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PRINTING THE IMPOSSIBLE TRIANGLE: THE COPYRIGHT IMPLICATIONS OF THREE-DIMENSIONAL PRINTING

BRIAN RIDEOUT*

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ABSTRACT

Three-dimensional printing (3D printing), which allows users to digitize and replicate objects, is emerging as the next potentially disruptive technology. It is now possible to “print” intricate objects from furniture to food to human organs. Because 3D printing relies on computer-based blueprints in order to create physical objects, digital copyright infringement can now impact the physical world. The first example occurred in February 2011, when the world’s first Digital Millennium Copyright Act (DMCA) takedown notice for a 3D printed object was sent. This article describes how 3D printing works in relation to copyright law, first by discussing this DMCA takedown request, and then discussing the validity of the copyright complaint. This article then discusses future copyright concerns for the open source 3D printing community in light of how the 3D printing community handled its first copyright complaint.

I. INTRODUCTION

Copyright law has consistently struggled with advancements in new technologies. Three-dimensional (“3D”) printing, which allows users to digitize and replicate objects, is emerging as the next potentially disruptive technology that will challenge existing intellectual property conceptions. The spread of the

personal computer and development of the Internet have made the copying of books, music, and movies inexpensive and easy, and the enforcement of copyright more difficult. Some believe a new industrial revolution may be on the way where consumers can download products, as they do with books, movies, and music, and print them out at home.¹

With 3D printing, the possibility of one day making anything, anytime, out of almost any material, is becoming increasingly more feasible. It is now possible to “print” intricate objects from furniture,² to food,³ to human organs.⁴ 3D printing tools are rapidly becoming cheaper and more accessible, making it possible for average consumers to be able to copy and create new 3D objects at home. The cost of a 3D printer has dropped rapidly in recent years and, as a result, a vibrant community of 3D printing enthusiasts has arisen to create and share designs for 3D objects freely.

So far, 3D printing hobbyists have not been very concerned about copyright laws. However, the potential role of copyright law in 3D printing must be addressed before the technology becomes ubiquitous. Because 3D printing relies on computer-based blueprints in order to create physical objects, digital copyright infringement can now impact the physical world. The first example of this happening occurred on February 17, 2011, when Dr. Ulrich Schwantiz sent the world’s first Digital Millennium Copyright Act (“DMCA”) takedown notice for an object created by a fellow member of the 3D printing community.⁵

Dr. Schwantiz eventually dropped his complaint, but the proliferation of 3D printing may lead to further attempts to use copyright law to prevent the sharing of 3D designs. In addition, artists, designers, and inventors may press to increase their legal protections, which will have a significant impact on these burgeoning 3D printing communities and on the public at large. Part II of this paper describes how 3D printing works. Part III explains the development of 3D printing from a high-end design tool to a hobby currently being explored by open source 3D printing communities. Part IV explains existing copyright law in relation to 3D printed objects, first by discussing Dr. Schwantiz’s DMCA takedown request, and then discussing the validity of the copyright complaint. Finally, Part V discusses future copyright concerns for the open source 3D printing community in light of how the 3D printing community handled its first copyright complaint.

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¹ Peter Hanna, *The Next Napster? Copyright Questions as 3D Printing Comes of Age*, ARSTECHNICA.COM (Apr. 5, 2011), <http://arstechnica.com/tech-policy/news/2011/04/the-next-napster-copyright-questions-as-3d-printing-comes-of-age.ars/>.

² See Bram Geenen, *Gaudi Stool*, FREEDOM OF CREATION, <http://www.freedomofcreation.com/shop/order.php?pid=835> (last visited Sept. 22, 2011).

³ See Daniel L. Cohen et al., *Hydrocolloid Printing: A Novel Platform for Customized Food Production*, *Solid Freeform Fabrication Symposium*, http://creativemachines.cornell.edu/sites/default/files/SFF09_Cohen1_0.pdf (last visited Oct. 28, 2011)(discussing the use of 3D printing with hydrocolloids to mimic existing foods).

⁴ See David Simonds, *Making a Bit of Me*, THE ECONOMIST (Feb. 18, 2010), available at <http://www.economist.com/node/15543683> (discussing the arrival of the first commercial 3D bio-printer for manufacturing human tissue and organs).

⁵ See Bre Pettis, *Copyright Policy*, THINGIVERSE (Feb. 18, 2011), <http://blog.thingiverse.com/2011/02/18/copyright-and-intellectual-property-policy>.

II. HOW 3D PRINTING WORKS

Basically, a 3D printer is a machine that can turn a computer model into a physical object. 3D printing relies on computer-aided design (“CAD”) files either created from scratch or drawn from a 3D scan of an object that are later used to create 3D objects anywhere at anytime by using a 3D printer.⁶ A 3D printer uses CAD solid-modeling software to take a virtual 3D model of an object and breaks it into a series of two dimension cross-sectional slices.⁷ 3D printers use a method similar to a typical ink-jet printer to create an object by stacking one layer of material—typically plastic or metal—on top of another, in successive, ultra-thin layers.⁸ With each pass of the printing heads, the base on which the object is being made moves down one layer.⁹ In this way, little by little, the object takes shape. Printing a “scaffold” of soluble material that can be melted away once the object is complete allows the creation of complex shapes.¹⁰ Because 3D printers create objects by building them up layer-by-layer, they can even create objects with internal movable parts.¹¹

III. THE OPEN SOURCE 3D PRINTING COMMUNITY

Traditionally, companies utilized 3D printers to produce 3D “form-and-fit” concept models, which could be used for visualizing early product design.¹² Now, cheaper machinery, simpler CAD software, and a growing number of online electronic design blueprints are bringing 3D printing to a tipping point where it is becoming easy and versatile enough for widespread personal use.¹³ Personalized 3D printing is currently in the development stage, with universities and online user communities driving much of the innovation in home printing capability.

The 3D printing community emphasizes an “open source” system whereby ownership and control over designs is spread over all individuals who contribute to the development and implementation of the designs. With an open source model, as with copyright, ownership of the design vests in the individual who first authors it; that is, the individual who fixes the design in a tangible medium of expression.¹⁴ The owner of open source designs grants to the world a General Public License (“GPL”) whereby anyone is free to tinker with the designs, modify them for his or

⁶ See Emanuel Sachs et al., *Three-Dimensional Printing: Rapid Tooling and Prototypes Directly from a CAD Model*, 39 CIRP Annals—Manufacturing Technology 1, at 201–04 (1990).

⁷ See *id.*

⁸ See *id.*

⁹ See *id.*

¹⁰ See *id.*

¹¹ Michael Weinberg, *It Will Be Awesome if They Don't Screw it Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology*, PUBLIC KNOWLEDGE (Nov. 10, 2010), <http://www.publicknowledge.org/it-will-be-awesome-if-they-dont-screw-it-up>.

¹² See Sachs, *supra* note 6, at 201–04.

¹³ See HOD LIPSON & MELBA KURMAN, *FACTORY AT HOME: THE EMERGING ECONOMY OF PERSONAL FABRICATION* 35, (2010), available at <http://web.mae.cornell.edu/lipson/FactoryAtHome.pdf>.

¹⁴ See 17 U.S.C. §102(a) (2000) (open source software will generally meet the requirements of being an “[o]riginal work[] of authorship fixed in any tangible medium of expression . . .”).

her own convenience, and use the designs and its modifications under the requirements that all improvements be similarly dedicated to the public and that no commercial use is made of the code or the improvements.¹⁵ This flexibility supports innovation and development as designs can be modified and developed to suit the evolving needs of 3D hobbyists.

For example, the development of open source 3D printers has greatly reduced the cost of a 3D printer.¹⁶ In 2004, Adrian Bowyer realized that it could be possible to design a 3D printer that could manufacture a significant fraction of its own parts, creating what would essentially be a self-replicating machine.¹⁷ Bowyer named the project RepRap, short for Replicating Rapid Prototyper, so named because, not counting nuts and bolts, it can print 50% of its parts, with the remaining parts being cheap and available.¹⁸ The primary goal of the RepRap project is to create and to give away a machine that allows its owner to create objects as well as cheaply and easily make another such machine for someone else.¹⁹ For these reasons it was decided to give the machine designs away for free under the GNU General Public License (“GNU GPL”) on the web.²⁰

Also, websites have emerged to host and distribute 3D designs. Some websites, such as Shapeways, have commercialized aspects of the 3D printing process by allowing individuals to order custom designs, which Shapeways will fabricate and ship to them.²¹ As a result, individuals do not even need to own a 3D printer in order to design and print a 3D object. Other websites, such as Thingiverse, utilize an open source model where users share designs under Creative Commons licenses and the emphasis is on community collaboration.²²

Thingiverse describes itself as “a place to share digital designs that can be made into real, physical objects.”²³ Websites like Thingiverse serve as a place for online communities of users to freely upload, improve upon, and virtually distribute objects anyone can make if they have access to a 3D printer. Each design on Thingiverse is featured on a web page bearing a description, images of the finished object, information about the designer, license information, and

¹⁵ See *About the Licenses*, CREATIVE COMMONS, <http://creativecommons.org/licenses/> (last visited Sept. 22, 2011).

¹⁶ E. Sells et al., *RepRap: The Replicating Rapid Prototyper - Maximizing Customizability by Breeding the Means of Production*, in 1 HANDBOOK OF RESEARCH IN MASS CUSTOMIZATION AND PERSONALIZATION 568–80 (Frank T. Piller & Mitchell M. Tseng eds., 2009).

¹⁷ *Id.*

¹⁸ See *About*, REPRAP.ORG, <http://www.reprap.org/wiki/RepRapWiki:About> (last viewed Sept. 22, 2011); see also Adrian Bowyer, Ctr. for Biomimetic and Natural Tech., Dep’t of Mech. Eng’g, Univ. of Bath, Keynote Address at the Eighth National Conference on Rapid Design, Prototyping and Manufacture: The Self-replicating 3D Printer — Manufacturing for the Masses (June 2007).

¹⁹ See *About*, REPRAP.ORG, <http://www.reprap.org/wiki/RepRapWiki:About> (last visited Sept. 22, 2011).

²⁰ See *id.*; see also *GNU General Public License v3.0*, GNU OPERATING SYSTEM (June 29, 2007), <http://www.gnu.org/licenses/gpl-3.0.html> (allowing the licensee to copy, modify, and distribute works licensed under GPL 3.0).

²¹ See *About Us*, SHAPEWAYS.COM, <http://www.shapeways.com/about/> (last visited Sept. 22, 2011).

²² See *Welcome to the Thingiverse*, THINGIVERSE, <http://www.thingiverse.com/> (last visited Sept. 22, 2011).

²³ See *id.*

comments from community members.²⁴ If a community member wants to use a design, they can download the CAD file, and further customize it or print out a copy of the original.²⁵ Members can also share helpful information on how the product works once manufactured.²⁶

When content is uploaded to Thingiverse a user is asked to select a secondary copyright license, which is in addition to the license the user grants to Thingiverse and its affiliated companies and partners.²⁷ This license governs how third parties, including other users, may use uploaded content.²⁸ Attribution and design sharing are written into the code and default settings of Thingiverse, which encourages users to share content while making sure the original author of works gets credit.²⁹

While a Thingiverse user can designate their copyright license to be an “All Rights Reserved” license, the site also allows users to license works under the Creative Commons, GNU GPL, LGPL, and BSD licenses, as well as allowing them to release works into the public domain.³⁰ Thingiverse also fully implements Creative Commons RDFa specification for expressing licensing and authorship information on the semantic web, which means that aside from telling computers that a work is licensed under Creative Commons, Thingiverse also tells computers the title of a work, its author, and other interesting semantic information.³¹

IV. THE WORLD’S FIRST 3D PRINTED DESIGN DMCA TAKEDOWN NOTICE

On January 27, 2010, Dr. Ulrich Schwanitz, known as user “trompevenlo” on 3D modeling forum Shapeways, figured out how to make a 3D version of the Penrose triangle.³² The Penrose triangle is an “impossible figure” that was published by Penrose and Penrose in a 1958 article in the British Journal of Psychology.³³ An impossible figure is a type of optical illusion consisting of a two-dimensional figure that is instantly and subconsciously interpreted by the visual system as representing a projection of a 3D object, although it is not actually possible for such an object to exist.³⁴ At first glance, the Penrose triangle appears

²⁴ See *id.*

²⁵ See *id.*

²⁶ See *id.*

²⁷ See *Terms of Services*, THINGIVERSE, <http://www.thingiverse.com/legal> (last visited Sept. 22, 2011).

²⁸ See *id.*

²⁹ See *Upload*, THINGIVERSE, <http://www.thingiverse.com/upload> (last visited Sept. 22, 2011).

³⁰ See *Terms*, *supra* note 27; see also *Various Licenses and Comments About Them*, GNU OPERATING SYSTEM, <http://www.gnu.org/licenses/license-list.html> (last visited Sept. 22, 2011) (further defining Lesser General Public Licenses and Berkeley Software Distribution licenses).

³¹ See Ben Adida & Mark Birbeck, *RDFa Primer: Bridging the Human and Data Webs*, W3C (Oct. 13, 2008), <http://www.w3.org/2006/07/SWD/RDFa/primer/>.

³² *Impossible Triangle*, SHAPEWAYS (Jan. 27, 2011), http://www.shapeways.com/model/206411/impossible_triangle_5_12_cm.html.

³³ Lionel S. Penrose & Robert Penrose, *Impossible Objects: A Special Type of Illusion*, 49 BRIT. J. PSYCHOL. 31 (1958).

³⁴ *Id.* at 31.

to be a two-dimensional depiction of a 3D triangle built from square beams.³⁵ The properties of this two-dimensional drawing cannot be realized by any 3D object, hence, the Penrose triangle is an “impossible object.”³⁶

However, it is possible to create a 3D object that resembles a two-dimensional representation of a Penrose triangle when viewed from the right angle. This is exactly what Dr. Schwanitz figured out how to do. On February 16, 2010, Dr. Schwanitz received the printed model of his triangle and posted a video proving that the optical illusion worked.³⁷ After a video of the shape was released, another 3D printing enthusiast named Artur Tchoukanov worked out how to create the shape, and uploaded instructions for his own version of the impossible triangle to Thingiverse.³⁸

A landmark in personal 3D printing occurred when Dr. Schwanitz sent the world’s first DMCA takedown notice for a copyrighted object in the 3D printing community.³⁹ The takedown notice suggests Schwanitz was concerned about the electronic file that allows individuals to print their own objects, but his language is unclear.⁴⁰ Dr. Schwanitz alleged, “[t]he electronic models ‘Penrose Triangle by artur83’, located on your site at <http://www.thingiverse.com/thing:6456> and ‘Penrose Triangle Illusion by chylld’, located on your site at <http://www.thingiverse.com/thing:6474>” infringed on his copyright.⁴¹ However, the takedown notice did not specify whether Schwanitz was asserting copyright in the structure itself, the 3D design file, or just the image of the Penrose triangle.

3D printing complicates the inquiry into what should be considered copyrightable intellectual property: the electronic blueprints and/or the resulting physical object. Thingiverse users Artur83 and Chylld might have violated copyright in two ways: the 3D CAD files could be protected works, and the actual Penrose triangle produced by a 3D printer could be a protected work.

A. Copyright in CAD Files Used to Create 3D Printed Objects

It is possible that the CAD files used by Artur83 and Chylld, to generate the 3D Penrose triangles, were infringing. Dr. Schwanitz’s CAD files are protectable to the extent that they are “original works of authorship fixed in a tangible medium of expression.”⁴² However, the first major problem with Dr. Schwanitz’s copyright complaint is that Artur83 independently created his Penrose triangle after being inspired by Schwanitz,⁴³ and Chylld then made a derivative of

³⁵ *Id.*

³⁶ *Id.*

³⁷ Trompeveno, *A Real Model of the Impossible Triangle*, YOUTUBE (Feb. 16, 2011), <http://www.youtube.com/watch?v=EMhNapObKQk>.

³⁸ *See Penrose Triangle Illusion by artur83*, THINGIVERSE (Feb. 21, 2011), <http://www.thingiverse.com/thing:6456>.

³⁹ *See Pettis, supra* note 5.

⁴⁰ *See id.*

⁴¹ *See id.*

⁴² 17 U.S.C. § 102(a) (1994).

⁴³ *See Penrose, supra* note 38 (“Inspired by Ulrich Schwanitz’s ‘challenge’ about the ‘Impossible Penrose Triangle’ I thought I’d give it a try.”).

Artur83's public domain licensed work.⁴⁴ Artur83 had to independently make a Penrose triangle because Schwanitz refused to share a 3D model of his triangle online.⁴⁵ Schwanitz gave the media just two images of the object, both from the same perspective, and declined to divulge how he was able to successfully create the illusion.⁴⁶

Using a different file to create the same object would probably not be a violation of the copyright of the original file as some sort of derivative work.⁴⁷ As a result, the copyright on the file itself would be of limited value. Moreover, the degree of copyright protection of Schwanitz's 3D printing CAD file could be further limited, depending on whether a court treated it more like a computer program or a blueprint.

Copyright in computer programs comes up frequently where programmers assert their computer source code was a copyrighted creative work.⁴⁸ Software generally is classified as either an operating system or an applications program. CAD files would not be considered operating systems, which perform internal computer operations, because they are designed to accomplish a specific task for the user.⁴⁹ Applications programs, on the other hand, perform specific tasks for, and provide output to, the user.⁵⁰

At first glance, this may seem like what a 3D CAD file does. Users take a 3D CAD file, which describes the surface geometry of a 3D object, and uses Stereolithography ("StL") software to run the file and output a desired 3D object.⁵¹ In each CAD file, the surface of an object is tessellated, or broken down logically, into a series of small triangles called facets.⁵² Each facet is described by a perpendicular direction and three points representing the vertices (corners) of the

⁴⁴ See *Penrose Triangle Illusion by chylld*, <http://www.thingiverse.com/thing:6474> (last visited Sept. 22, 2011).

⁴⁵ See *Impossible Triangle- dice 7.5"- 19cm*, http://www.shapeways.com/model/206411/impossible_triangle_5_12_cm.html (last visited Oct. 28, 2011) ("To not spoil the visual experience, the ability to view the 3D model has been deliberately removed from this page.")

⁴⁶ Suzanne Labarre, *Impossible Penrose Triangle: Now Possible With 3-D Printing?*, FAST COMPANY'S CO. DESIGN. (Feb. 14, 2011), <http://www.fastcodesign.com/1663226/impossible-triangle-now-possible-with-3-d-printing>.

⁴⁷ *Demetriades v. Kaufman*, 680 F. Supp. 658, 662 (S.D.N.Y. 1988) (quoting *Eden Toys, Inc. v. Marshall Field & Co.*, 675 F.2d 498, 500 (2d Cir. 1982) ("It is a fundamental maxim of copyright law, [therefore], that a copyright protects 'only the work's particular expression of an idea, not the idea itself.'").

⁴⁸ See U.S. Copyright Office, *Circular 61: Copyright Registration for Computer Programs* (June 1999), available at <http://www.copyright.gov/circs/circ61.html>; see also Raymond T. Nimmer, *The Law of Computer Technology* § 1:16 (2009) (describing the exclusive rights granted under copyright law for software).

⁴⁹ See, e.g., *Apple Computer, Inc. v. Franklin Computer Corp.*, 714 F.2d 1240 (3d Cir. Pa. 1983), cert. dismissed, 464 U.S. 1033 (1984).

⁵⁰ See, e.g., *Whelan Assocs., Inc. v. Jaslow Dental Lab. Inc.*, 609 F. Supp. 1325 (E.D. Pa. 1985) (program that processed orders, controlled inventory, and performed invoicing for dental laboratories); *Synercom Tech., Inc. v. U. Computing Co.*, 462 F. Supp. 1003 (N.D. Tex. 1978) (program that performed structural analyses of buildings for construction engineers).

⁵¹ *The StL Format: Standard Data Format for Fabbers*, FABBERS.COM, <http://www.ennex.com/~fabbers/StL.asp> (last visited Sept. 22, 2011).

⁵² *Id.*

triangle.⁵³ These data points are used by a slicing algorithm to determine the cross sections of the 3D shape to be built by the 3D printer.⁵⁴

What differentiates 3D CAD files from other computer programs is that the 3D CAD files are basically just a triangular representation of a 3D object. The CAD files themselves do not control how 3D printers operate, they merely serve as more of a blueprint for software to utilize. As a result, courts would likely not find CAD files to be considered copyrightable software.

What is more likely is that 3D printing CAD files fall under the enumerated category of “pictorial, graphic, and sculptural works” protected by Copyright,⁵⁵ which is defined as including “technical drawings, diagrams, and models.”⁵⁶ CAD files are similar to architectural plans, which “are subject to certain qualifications peculiar to this form of work.”⁵⁷ The copyright statute states:

[It] does not afford, to the owner of a copyright in a work that portrays a useful article as such, any greater or lesser rights with respect to the making, distribution, or display of the useful article so portrayed than those afforded to such works under the law . . . in effect on December 31, 1977.⁵⁸

Because any building or house undoubtedly falls within this definition, architectural plans necessarily depict a useful article and are subject to this restriction. CAD files, on the other hand, do not necessarily portray “useful articles” for the purposes of copyright law.⁵⁹ Therefore, to assess the copyrightability of the CAD file, the copyrightability of the underlying object depicted must be examined.

B. Copyright in 3D Printed Objects

While some physical objects are protected by copyright, patent, or trademark, they are the exception to the rule.⁶⁰ The sculpture clause of the Copyright Act establishes the broad category of “pictorial, graphic, or sculptural works” eligible for copyright protection, provided that such works satisfy the Act’s other requirements.⁶¹ The Act, however, excludes any “useful article”—defined as

⁵³ *Id.*

⁵⁴ *Id.*

⁵⁵ 17 U.S.C.A. § 102(a)(5) (West 2001); *Multimatic, Inc. v. Faurecia Interior Systems USA, Inc.*, 358 F. App’x 643, 649 (6th Cir. 2009); *Robert R. Jones Assocs., Inc. v. Nino Homes*, 858 F.2d 274, 278 (6th Cir. 1988).

⁵⁶ 17 U.S.C.A. § 101 (West 2010); *see also Demetriades v. Kaufman*, 680 F. Supp. 658, 663 n.6 (S.D.N.Y. 1988) (“Consistent with explicit congressional intent, these sections have been interpreted to include architectural drawings.”).

⁵⁷ RAYMOND T. NIMMER, *THE LAW OF COMPUTER TECHNOLOGY* 2–105 (1985).

⁵⁸ 17 U.S.C. § 113(b) (2006).

⁵⁹ *Id.* at § 1.01 (explaining that a “useful article” is one which has “an intrinsic utilitarian function”).

⁶⁰ *See, e.g.*, 17 U.S.C. § 102 (2006) (granting copyright to certain “pictorial, graphic, or sculptural works”); 35 U.S.C. § 171 (2006) (granting patent protection to “[w]hoever invents any new, original and ornamental design for an article of manufacture . . . subject to the conditions and requirements of this title.”); *Lanham Act*, 15 U.S.C. § 1125(a) (2006) (granting trade dress protection to goods).

⁶¹ 17 U.S.C. § 102 (2006).

“an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information”—from copyright eligibility.⁶² This limitation is in keeping with the notion that functional items are not eligible for the relatively long-term protections of copyright, as opposed to the more temporary rights provided by the Patent Act.⁶³

Congress attempted to draw a clear line between copyrightable works of applied art and uncopyrightable works of industrial design by restricting the definition of sculptural works eligible for copyright protection as follows:

Such works shall include works of artistic craftsmanship insofar as their form but not their mechanical or utilitarian aspects are concerned; the design of a useful article, as a pictorial, graphic or sculptural work only if, and only to the extent that, such design incorporates pictorial, graphic, or sculptural features that can be identified separately from and are capable of existing independently of, the utilitarian aspects of the article.⁶⁴

So while “useful articles,” taken as a whole, are not eligible for copyright protection, individual design elements comprising these items may, viewed separately, meet the Copyright Act’s requirements. Specifically, if a useful article incorporates a design element that is physically or conceptually separable from the underlying product, the element is eligible for copyright protection.⁶⁵ For this reason, one may not copyright the general shape of a lamp because its overall shape contributes to its ability to illuminate a room.⁶⁶ However, one can copyright the fanciful designs on the lamp’s base as long as the designs are unrelated to the lamp’s utilitarian function as a device used to light up a room.⁶⁷ The 3D Penrose triangle, while an appealing illusion to look at, would likely not be found to be a useful article, and therefore would be eligible for copyright protection.⁶⁸

⁶² 17 U.S.C. § 101–02 (2006); *see also* H.R. REP NO. 94-1476, at 5668 (1976) (stating that works of “artistic craftsmanship” are not protected by the Act, “insofar as their . . . utilitarian aspects are concerned.”).

⁶³ *See Chosun, Int’l, Inc. v. Chrisha Creations, Ltd.*, 413 F.3d 324, 328 (9th Cir. 2005) (stating the general principle that intellectual property owners should not be permitted to re-categorize one form of intellectual property as another, thereby extending the duration of protection beyond that which Congress deemed appropriate for their actual creative efforts). *See, e.g.*, *Dastar Corp. v. Twentieth Century Fox Film Corp.*, 539 U.S. 23, 36–38 (2003) (interpreting the Lanham Act so as to avoid perpetual unfair competition protection when copyright protection of a more limited duration was available, as the Court believed that a contrary interpretation “would be akin to finding that [the Lanham Act] created a species of perpetual patent and copyright”); *TraFFix Devices, Inc. v. Mktg. Displays, Inc.*, 532 U.S. 23, 29–30 (2001) (holding that where trade dress was previously protected under the Patent Act by an expired utility patent, the dress is presumed to stand outside the Lanham Act’s scope).

⁶⁴ 17 U.S.C. § 101 (2006).

⁶⁵ *See id.*; *see also Mazer v. Stein*, 347 U.S. 201 (1954).

⁶⁶ *See Mazer*, 347 U.S. at 201.

⁶⁷ *See Chosun*, 413 F.3d at 324, 328 (citing *Mazer*, 347 U.S. at 201); *see also* Copyright Office, COMPENDIUM II OF COPYRIGHT OFFICE PRACTICES § 505.03 (1984) (recognizing that a “carving on the back of a chair, or pictorial matter engraved on a glass vase, could be considered for [copyright] registration” on the basis of separability).

⁶⁸ *See Gay Toys, Inc. v. Buddy L Corp.*, 703 F.2d 970 (6th Cir. 1983) (the fact that the toy airplane is to be played with and enjoyed and in that sense possesses useful characteristics that permit a child to dream and let his or her imagination soar does not turn the toy into an article with an intrinsic utilitarian function); *see also Masquerade Novelty, Inc. v. Unique Indus., Inc.*, 912 F.2d 663 (3d Cir. 1990)

Even if the 3D Penrose triangle was sufficiently creative to obtain copyright protection, it is unlikely that Artur83 and Chylld violated Schwanitz's copyright. First of all, Schwanitz's design was based on the preexisting 2D Penrose triangle that was in the public domain.⁶⁹ Schwanitz's rendering the 2D image in 3D form may introduce enough creativity into the model for him to claim it is separately copyrightable, but the copyright would only apply to the original aspects of his work. Furthermore, the supposedly infringing works are not a "copy" of the Schwanitz design, but rather, are interpretations of the underlying public domain work inspired by Schwanitz's design.⁷⁰

Given that Dr. Schwanitz's copyright was relatively weak to begin with, and Chylld and Artur83 did not directly copy either Schwanitz's 3D CAD file or his printed Penrose triangle, it is very likely that a claim of copyright infringement by Schwanitz would have failed. Nevertheless, Thingiverse felt compelled to comply with the DMCA takedown request sent by Schwanitz, not wanting to be exposed to possible secondary liability.⁷¹

C. Analyzing Thingiverse's Secondary Liability

As noted above, Dr. Schwanitz's copyright infringement claim was tenuous at best, but it still provides an opportunity to examine the potential liability of Thingiverse and similar websites that host and distribute 3D design files. Downloading or sharing copyrighted 3D CAD files can constitute copyright infringement, which would implicate the DMCA. As a service provider, Thingiverse sought to take advantage of § 512(c), which is a safe harbor provision for service providers designed to shelter service providers from the infringing activities of their customers.⁷² Thingiverse initially removed the allegedly infringing files, a requirement to take advantage of the safe harbor provisions.⁷³ Because this was the first DMCA complaint involving the 3D printing community, it is understandable that there were problems with both Dr. Schwanitz's DMCA complaint and Thingiverse's response to that complaint.

Section 512(c) "limits the liability of qualifying service providers for claims of direct, vicarious, and contributory infringement for storage at the direction of a user of material that resides on a system or network controlled or operated by or for the service provider."⁷⁴

(animal nose masks were not "useful articles" and were thus entitled to copyright protection, as the nose masks had no utility that did not derive from their appearance).

⁶⁹ See Jonathan Wong, *Penrose Triangle Illusion*, THINGIVERSE (Feb. 19, 2011), <http://www.thingiverse.com/thing:6513> ("[A] 3D-printable version of the Penrose Triangle illusion, based solely on the 1934 design painted by Swedish artist Oscar Reutersvärd. The design also appeared on Swedish postage stamps in the early 1980s.").

⁷⁰ See *id.*

⁷¹ Pettis, *supra* note 5 ("Since we'd like to continue to be a place where people can openly share their designs with the world, we have complied.").

⁷² 17 U.S.C. § 512(c) (2006); see 17 U.S.C. § 512(k)(1)(B) (2006) ("[T]he term 'service provider' means a provider of online services or network access, or the operator of facilities therefore . . .").

⁷³ 17 U.S.C. § 512 (2006).

⁷⁴ 17 U.S.C. § 512(c) (2006); see H.R. REP. NO. 105-551, pt. 2, at 53 (1998).

To be eligible for the safe harbor at [§512(c)], a service provider must first meet the threshold conditions set out in §512(i), including the requirement that the service provider: “[H]as adopted and reasonably implemented, and informs subscribers and account holders of the service provider’s system or network of, a policy that provides for the termination in appropriate circumstances of subscribers and account holders of the service provider’s system or network who are repeat infringers[.]”⁷⁵

The statute does not define “reasonably implemented.” In *Perfect 10, Inc. v. CCBill LLC*, the court held that a “service provider ‘implements’ a policy if it has a working notification system, a procedure for dealing with DMCA-compliant notifications, and if it does not actively prevent copyright owners from collecting information needed to issue such notifications.”⁷⁶ Because Thingiverse was able to receive notice from Dr. Schwanitz, dealt with the complaint notification, and did not actively prevent copyright owners from collecting information needed to issue such notifications, it seems that Thingiverse satisfied this requirement.

In addition, the safe harbor under § 512(c) requires:

- The provider must not have the requisite level of knowledge of the infringing activity;
- If the provider has the right and ability to control the infringing activity, it must not receive a financial benefit directly attributable to the infringing activity; and
- Upon receiving proper notification of claimed infringement, the provider must expeditiously take down or block access to the material.⁷⁷

Thingiverse appears to have met these criteria by taking down the requested files once notified.

Finally, the service provider must have filed with the Copyright Office a designation of an agent to receive notifications of claimed infringement and make that information publicly available on its website.⁷⁸ Thingiverse had previously not considered its obligation to respond to takedown notices in a timely manner or risk losing protection under the “Safe Harbor” provision. As of March 21, 2011, neither Thingiverse nor its parent company, MakerBot Industries, had designated an agent to receive notifications of claimed infringement by providing contact information to the Copyright Office.⁷⁹ Also, Thingiverse had not posted the contact information of its designated agent to receive notification of claimed infringement.⁸⁰ When Dr. Schwanitz sent his DMCA takedown request, he emailed “info@thingiverse.com” and “support@thingiverse.com”, because

⁷⁵ *Perfect 10, Inc. v. CCBill L.L.C.*, 488 F. 3d 1102, 1109 (9th Cir. 2007) (quoting 17 U.S.C. § 512(i)(1)(A) (2006)).

⁷⁶ *Perfect 10*, 488 F. 3d at 1109.

⁷⁷ 17 U.S.C. § 512(c) (2006).

⁷⁸ *Id.*

⁷⁹ See *Directory of Service Provider Agents for Notification of Claims of Infringement*, <http://www.copyright.gov/onlinesp/list> (last visited Sept. 13, 2011).

⁸⁰ INTERNET ARCHIVE WAYBACK MACHINE, http://web.archive.org/web/*/http://www.thingiverse.com/legal (accessed by searching for thingiverse.com in the Internet Archive index) (last visited Sept. 13, 2011)(an archived copy of the site from June 2009 makes no mention of the DMCA or a designated agent).

Thingiverse had yet to update its copyright policy.⁸¹

As a result of receiving its first DMCA takedown notice for the Penrose triangle, Thingiverse had to learn more about the DMCA and updated its legal page with a new DMCA specific policy.⁸² The Thingiverse legal page has been updated with the contact information of its designated agent to receive notification of claimed infringement, as well as a procedure for reporting copyright or intellectual property infringements.⁸³ While Thingiverse would now qualify under the safe harbor provisions, without this language Thingiverse could have been exposed to liability.

However, Dr. Schwanitz's takedown notice also did not comply with the requirements of the DMCA, as it lacked an "under penalty of perjury" statement.⁸⁴ The DMCA safe harbor provision requires a complainant to declare, under penalty of perjury, that he is authorized to represent the copyright holder, and that he has a good-faith belief that the use is infringing; thus, a notification must do more than identify infringing files.⁸⁵ The penalty of perjury is meant to deter the sending of false or misleading notices.⁸⁶

"This requirement is not superfluous. Accusations of alleged infringement have drastic consequences: A user could have content removed, or may have his access to a service terminated entirely."⁸⁷ Also, if the content is non-infringing, speech protected under the First Amendment could be removed.⁸⁸ Therefore, courts do not require a service provider to respond to DMCA complaints "if the complainant is unwilling to state under penalty of perjury that he is an authorized representative of the copyright owner, and that he has a good-faith belief that the material is unlicensed."⁸⁹

Thingiverse should not have taken down the allegedly infringing material until Dr. Schwanitz effectively complied with the requirements of the DMCA. Thingiverse still would have needed to respond to the inadequate notice and explain the requirements for substantial compliance.⁹⁰ By making Dr. Schwanitz comply with the penalty of perjury requirement of the DMCA, his takedown request could have been delayed, and he would have been required to fully consider the merits of his actions. Thankfully, after sending the DMCA takedown, Schwanitz decided to withdraw the complaint and release his design into the public

⁸¹ See Pettis, *supra* note 5.

⁸² See *id.*

⁸³ See *Copyright and Intellectual Property Policy*, THINGIVERSE, <http://www.thingiverse.com/legal> (last visited Oct. 28, 2011).

⁸⁴ *Perfect 10, Inc. v. CCBill L.L.C.*, 488 F. 3d 1102, 1112 (9th Cir. 2007) ("Compliance is not 'substantial' if the notice provided complies with only some of the requirements of § 512(c)(3)(A).").

⁸⁵ 17 U.S.C. § 512(c)(3) (2006).

⁸⁶ See *Perfect 10*, 488 F.3d at 1112 ("Compliance is not 'substantial' if the notice provided complies with only some of the requirements of § 512(c)(3)(A).").

⁸⁷ *Id.*

⁸⁸ *Id.*

⁸⁹ *Id.*

⁹⁰ *Perfect 10*, 488 F.3d at 1112 ("[S]ervice provider will not be deemed to have notice of infringement . . . so long as the service provider responds to the inadequate notice and explains the requirements for substantial compliance.").

domain after it was established that similar or near-identical creations could be made based on the original Penrose triangle illusion, without infringing his copyright.⁹¹

V. THE FUTURE ROLE OF COPYRIGHT IN THE 3D PRINTING COMMUNITY

Dr. Schwanitz may have sent the world's first DMCA notice to a 3D printing website, but it will likely not be the last. The complicated nature of copyright in 3D printed designs should be a major concern for the open source 3D printing community in light of how the 3D printing community handled its first copyright complaint. There are two possibilities for how copyright law will impact 3D printing in the future. On the one hand, it is possible 3D printing could be subjected to expanded copyright laws. On the other hand, 3D printing could rely on better community self-policing and attempt to forgo the traditional copyright regime altogether.

A. *Expanded Copyright Laws to Control 3D Printing*

Because 3D printers can theoretically create 3D objects anywhere at anytime, concerned intellectual property owners (artists, designers, inventors, etc.) may seek to increase their legal protections from what they would likely perceive as a threat to their intellectual property. Multiple forms of intellectual property protection are potentially available to 3D printed designs. However, it is likely some observers believe that this "ragged quilt of protection" does not adequately protect designers.⁹² Intellectual property owners could increase their legal protections by trying to control either the 3D CAD files or by expanding intellectual property protection for 3D objects.

1. *Expanded Protection of 3D CAD Files*

If intellectual property owners wanted to stop the spread of CAD files, they would need to either go after individual users or lobby for expanded protection for 3D CAD files. One option would be to eliminate the §512 exception as applied to websites that host 3D CAD files. If §512 did not apply to service providers, intellectual property owners could essentially make sites like Thingiverse liable for postings by users. This could greatly hinder the growth of hosting websites.

Also, similar to how Dr. Schwanitz went after Thingiverse instead of the users that uploaded allegedly infringing objects, patent holders could seek to expand the doctrine of contributory infringement to sue 3D printing file-sharing sites. The doctrine of contributory patent infringement, which is codified in 35 U.S.C. § 271(c), imposes liability on a company that knowingly sells either a

⁹¹ See *Penrose Triangle Illusion by Chyllid*, THINGIVERSE (Feb. 19, 2011), <http://www.thingiverse.com/thing:6513> ("This is a 3D-printable version of the Penrose Triangle illusion, based solely on the 1934 design painted by Swedish artist Oscar Reutersvärd. The design also appeared on Swedish postage stamps in the early 1980s.")

⁹² Gerard Magliocca, *Ornamental Design and Incremental Innovation*, 86 MARQ. L. REV. 845, 850 (2003).

special-purpose component of a patented device or a special-purpose device used to practice a patented method, provided the component or device is not “a staple article or commodity of commerce suitable for substantial noninfringing use.”⁹³

It could be possible to expand liability to cover websites that host infringing CAD files. In *Metro-Goldwyn-Mayer Studios Inc. v. Grokster*, the Supreme Court recognized a fundamental purpose of contributory infringement liability: because “it may be impossible to enforce rights in the protected work effectively against all direct infringers, the only practical alternative [is] to go against the distributor of the copying device for secondary liability.”⁹⁴ Because a 3D printer can copy any 3D object, patent holders may argue that the copying device could be the CAD files themselves. If this happens, hosting websites will want to press for a similar safe harbor to §512 to avoid liability.

Another way to control the spread of 3D CAD files would be to expressly forbid the very act of making 3D models from scans of real world objects for commercial purposes. Generally, proving copyright infringement requires the copyright owner to show copying of the protected elements of the work. A CAD file contains a digital representation of a real object, but is not a copy of that work. Writing for *Ars Technica*, Peter Hanna suggests creating a 3D design file from a scan of a physical object could be considered unlawful “format shifting.”⁹⁵ Hanna suggests making this kind of “physical-to-digital” format shifting illegal in order to protect designers.⁹⁶ This suggestion seems inapposite to copyright law as it could deprive the public of the ability to make use of a tool capable of non-infringing uses.⁹⁷

2. Expanded Copyright Laws to Control 3D Objects

Intellectual property owners could also attempt to expand their intellectual property protection by getting *sui generis* copyright-like protection for their utilitarian objects. While the Penrose triangle was not a utilitarian object, many things that can already be created by 3D printers certainly would be considered utilitarian and thus not protectable by copyrights.⁹⁸ The most likely way to achieve this type of protection is to eliminate or restrict the application of the copyright separability test.⁹⁹ Instead of separating design elements from functional

⁹³ 35 U.S.C. § 271(c) (2006).

⁹⁴ *Ricoh Co. v. Quanta Computer Inc.*, 550 F.3d 1325, 1338, (Fed. Cir. 2008) (citing *Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd.*, 545 U.S. 913, 929–30 (2005)).

⁹⁵ Hanna, *supra* note 1.

⁹⁶ *Id.*

⁹⁷ *Sony Corp. of Am. v. Universal City Studios, Inc.*, 464 U.S. 417, 444 (1984) (“Whatever the future percentage of legal versus illegal home-use recording might be, *an injunction which seeks to deprive the public of the very tool or article of commerce capable of some non-infringing use would be an extremely harsh remedy, as well as one unprecedented in copyright law.*”)(emphasis added)(quoting *Universal City Studios, Inc. v. Sony Corp. of Am.*, 480 F. Supp. 429, 468 (C.D. Cal. 1979)).

⁹⁸ See, e.g., Ben Jackson, *Flushable Toilet*, THINGIVERSE (Mar. 20,2011), <http://www.thingiverse.com/thing:7158>; Dave Matsumoto, *Replacement Backpack Zipper Tab*, THINGIVERSE (Mar. 14,2011), <http://www.thingiverse.com/thing:7038>; *Rollerblade/Shopping Carry Handle*, (Mar. 17,2011), <http://www.thingiverse.com/thing:7084>.

⁹⁹ See *supra* Part V.b.

elements, intellectual property owners could work to expand copyright protection to all functional items that contain design elements, similar to the way boat hull designs have been protected.¹⁰⁰

The Vessel Hull Design Protection Act (“VHDPA”) statutes do not provide copyright protection to vessel hull designs per se, rather the VHDPA is a sui generis form of industrial design protection that protects “both the ornamental appearance and utilitarian function of the vessel hull”¹⁰¹ When someone registers an original vessel hull design under the VHDPA, they obtain simultaneous protection of a combination of aesthetic as well as utilitarian characteristics of an original vessel hull design.

Right now the VHDPA only applies to vessel hulls, but the basic legislative structure exists to simply broaden the law to include protection for all 3D objects.¹⁰² For many years, articles of clothing have been identified as “useful” items and, hence, excluded from copyright eligibility.¹⁰³ However, this has not stopped people from pressing for legislation that would allow clothing to be copyrighted.¹⁰⁴ The same type of legislation could be enacted to include 3D printed designs within the scope of copyright protection.

Although the establishment of sui generis regimes, either controlling CAD files or 3D printed designs, may reduce harmful effects that could possibly result from increased access to 3D printing, experts have also expressed concerns about the expansion of intellectual property rights.¹⁰⁵ Michael Weinberg of Public Knowledge warns that this could create a type of quasi-patent system, without the requirement for novelty or the strictly limited period of protection.¹⁰⁶ The patent system and other traditional intellectual property regimes leave certain subject matter outside the scope of protection on purpose. The Supreme Court explained this rule as resulting from the judgment that “[w]ere it otherwise patents might

¹⁰⁰ Vessel Hull Design Protection Act, 17 U.S.C. §§ 1301–32 (2006) (providing for protection for original designs of vessel hulls).

¹⁰¹ Vessel Hull Design Protection Act: Hearing on H.R. 2696 before the H. Subcomm. on Courts and Intellectual Prop., 105th Cong. (1998) (statement of Prof. William T. Fryer, Professor, University of Baltimore School of Law), available at http://commdocs.house.gov/committees/judiciary/hju57742.000/hju57742_of.htm; Federal Document Clearing House, Testimony of William T. Fryer III, H.R. Judiciary Subcomm. on the Courts and Intellectual Prop., Oct. 23, 1997, 1997 WL 662281 (F.D.C.H.).

¹⁰² See 17 U.S.C. § 1301(b)(2) (2006) (“A ‘useful article’ is a vessel hull, including a plug or mold, which in normal use has an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information.”).

¹⁰³ See, e.g., *Fashion Originators Guild of Am. Inc. v. FTC*, 114 F.2d 80, 84 (2d Cir. 1940)(L. Hand, J.) (holding that “ladies’ dresses” are useful articles not covered by the Copyright Act), *aff’d*, 312 U.S. 457 (1941).

¹⁰⁴ See Design Piracy Prohibition Act, H.R. 5055, 109th Cong. (2006). The proposed legislation would amend chapter 13 of title 17 of the United States Code; see also Protection for Fashion Design, 109th Cong. (July 27, 2006) (statement of the United States Copyright office before the Subcommittee on Courts, the Internet, and Intellectual Property) <http://www.copyright.gov/docs/regstat072706.html>.

¹⁰⁵ Regan E. Keebaugh, Note, *Intellectual Property and the Protection of Industrial Design: Are Sui Generis Protection Measures the Answer to Vocal Opponents and a Reluctant Congress?*, 13 J. INTELL. PROP. L. 255, 258 (2005).

¹⁰⁶ Michael Weinberg, *It Will Be Awesome if They Don’t Screw it Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology*, PUBLIC KNOWLEDGE (Nov. 2010), <http://www.publicknowledge.org/it-will-be-awesome-if-they-dont-screw-it-up>.

stifle, rather than promote, the progress of useful arts.”¹⁰⁷

To the extent that proposed sui generis regimes broaden the scope of intellectual property protection and award new proprietary rights, they may diminish the public domain and hamper both future innovation and competition.¹⁰⁸ Fear of infringement lawsuits would limit the ability of the 3D printing community to fully explore the nascent printing technology. This could also raise prices and limit the products that become available to the public, at least in the short term.¹⁰⁹

B. Community Self-policing

A better alternative to the growing likelihood of litigation over copyright and 3D printing is for the 3D printing community to avoid traditional intellectual property law altogether and continue to emphasize an open source system, whereby ownership and control over designs is spread over all individuals who contribute to the development and implementation of the designs. Creative Commons licenses provide a framework to guide the 3D printing community and make it easier to attribute and give credit to original creators. Unfortunately, not everyone is going to be willing to follow the open source model, and Creative Commons licenses do not cover an instance where a design from outside the 3D printing community is copied without permission and then shared. The 3D printing community needs to decide how to deal with this situation before more DMCA complaints are filed.

Thingiverse had to learn this the hard way, implementing a DMCA policy only after receiving their first takedown notice. Other sites in the 3D printing community should implement similar policies in order to qualify under the safe harbor provisions of §512 and should also develop a system for flagging potentially infringing objects in a way that would not chill speech and hamper collaboration. Additionally, members of the 3D printing community should fight to limit any further expansion of intellectual property rights over 3D printed objects while 3D printing technology is so young.

VI. CONCLUSION

A blog posting on Thingiverse has already stressed the need to resolve future disputes over ownership of 3D printed objects as a community.¹¹⁰ Copyright law could play a central role in determining how 3D printing technology is used in the future. The proliferation of 3D printing may lead to further attempts to use the DMCA to prevent the sharing of 3D designs. In addition, artists, designers, and inventors may press to increase their legal protections, which will have a significant impact on these burgeoning 3D printing communities and on the public at large.

¹⁰⁷ KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 427 (2007).

¹⁰⁸ See Mark D. Janis, *Second Tier Patent Protection*, 40 HARV. INT'L L.J. 151 (1999).

¹⁰⁹ See Peter K. Yu, *The International Enclosure Movement*, 82 IND. L.J. 827 (2007).

¹¹⁰ Duann Scott, *IP, 3D Printing & DMCA*, SHAPEWAYS (Feb. 20, 2011), <http://www.shapeways.com/blog/archives/747-IP,-3D-Printing-DMCA.html>.

It is important that both the 3D printing community and legislators know the potential consequences of too much or too little regulation. In a world with cheap and accessible 3D printing, all goods could be essentially embodiments of intangible designs, and as a result, intellectual property. As the line between a physical object and a digital description of that object continues to blur, the regulation of these goods could be left entirely to intellectual property law, where intellectual property control systems could be used to limit the production of physical objects.

3D printing is a promising technology that has potential to spark a new industrial revolution. It also could lead to at home piracy of 3D objects, severely impacting copyright and patent owners. It is too early to tell which of these futures is more likely; but for now, the 3D printing community should focus on expanding the use of Creative Commons licenses and fighting the expansion of traditional intellectual property norms into 3D printing. This will ensure that the vibrancy and innovation of the nascent 3D printing community is not crippled by legal interference.