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Bridging the Divide Between Users and 3D Printers

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Abstract

A system model and associated parameters for the design of a web based 3D printer selection system is envisioned. Accessible through a webpage that will be mapped to a central 3D printer database, the system will provide users with access to the database of 3D printers available around the world. The purpose of the selection system is to match user 3D printing requirements to available 3D printers. It is anticipated that the selection system will help bridge the divide between users and 3D printers by helping to facilitate the 3D printer selection process.

Introduction

Friedman (1999) has suggested that technology—ie computers, modems, cell phones, cable systems, the Internet, and the like—have enabled us all to reach further into more and more countries and into one another's lives, faster, deeper, and cheaper than we've ever done before. Referring to this phenomenon as "the democratization of technology", this phenomenon, according Friedman, has put banks, offices, newspapers, bookstores, brokerage firms, schools, and even factories in our homes.

3D printing has paved a path for the democratization of manufacturing and is perceived by some as the next industrial revolution (Berman, 2012). It has created a paradigm shift in the practice and process of traditional manufacturing aided by the interconnectivity and digitization offered by information technology. It has become an integral part of the visualization, design, and prototyping process and in the production of goods.

3D printing is also equipping users ranging from the novice to manufacturing professionals with the ability to quickly transform ideas into tangible products. As 3D printing becomes more accessible, demand continues to increase aided by numerous 3D printers being introduced to the market every year. That is, as more and more users flock to this technology, purveyors of 3D printers from around the world are seizing upon this opportunity to launch various types of 3D printers. This has spawned new 3D printing industries and small businesses as well as industries and small businesses that take advantage of the technology. As a result, end users around the globe are experiencing greater difficulty in making educated decisions during the selection of 3D printers. This has resulted in incorrect pairing of ideas/designs with 3D printer causing unwanted delays and unexpected costs for an average user.

Roberson (2013), Wong (2012), Rao (2007), Mahesh (2004), Masood (2002), and Brown (2002) and other 3D printer experts have studied and reported on strategies for selecting suitable 3D printers based on a given design. However, many have either limited their investigations to professional users or restricted their research to 3D printer parameters and part accuracies. Also, at any point in time, research is superseded as new and improved 3D printers are introduced to the market. Moreover, many 3D printer manufacturers such as 3D systems, Stratasys, and Makerbot provide their printer specifications either differently or in disparate format making “apples to apples” comparison difficult for the end-user. As well, the layperson and even professionals may not have access to these resources or may have difficulty assimilating these through conference and journal papers. And in many instances, jargon and many terms may make no sense to the layperson as they study the literature. Thus a system design and associated parameters of a web based 3D printer selection system, which will enable end users to match product specification to 3D printers via a webpage is envisioned.

System Model and Method

Figure 1 depicts the high level architecture of the system. Kind of like a digital index, this resource will enable any category of end user to match their product specification to 3D printers by means of a webpage mapped to a central 3D printer database. Any users connected to a network can enter the CAD geometry and product specifications into a web based form to enable selection of a 3D printer. The parameters that drive the selection of 3D printers have been reverse engineered from most common and widely used 3D printer specifications such as 3D Systems, Stratasys, and Makerbot.

The system level architecture has been designed as an improvement over previous research to include a web based entry and display system making the selection system more accessible. Also the purpose of the selection system is to display printer specification in a common format for “apples to apples” comparison. It is anticipate that any user will be able to access the selection webpage and can enter data from any platform including PCs, Macs, cellphones, and tablets.

Level 1 of the system is used by a user to enter user category and desired product specifications and submit them to the 3D printer server. System Level 2 converts the users’ inputs into matching and mapping query to the large database of 3D printers.

Once a suitable match has been found, a webpage containing suitable 3D printers will be displayed in Level 3 with a hyperlink to the machine webpage hosted on the manufacturer’s website. At level 3, the user will be prompted to complete a quick survey summarizing their experiences with using the system. In addition they will be asked for their thoughts on how to improve the system. The feedback will be used to improve the system.

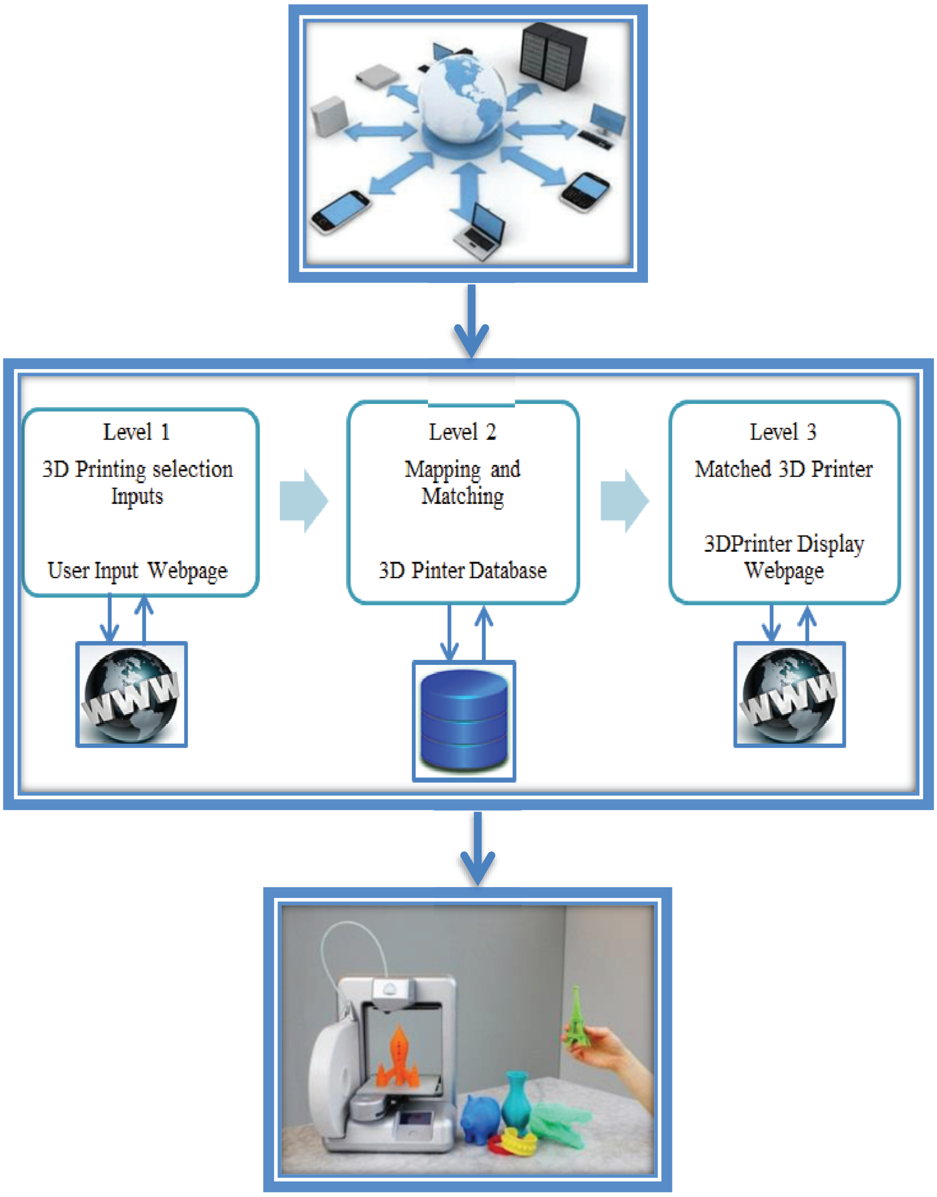

Figure 1. 3D printer selection system architecture.

As new 3D printers become available commercially, they will be added to the database. The authors and the graduate student dedicated to creating this database of 3D printers will continuously update the database as new 3D printers become available. The webpage of the system and the resource will be hosted on a campus library webpage as depicted in Figure 2.

Figure 2. Campus 3D printing webpage where the system will be hosted.

3D Printer Selection System User Interface

The selection parameters of the web based 3D printer selection system are the product and design specifications such as model dimensions, material type and the category of users to name a few. Figure 3 depicts the parameters of the system that the end user inputs at Level 1. These parameters that drive the selection of 3D printers have been reverse engineered from most common and widely used 3D printer specifications such as 3D Systems, Stratasys, and Makerbot.

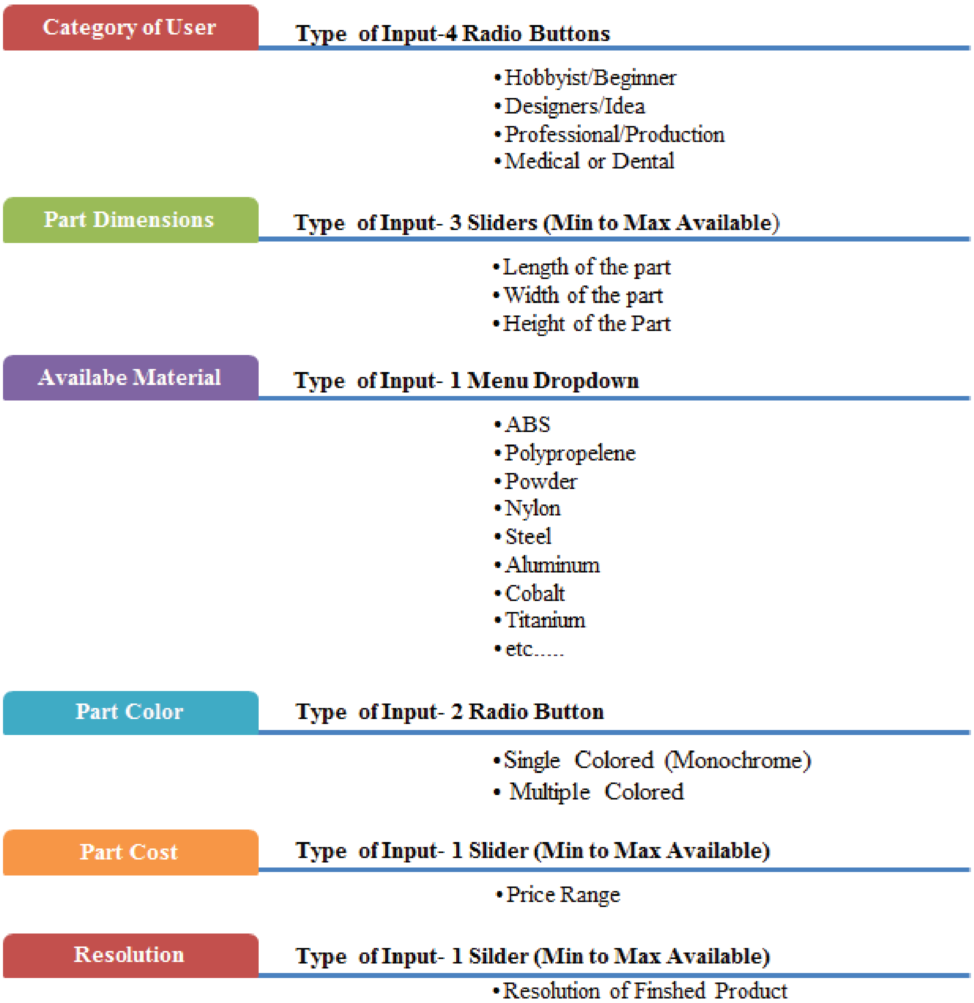

Figure 3. Selection parameters based on selected 3D printers.

Broadly these parameters are classified as category of user, the part dimensions of the product, the material of the product, different colors needed, the overall part costs, and the resolution of the desired product. The Novice users who may need further help on the material can visit a webpage tab (part of future work) to learn more about the material properties. A radio button is used to select the user type ranging from a hobbyist to design, manufacturing professional, or a medical professional. Three sliding inputs are incorporated for entering the part build volume indicating the length, width, and height of the part. The users will have the ability to select the product's material using a drop down menu. Choice of part color is entered by means of a radio button. Range of part costs such as cost/cubic inch and resolution is entered through a slider input. Figure 4 illustrates an example of the system interaction.

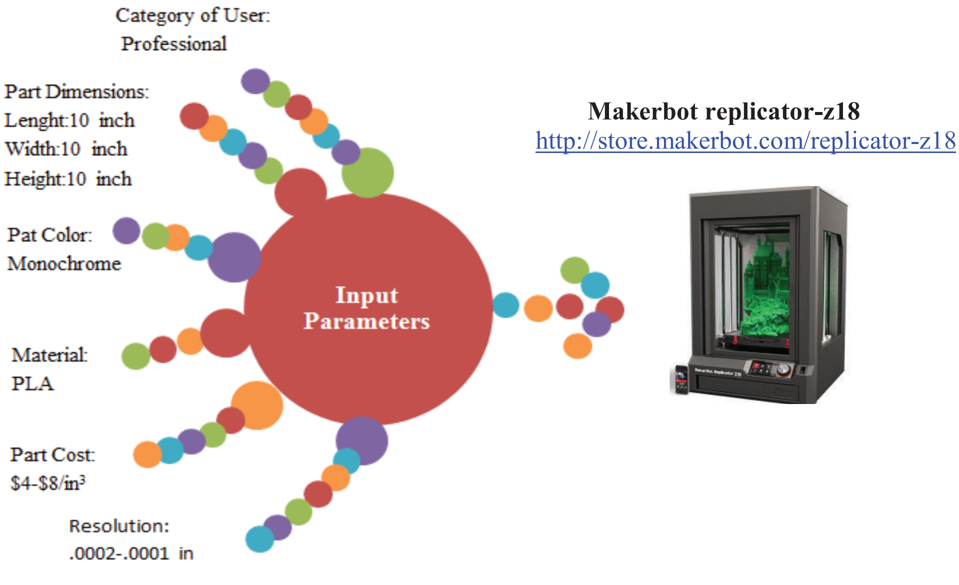

Figure 4. Example of system interaction.

Conclusions

The goal of this endeavor was to further the democratization of manufacturing by making 3D printing more accessible to the broader community of users. The problem for this population is identifying suitable 3D printer to fit their needs. Previous research has been somewhat inaccessible, and archaic to the novice user in the rapidly increasing market of 3D printers. Also many big 3D printer manufacturers such as 3D systems, Stratasys, and Makerbot provide their printer specifications either differently or in disparate format making "apples to apples" comparison difficult for the end-user. A system model and system parameters has been identified, which will aid users in the process of identifying appropriate 3D printers and meet their unique needs. Initially the system, along with the website interface will be hosted by a library. The resource on the library webpage and the database will continuously expand and improve the 3D printing pairing engine. Researchers and educators in the engineering design graphics community will benefit greatly from the use of this tool. They will save time by using the 3D printer selection webpage instead of visiting the hundreds of 3D printer manufacturers' webpages available to match their design requirements with an appropriate 3D printer.

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