed for a better visualization of how the printers are processed. The video covered a lot of the topics that will be written about in the research essay; therefore, the video is relevant for the topic.

NYU Researchers report cybersecurity risks in 3D printing. (2016, July 12). Retrieved from

<http://engineering.nyu.edu/press-releases/2016/07/12/nyu-researchers-report-cybersecurity-risks-3d-printing>. Accessed 14 February 2017.

This article from the New York University Tandon School of Engineering focuses on the security aspect of 3D printing, specifically cybersecurity. The article focused on the 3D

association with cybersecurity through the printing orientation and insertion of fine defects. The article mentions how the products formed during the 3D printing process come from a computer aided design and how there is a large possibility for the strength of the design to change. Hacking and how there can be defects in the objects that are printed is also noted in the article. This article is credible as it comes from a university, specifically their engineering research department. This indicates that the information from this article has been researched upon; therefore, the information is reliable. The information contained in this article is highly relevant to the security concerns of 3D printing and can be a great source to obtain information to analyze and relate to the security problems with 3D printing.

Ebrahim, T. Y. (2016). 3D printing: Digital infringement & digital regulation. *Northwestern Journal of Technology and Intellectual Property*, 14(1), 37-74. Retrieved from <https://search.proquest.com/docview/1763734055?accountid=14541>. Accessed 13 February 2017.

This scholarly journal article discusses the legal aspects of 3D printing. It specifically mentions infringement, both direct and indirect infringement. The article mentions patents a lot to indicate how important it is to claim that the design belongs to a certain individual. The scholarly journal article also discusses computer-aided designs (CAD) and how these digital files can be easily transmitted online to the public; therefore, the individuals' designs could be used by another individual. This source is very good for looking at the security concerns associated with 3D printing as it goes into great detail about the various infringements that can be posed. The scholarly journal article was also

written not too long ago in 2016; therefore, the information is up-to-date and reliable. The article is also scholarly and comes from a student at the University of Houston Law Center. At the end of the scholarly journal, the author Ebrahim Y. Tabrez acknowledges his professors and the Deans at the University for their insight and assistance in writing this journal article. This indicates how he was able to get help from those who have a different kind of knowledge about the topic which aided in the construction of the journal article. As he thanks those around him in the University of Houston Law Center and includes the references at the end of the article, it indicates that the information is reliable.

Marcovitz, H. (2017). *What is the future of 3D printing?*. San Diego, CA: Reference Point Press.

In the *What is the Future of 3D Printing?* book, there is a main focus on what 3D printing has been used for and will continue to be used for. It gives a brief description of what 3D printing is which will be useful in the introduction and background section of the research paper. It also looks at the use of 3D printing in terms of transportation, medicine, homes, and launching in space. It shows how versatile 3D printing is and how it can be used in many different applications. The book was written this year in 2017, so the information is recent and relevant. The book notes that the author has family members who work as a computer-aided design modeler which indicates that the information found in the book is based on fact as someone who constantly works with 3D printers is related to the author, giving the author some credibility.

Neely, E. L. (2016). *The Risks of Revolution: Ethical Dilemmas in 3D Printing from a US*

Perspective. *Science and Engineering Ethics*, 22(5), 1285-1297. doi:10.1007/s11948-015-9707-4. Retrieved from

<http://link.springer.com.mutex.gmu.edu/article/10.1007%2Fs11948-015-9707-4>.

Accessed 14 February 2017.

This scholarly journal article discusses the ethical aspects of 3D printing and the risks associated with the use of 3D printers. The article is organized into different aspects, making it easier to follow and understand. It contains information relevant to the research as it explains two main ethical concerns of 3D printing: safety and intellectual property. It goes into detail about independent and detail infringement. At the end of the scholarly journal article, there is a bibliography page indicating where some of the facts and statistics came from. This shows that the information is more likely to be reliable and accurate as there is information to support the claims made in the scholarly journal article.

Otfinoski, S. (2017). *3D printing: science, technology, engineering*. New York, NY: Children's Press, an imprint of Scholastic Inc.

This book is good as it is concise and has easy to understand explanations of 3D printing, allowing for a better understanding of three dimensional printing. The book covers multiple topics that can be used in the background information section of the essay to give the readers a better understanding of what 3D printing is and what makes it unique compared to traditional printers. Some of the topics in the book that can be used in the background section of the research paper are the following: what 3D printing is, the 3D printing process, and what it is like to be working with a 3D printer. The book also has

additional information that can be useful in analyzing 3D printers in the research paper such as the benefits and risks of 3D printing as well as what can be expected from 3D printers in the future. This book is good because it is very recent as it was just published in the beginning of this year. This means that all the information in the book is updated and reliable.