Design and Implementation of Brush System for Chinese Writing Based on 3D Printing Platform

Hui-Kai Su, Jing-Jie Zhou, Sung-Kai Wang, Chi-Hsuan Han, and Yi-Zu Tu
Department of Electrical Engineering, National Formosa University, Taiwan.

3D printing is a hot topic in recent years. The advantages of its rapid prototyping can meet the customized requirements. The Chinese writing brush is a popular art in Asia region. The paper designs and implements a brush system for Chinese writing based on a simple 3D printing platform. In the result, the system can write Chinese words automatically according to the users' inputs. The users can construct the system easily by themselves. The value of 3D printing system would be added.

I. INTRODUCTION

In recent years, the 3D printing system is very popular in Maker communities. Users can construct and reconstruct the 3D printing system easily by themselves. Beside of printing 3D objects, the 3D printing system can be enhanced to make an ice cream, laser printing for board, etc.

However, the Chinese writing brush is a popular art in Asia area. How to brush a good Chinese word automatically is very interesting. This paper designs and implements a brush system for Chinese writing based on a simple 3D printing platform. The users can construct the system easily by themselves. The value of 3D printing system would be added.

II. HARDWARE IMPROVEMENT

A. Rail Improvement

Our system is based on a traditional delta 3D printer. The rail and related parts are improved and shown in Fig. 1.

B. Nozzle Improvement

Due to the writing brush, the nozzle of the 3D printer has to be replaced to a brush pen. First, the whole iron block of the nozzle is removed. Second, the new part binding a brush pen is design and produced. Finally, the new brush part is installed into the 3D system. The improvement result is shown in Fig. 2.

III. SOFTWARE DESIGN

The system control software is design and shown in Fig. 3. The software has to communicate with the printer's motherboard by a USB cable. Our system control software is developed by VB (visual basic) programming language based on .NET library. The user would input a Chinese word to the system control software. The system control software has to decoded the inputted word and convert to G code from Big5 code. The key function is to convert the Big5 code to the writing paths, and then convert the writing paths to the G code. Finally, the system control software transmit the G-code to our brush system to write brush. The software operations are shown in TABLE I.

A. Printer Connection

The system control software is connected to the brush system with a USB cable, and the USB port is drived to a serial port. The system control software is communicate to the brush system by using the .NET IO.Port function. In the Fig. 3, the parameters of COM7 and 115200bps are configured.

B. Writing Path Converter

The word inputted by a user cannot convert to G code directly. In order to write a Chinese word automatically, how to convert the word code to the G code is the key technology [1][2]. In our control software, the Big5 code is decoded from the word inputted by a user first. Second, the writing paths of the word is converted by the external system that is the Education Department stroke system. The writing paths is described in a XML file. Finally, the G code of the writing paths is converted from the XML file.

Fig. 1. The rail improvement.

Fig. 2. The nozzle improvement.

Fig. 3. The system control software.

TABLE I
The software operations.

Object	Function
Connection Field	Port Information connected to the printer
Field 1	Fill in the word you want to write
Press 1	To produce the Gcode of writing
Press 2	Gcode in execution Box2
Press 3	Gcode in execution Box3
Box 1	Message returned by printer when connected to printer
Box 2	Gcode that produce the written font
Box 3	Transfer Gcode fields when testing

The system control software communicates to Education Department stroke system with HTTP message. The parameters of writing-path request to the Education Department stroke system is shown in Fig. 5. The result of the writing-path response is shown in Fig. 6. Each node (Storke) represents a stroke, and each track represents the motion coordinate of the stroke[3].

```
Dim N As Long, BIG5 As String, B1 As String, B2 As String
N = Asc(TextBox2.Text) + 65536
B1 = Hex(N \ 256)
B2 = Hex(N Mod 256)
BIG5 = B1 & B2
```

Fig. 4. The conversion of Big5 code.

```
<param name="allowScriptAccess" value="sameDomain">
<param name="allowFullScreen" value="true">
<param name="flashVars" value="penSize=45&locale=zh_TW&StrokeDefURL=/
provideStrokeInfo.do?big5=AAEA&EvtReportURL=/wrongStrokeOrder.do?
big5=AAEA&wavURL=/sound/2828.mp3">
<embed src="/StrokeExercisePanel.swf" quality="high" bgcolor="#869ca7" width=
```

Fig. 5. The parameters of writing-path request.

```
<Word unicode="虎" version="1.0" x="1024" y="1024">
  <Stroke>
    <Outline>...</Outline>
    <Track>
      <MoveTo x="883.0" y="163.0"/>
      <MoveTo x="976.0" y="180.0"/>
      <MoveTo x="976.0" y="600.0"/>
    </Track>
  </Stroke>
  <Stroke>...</Stroke>
  <Stroke>...</Stroke>
```

Fig. 6. The Literal XML.

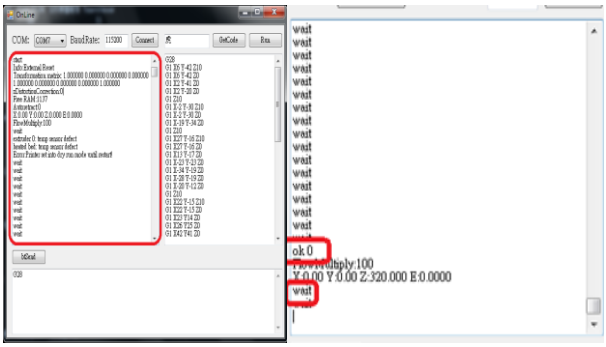

Fig. 7. The process of system control software.

C. Printer Control

The message from the printer is shown in the left side of Fig. 7. The system control software communicates to the brush system based on text messages that are G codes. In the example on the right side of Fig. 7, when the brush system receives the message, an initial location message (G28) is sent. The brush system would return "ok 0"[4]..

IV. Results

The whole process data flow is shown in Fig. 8. After receiving the user's input, the software would process the input word. Moreover, the the system control software request the writing path to the Education Department stroke system with HTTP. After receiving the writing path, the G codes of the writing path would be generated. Finally, the system control software would control the brush system to write brush with the G codes. The results of the writing brush are shown in Fig. 9.

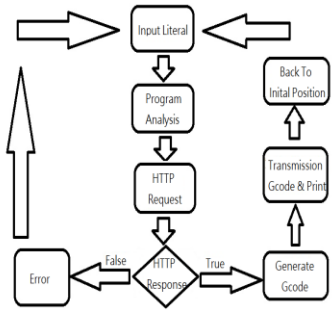

Fig. 8. The data flow chart.

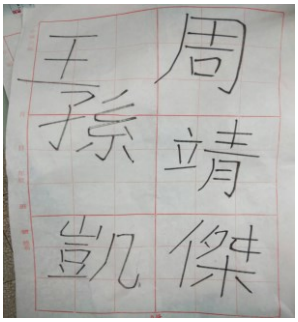

Fig. 9. The brush results.

V. CONCLUDSION

The paper designed and implemented the brush system for Chinese writing based on 3D printing platform. The Chinese words can be written according to the MOE on-line dictionary. In the future, the brush system could be extended to support various fonts.

Reference

[1] Reprap.org. (2018). G-code - RepRapWiki. [online] Available at: http://reprap.org/wiki/G-code [Accessed 5 Feb. 2018].

[2] En.wikipedia.org. (2018). G-code. [online] Available at: https://en.wikipedia.org/wiki/G-code [Accessed 5 Feb. 2018].

[3] Stroke-order.learningweb.moe.edu.tw. (2018). [online] Available at: http://stroke-order.learningweb.moe.edu.tw/home.do [Accessed 5 Feb. 2018].

[4] Open-platform-club.org. (2018). [online] Available at: http://www.open-platform-club.org/2013/06/stl_27.html [Accessed 5 Feb. 2018].