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## 3D printed weapon prevention strategy in 3D printing

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### Abstract

With the development of 3D printing technology, people can search 3D weapon models as firearm, gun, and knife to print physical 3D objects with home 3D printers. Specially, with new materials user could print dangerous weapons and can use them to do damage. So, restricting the creation of

weapons is urgent issue in 3D printing to prevent the increase of crime and violence. In this paper, I would like to present ideas to prevent the print out of 3D weapons from 3D weapon models using 3D printer.

**Keywords:** 3D printing, 3D printing security, 3D printing weapon, 3D firearm, and 3D gun

### 1. Introduction

Three dimension (3D) printing revolution help users can realize their ideas from the digital models with 3D printers [1-4]. With the development of 3D printing technology, people can download 3D models on the internet and print out with home 3D printers as shown in Fig. 1. Thus, anyone can search 3D weapons such as firearm, gun and knife to print out or share them unlimitedly. This has led to the fear of the increased violence and crime. So, an anti-weapon filtering solution is necessary for 3D printing safety.



**Fig 1:** 3D printed weapon by 3D Printer

Up to the present time, there is no solution to stop the print out of weapons in 3D printing industrial. The handgun detection techniques based on image processing methods could only apply to the surveillance systems or the checking security systems in special places [5-8]. They could not be applied to 3D printing. On the other hand, the matching methods for 3D model could not also apply to 3D printing to prevent the creation of weapons. Because, the 3D model matching techniques must access to 3D model database for giving the decision, and if input model is not stored in 3D model database, it will not be recognized by the matching techniques. So, anti-weapon filtering algorithm for 3D printing should detect and recognize exactly all most 3D weapon models with high accuracy.

This paper presents strategies to prevent the 3D printing of weapons as 3D gun, 3D firearm or knife in 3D printing industry. Previous researches to prevent gun, knife and the related researches are explained in section 2. In section 3, we will propose the strategies to prevent the creation of 3D weapons from 3D printer. Conclusion is shown in section 4.

**2. Related Work**

The handgun detection issues are proposed and solved several years ago. All handgun detection techniques are based on image processing [5-8] and only applied to the monitoring systems or the checking security system at special places as airport, building or important events. It is useful to detect where weapons are keep on the body or in the luggage (see

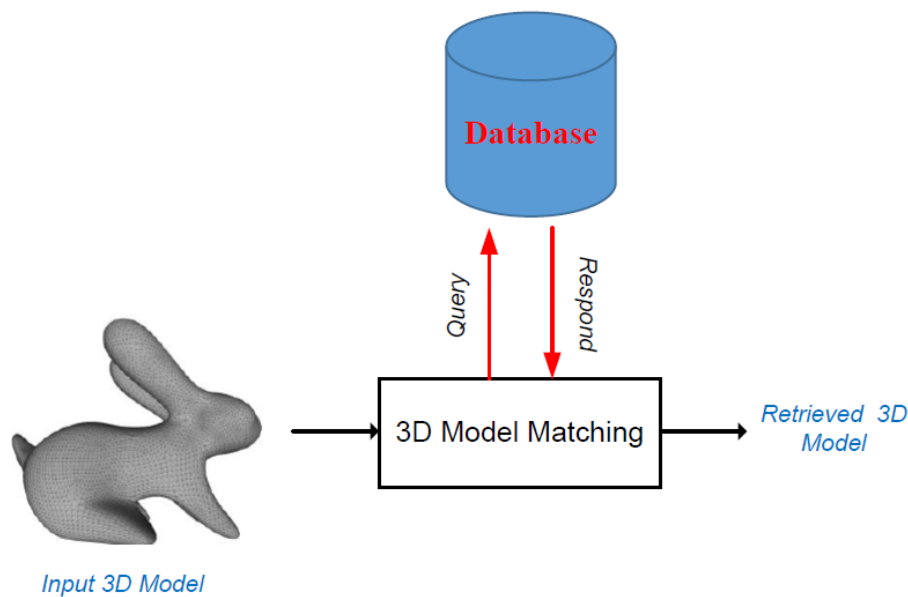
Fig. 2). Consequently, all handgun detection techniques are based on image processing and only applied to the monitoring systems or the security checking system at special places as airport, building or important events. It is only useful to detect where weapons are kept on the body or in the luggage but it is unsuitable to detect anti-3D weapon models for safe 3D printing.



**Fig 2:** Weapon Detection for Security Checking

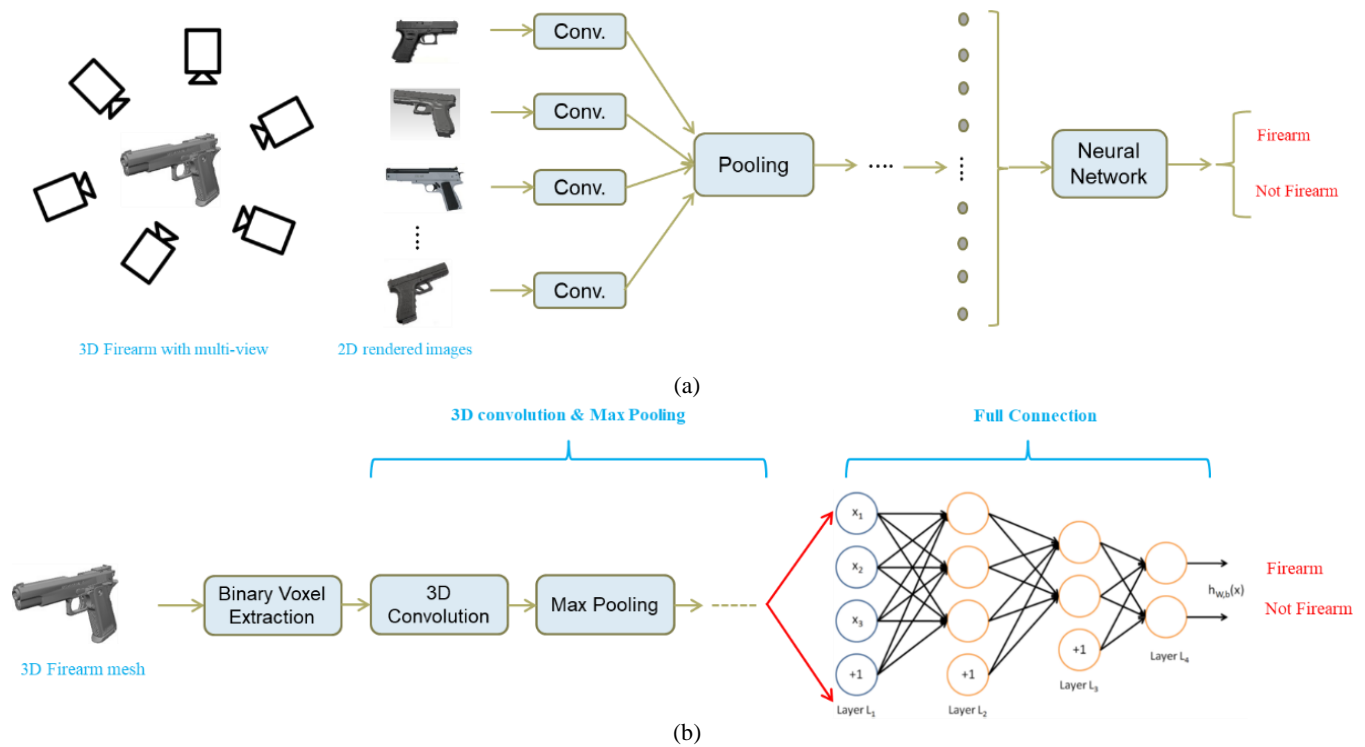
3D model matching has been researched since 2000s. The key content of 3D model matching method is to find similar models with input model from the database of 3D models as shown in Fig. 3 [10-14]. Researchers introduced a search engine for 3D models that supports queries based on 3D sketches, 2D sketches, 3D models, and/or text keywords or they proposed a 3D model matching method based on shape distributions. Moreover, other authors presented a 3D model matching method based on combining skeleton topology and shape features. Overall, 3D model matching techniques could

only search similar models in the database of 3D models when user give an input model. Actually, they could not detect whether a 3D model is weapon or not, even they could not find similar models or find incorrect models if the input model was not included in database. Moreover, these 3D model matching methods often combine with the searching process, and the accuracy of these method is not high. Consequently, 3D matching techniques could be not applied to prevent the print out of 3D weapons in 3D printing industry.



**Fig 3:** Main content of 3D model matching

### 3. 3D Printed Weapon Prevention Strategy in 3D Printing



**Fig 4:** Ideas to recognize firearm for 3D printing.

First strategy, Gao *et al.* [17] proposed an anti-3D weapon model detection algorithm to prevent the printing of anti-3D weapon models for safe 3D printing based on the D2 shape distribution and an improved convolutional neural networks (CNNs). The purpose of this method is to detect anti-3D weapon models when they are used in 3D printing. The restriction of this method is to only detect gun, firearm or knife when user uses them in the 3D printing. Moreover, to implement this research, developer need to integrate this method to current 3D printing software.

Second strategy, I would like to proposed ideas to filter or recognize gun, firearm based on deep learning when these models are used in 3D printing process. The detailed ideas are described in Fig. 4. First idea is based on multi-view and deep learning for 2D image processing (Fig. 4a). With this idea, 3D firearm model is used to render 2D firearm image by multi-view, and then CNNs method is applied to distinguish which is the gun or not. In Fig. 4.b, I would like to present an idea to recognize which is firearm or not using binary voxel and 3D convolutional neural networks. The main content of this idea is convert 3D firearm models to voxel, and then use 3D CNNs to recognize which is firearm or not.

#### 4. Conclusion

In this paper, I presented the related works to 3D printed weapon in 3D printing industry. I also presented my previous research and propose ideas prevent the print out of 3D weapon from 3D printers. I hope that this paper is useful for researchers, who are researching and intending to study about 3D printing technology, 3D printing security, and especially in topic 3D printed weapon prevention in 3D printing for safe 3D printing.

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#### Disclosure of conflict of interest

On behalf of all authors, corresponding author declares that there is no conflict of interest to publish this research.

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