

An Automatic Licensing Framework for 3D Printed Content

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Abstract. The 3D printing (3DP) industry has been receiving increased public attention. Many companies are seeking ways to develop new means of creating and disseminating 3DP content, in order to capture new business opportunities. However, to date they have been limited in doing so because of the complex legal licensing environment and a lack of digital licensing standards. This research explores the appropriateness of UK automated licensing regulations in the development of a proposed licensing system in China. By means of empirical interviews with 3DP companies in China, two questions will be identified: (1) the way the automated licensing platform (ALP) framework could enable 3DP companies to license 3DP content; and (2) an effective technological solution to online licensing of 3D content. The interviews with 3DP companies are used to learn in depth about the current situation of 3DP copyrights in China, the gap between the status of the industry and the needs of relevant standards, and the importance of ALP in protecting copyrights and improving the 3DP industry.

Keywords: Automated licensing platform; 3D printing; Intellectual property

1. INTRODUCTION

3DP, also known as additive manufacturing, is a disruptive and innovative technology in the digital manufacturing era. It is a revolutionary technological platform where an abstract digital design file can be transformed to a physical object as long as there is a 3D printer. This technology is now more popular because the process cost has reached an affordable level, particularly for mass customisation and large-scale applications (Gosselin et al., 2016; Rayna and Striukova, 2016). The process first starts with data preparation of 3D models with any complex shape or geometry, then the data is sliced into

successive thin horizontal cross-section by special software, the digital information thereafter transmitted to a 3D printer. Finally, the final object is created layer by layer. This process can be represented or recorded by a digital file (Gao et al., 2016).

3DP is no longer distant from designers in the industry and is with easy access to the public, including home users. A huge number of manufactures, innovation companies, and even e-commerce companies have already, or will be, benefited from this technology. The expansion of the mobile communication industry and the Internet offers great opportunity for online 3DP platforms, customised design service industry, and 3DP content sharing

community (Rayna et al., 2015). Moreover, the existence of 3DP technology accelerates the development of certain industries, for instance, spare parts manufacturing and printing materials suppliers.

Nevertheless, legislation always follows, and arguably lags behind, innovation. Copyright law is a classic example (Rideout, 2011). While a great number of individuals and companies are enjoying the benefits that 3DP can deliver, there is another group who is struggling with, if not suffering from, the Intellectual Property (IP) protection issues. Due to the wide coverage of the Internet and the development of communication technology, the owners of printable content are able to upload their digital property onto the Internet. Thus, interested individuals or companies are able to download the file without payment (Depoorter, 2013; Peacock, 2014). Afterwards, it is possible to redesign the downloaded content and print it out very easily. It might be acceptable if it is for individual use or education use. However, there is a possibility that the newly printed content will go to the market for commercial reasons. Likewise, the contents of legally patented products are accessible to the public, who might print the products and sell exactly the same products to the market directly by scanning the objects. Big companies are powerful enough and with easier access to track the origin and fight for the IP right of their products. However, it is difficult to small and medium size enterprises (Lessig, 2001).

This research project aims to tackle the aforementioned legal issue regarding 3DP. This is a consortium for academics in law, operations, and 3DP, and industry specialists. An online automated licensing platform, where contents are IP protected through an embedded electronic watermarking system, is proposed that could regulate authorised 3DP by tracking content and product information throughout the value chain. The main target audiences are in Chinese 3DP industry. This will be explained further in the next section.

In this project, different research methods are employed - for instance, qualitative interviews with companies in the 3DP industry to explore the current status of legislative issues with 3DP, and an industrial placement and case study. The latter is to develop a pilot system of the proposed licensing platform. There will also be workshops with industry specialists, academics, and government officials, in order to achieve a deeper understanding on the research topic. In this conference paper, the preliminary findings from the first stage of the qualitative interviews are presented.

The rest of this paper is organised as follows: Section 2 presents the relevant state-of-the-art. Section 3 summarises the findings from 15 qualitative semi-structured interviews. Finally, Section 4 concludes this paper.

2. LITERATURE REVIEW

2.1 Introduction to 3DP

3DP is a cost effective solution to many applications, including home users, or Do-It-Yourself (DIY) users (Rideout, 2011; Doherty, 2012; Gao et al., 2015). From a business perspective, the technology can offer quick customised solutions, and create a great opportunity for made-to-order production (Gao et al., 2015). Even if the process costs may still be higher than traditional manufacturing methods at this stage, the process technology can reduce other type of costs, such as inventory and warehouse costs. From a product design and quality management point of view, such technologies can phase in new revisions (be it due to upgrading of product features, or fixing design quality issue) without scrapping obsolete inventory. There are ten advantages for 3DP, which are: (1) No extra cost for complicated products; (2) No extra cost for diverse products; (3) No need for assembling; (4) Short duration; (5) Zero gap between design and production; (6) No special production skills needed; (7) Easy to produce; (8) Less production waste; (9) Possibility of mix of different materials; (10) High precision (Lipson and Kurman, 2013). In short, 3DP simply introduces more flexibility for factories.

In addition, in the report "Made in China 2025" which was published by the China State Council in 2015, China has put 3DP industry to be one of the priorities in this first ten-year plan to upgrade the manufacturing industry (China State Council, 2015). Indeed, 3DP is a great challenge and also provides an extraordinary chance of historical improvement for traditional Chinese manufactures (Lipson and Kurman, 2013).

2.2 3DP and IP

Notwithstanding the ten improvements that 3DP brings as detailed above, such convenience sometimes may introduce undesirable outcomes. First, the technology can literally apply to any finished products. Therefore, the ability to print unethical objects, such as lethal weapons or more specifically guns, would jeopardise public security and safety (Desai and Magliocca, 2013). Therefore, regulation could cover what should be, and what should not be, permissible objects to print. Nevertheless, this is not the focus of this project and hence no further discussion is made in this paper on this area of debate.

Second - and more importantly as it is the focus of this work - it is very easy to apply the technology to infringe IP or copyright of the digital content, even if the users are infringing unintentionally. In principle, the design of any physical object could be capable of copyright protection, so

any means of replication (e.g., scanning, in other words copying, a physical object and then printing it using a 3D printer) could be a breach of copyright law. The 3DP process is digital in nature so it is easier than ever before to “steal” a product design and then make small batch production. The situation is complicated by the current e-commerce technology. Imagine if these infringed products are sold online (e.g., e-bay or Taobao in China) - it is very difficult for the IP owners to track the origin of the infringement.

Additionally, 3DP processes and products differ from other ‘products’, like physical products, music, films, and etc. It is more complicated and, currently, new to the public. For example, Chinese IP regulation has not covered this area yet. Meanwhile, many 3DP companies attempt to develop a new means of creating and disseminating 3D printed content utilising their 3DP systems and to capture new business opportunities. However, their opportunities have been limited because of the complex legal licensing environment, a lack of appropriate digital licensing standards, and the possibility of being held liable for the infringing acts of users.

In this connection, a proactive approach to protect copyrighted objects is more desirable (Rideout, 2011). In fact, many companies do respect IP, for example, by paying for the corresponding licensing fee. Nevertheless, many of them did not (and will not) execute that simply because the transaction cost of so doing is very high, and on some occasions they even cannot pursue that because the IP owners do not make it available due to the high set up cost. Without seeing real business potential, obviously they would not invest in 3DP. In the UK, the relevant regulatory body called the Copyright Hub has set out a list of licensing standards to use in online licensing systems (El-Nazer, 2016). This research project is to explore the appropriateness of these guidelines to the Chinese context, in order to propose a suitable licensing system in China.

3. PRELIMINARY RESULTS

3.1 Research Design

In order to accomplish the objective of this paper outlined in previous section, empirical qualitative data are required. It is because nature of the problem is exploratory in nature, and hence qualitative type of research is more appropriate at this stage. In April 2016, 15 semi-structured interviews were thus conducted, each of which lasts for around 1 hour

The sample frame of these interviews is limited to companies which are related to 3DP business. They could be printers, manufacturers, or so. The natures of their business are: (1) Chinese 3DP manufacturer and 3DP

distributor of foreign brands; (2) 3DP and scanning software supplier; (3) 3DP material supplier and material institution; and (4) 3DP solution provider. The business area of the majority of the companies covers rapid prototyping and moulding of fashion products, mass customisation of spare parts in ships, jet engine, aerospace, and for education science training. The companies interviewed are located in Shanghai, Hangzhou, Ningbo, and Changsha. The interviewees are either general managers or technical managers who have good understanding on the 3DP business in China.

3.2 Findings

Through the semi-structured interviews, we are able to understand the current phenomenon of legal issues regarding the 3DP industry. One major reason behind the unregulated environment in China’s 3DP industry is due to fact that the industry is dynamic, fast growing, but on a very limited scale and which is, currently, unable to regulate itself.

According to an interviewee, the local market experienced a rapid growth in 2012 under multiple incentive policies from the Chinese government and exaggerated promotion of media has attracted a lot of players from various dissimilar fields. According to another interviewee who is also an entrepreneur from a leading company, the local government attracts industry newcomers with lucrative packages, which include three years’ exemption of office rental and monetary reward for IP awarded 3D technology. He further commented,

“The biggest problem in China’s 3DP industry is that it is with very low entry barrier with very niche market. The competition in this industry is very fierce because of the exaggeration of media that demonstrates public an illusion of the idea that the 3DP industry is the future. The reality is always cruelly disparate, in order to survive in the market, low price strategy is the only strategy. Thus, low quality and patent troll are the outcomes.[sic]”

On the other hand, the process and content of 3DP products are different from many other traditional objects or services, as they are more complicated. Moreover, the nature of IP Law is complicated, and when old laws meet new technology, it is often the case that legislation is unable to fit into the new eco-system. Therefore, it is difficult to offer effective protection.

The majority of the interviewed companies responded that contract law only protects the originality of content they received from customers. A general manager of a local B2B manufacturer, stated that,

"There is no way for us to trace the originality of the content given by customer. For instance, if someone gives us an iPhone, we will know that it is from Apple. However, most of the time when the product is received, we have no idea where or who the product/content belongs to. Furthermore, the bargaining power of customers is always stronger than us, if we emphasised too much on content originality, the customer can always choose to go for another company who does not ask for originality to complete the printing. We are too weak to pursue for intellectual property when there is lack of practical guidance on the law in the industry."

At the same time, there are also some companies interviewed who already saw the importance of IP protection of 3DP products. The chairman of a 3DP association in Hangzhou has adopted a creative method to encourage open source printable content designers to continuously contribute their innovation to an open source platform, where he allocates "profit share for content designer" after the product goes to mass production. The corresponding designer receives reward for their creativity. In the meantime, the manufacturer would change the image of "Made in China", which sometimes can indicate a fake copy, to "Created in China". The companies could strengthen their brand reputation and image by selling authorised 3D products. This is a win-win-win situation. He commented,

"Open source is the future, there will be only two types of factories in future, one is for printing material and another for production. We can produce everything at any time and are able to supply to the whole world. Till then, the standard and regulation of IP will automatically be set. If IP law applies at this dynamic stage, it will discourage designers to free their mind, there will be no imagination, then the industry will end."

The value chain of 3DP is straightforward, with the combination of equipment vendors, distributors and resellers, service providers, and also, material and software providers. When discussing the relationship between IP and technology, there are various formulations of IP, for instance, copyright, patent, trademark, registered design and utility patent. All of these terms are related to different value chain. An interviewee from a 3DP materials research institution proved that,

"We update our hardware frequently so we will not apply a patent for every stage's incremental improvement, we would also keep as trade secrets by not disclosing to the public. Furthermore, if someone wants to use our equipment, he only needs our formal license on the

application of the technology but not on the intellectual of product. Because the product is only the result of mass production, which does not follow the nature of the patent right."

4. CONCLUSIONS AND DISCUSSIONS

This is an early stage of this study and hence the analysis in Section 3 is also preliminary. Despite that, the results indicate at least two important issues in relation to the proposed research work. They are discussed below.

4.1 Potential issues from current IP Law: Illegal Usage Activities of IP

Nowadays, it is easier to access and obtain digital content due to the availability of open source file sharing. More importantly, this allows individuals to obtain digital printable content online without any payment to the content owner. Individuals can then customise and print an object for personal purposes. This leads to serious brand dilution as there is no way for a company to track counterfeiting. It is also extremely difficult to detect infringing activities which lead to prohibited usage of an IP protected item. This is complicated by a lack of IP standards and regulation for the 3DP industry.

In fact, the cost to protect IP for 3DP applications is very high, not to mention that it is very time consuming, as a heavy workload is required. This creates conflicts between innovation and business opportunities that make functional 3D printing technology outplay the importance of IP contents.

4.2 The Potential of Automated Licensing Systems

With the establishment of the automatic single copyright licensing online platform, all the IP contents are automatically protected by embedded watermarks. Users of 3D printable content pay a little amount every time they access the content via the platform, e.g. through advertising or the monitoring of use. Meanwhile, the owner of the content receives reward of their innovative works by inter alia automated pay-per-click downloads, and are able to track the usage activities of whom, where and how is their IP are being used. This couples with recent trend in "big-data" analysis.

From the industry's perspective, this automatic licensing method protects the originality of companies' products which exempt IP-cautious applicants from complex and confusing legal terms. Consequently, this eventually encourages more innovators to grow under the protection of a proper legal system. Under this system, all the stakeholders in the industry are more disciplined to

avoid legal disputes, as regulation and standards will set in automatically to work as a regulator.

4.3 Future Works

As mentioned above, this conference paper presents only the preliminary results of the first batch of the interviews. The project team is going to conduct more interviews in order to better generalise the results by covering more locations (i.e., regions) and more industries in China. Potential target locations include Beijing and Guangzhou. Then, more thorough content analysis will be conducted with the qualitative data. It is expected that this exploratory research will generate more insights from the industrialists on the design of the proposed licensing platform.

In the meantime, an industrial placement with a case company is arranged to develop a pilot system of the automatic licensing platform, with the help of the company data. The main objective is to prove the proposed concept is feasible and to resolve any technical barriers when the concept is used in real applications. This system is a proof-of-concept and if successful can be extended to a real commercial system, analogous to the UK Digital Copyright Hub system. Figure 1 illustrates the overall research method.

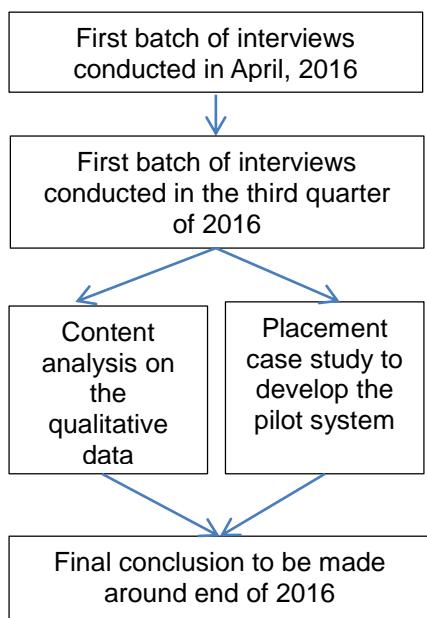


Figure 1: Overall research model.

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