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# GUI-based Chinese Font Editing System Using Font Parameterization Technique

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**Abstract**: When creating Roman fonts, about 256 characters should be designed. Whereas creating Chinese fonts, around 8,000 widely used characters should be designed from the total 80,000 to 100,000 characters. In order to solve these problems, many studies on programmable fonts have been performed since 1980s. METAFONT is a font designing system for improving the quality of TeX typesetting in TeX document, and it represents programmable fonts. However, as METAFONT is a programming language, it is very difficult for general font designers to design fonts directly by using it. In order to solve this problem, we propose a GUI-based Chinese font editing system by font parameterization technique, which can easily edit fonts in web browser.

***Key words: Font Editor, Programmable Font, Font Parameterization, METAFONT.***

## 1. Introduction

Recently, the development of portable devices has increased the number of places where fonts are essential, such as e-books, websites, mobile games, books, newspapers, etc. When creating Roman fonts, about 256 characters should be designed. Whereas creating Chinese fonts, around 8,000 widely used characters should be designed from the total 80,000 to 100,000 characters.

When generating fonts, characters are generally described as ‘outline’. It takes averagely more than 1 year to design one set of Chinese font with an outline font editing system. Similarly, it takes almost the same amount of time to change the style of an already

generated font using general outline editors. In order to solve these problems, many studies on programmable fonts have been performed since 1980s.

METAFONT is a font designing system for improving the quality of TeX typesetting in TeX document, and it represents programmable fonts. METAFONT can reduce the cost of generating fonts by deriving various fonts by changing size or shape of pen or values that are required to draw the characters.

However, as METAFONT is a programming language, it is very difficult for general font designers to design fonts by directly using it. In order to solve this problem, we proposed a GUI-based Chinese font editing system by font parameterization technique, which can easily edit fonts in the web browser. It cannot only be used by font designers but also by general users who do not have the programming skills.

In this paper, we discussed previous related work of this subject, and described the structural font generating program, which was the result of our work. We also explained the implementation of the GUI-based font editing system and showed several samples of resulted Chinese characters. In the end, we made our conclusion and also discussed the research direction for the future.

## 2. Related Works

### 2.1 METAFONT

METAFONT is a programming language developed by Professor Donald Knuth, Stanford University in the 1980s to define fonts in TeX (Donald, K., 1986). METAFONT uses ‘handwriting’ method to draw skeleton of characters, and fills the track of the skeleton with a pen to express fonts. In other words, METAFONT provides all the processes that we use to write characters on a plain paper with our hand, like selecting a pen, grabbing the pen, and drawing characters with desired directions in a human friendly way. Along with all these processes, METAFONT can also define the pen, curve using the Bezier cubic method, etc. It can enhance the productivity of font designed by reusability of code. However, there is no proper GUI-based font editor for Chinese fonts using the METAFONT (Crossland, D., 2008). In this paper, we address this limitation by presenting GUI-based Chinese font editing system using METAFONT.

### 2.2 Font editing environment using parameters

To Change the overall style of fonts, font designers must individually edit all characters. In the case of fonts with a large number of characters, such as Chinese and Korean, the tedious repetition is necessary. Recently various researches have been carried out to handle the style of fonts as parameters.

(1) Adobe Project Faces

Project Faces in Adobe released in 2015, it was implemented using PostScript (Adobe Inc., 2015). In the past, Adobe also implemented an interpolation font format called Multiple Master Font that extended the PostScript Type1 font using the programming language (Adobe Inc., 1992).

(2) Metaflop

Metaflop is a font editor which can generate fonts based on METAFONT (Metaflop, 2012). Metaflop provides 3 kinds of basic fonts based on METAFONT, and various fonts can be generated according to users' requirement through the GUI. However, Metaflop can only design the alphabet, number, pronunciation distinction mark, symbol, etc., and does not support Chinese Font.

(3) Prototypo

Prototypo is a web font editor implemented using the SVG Font format (Prototypo, 2014). When a parameter is input from the user, the mapped points of font are affected and the font shape changes. It is implemented using XML formatted SVG font format, and allows the user to specify parameters.

Chinese have a large number of characters, it is necessary to edit fonts using parameters. Existing font editors using parameters reduce the cost of editing fonts, which makes it possible to edit fonts with a convenience. However, all the font editors provide parameters based on the structure and style of Latin characters, so it is impossible to edit Chinese fonts. Therefore, a font editing environment using optimized parameters for Chinese is required.

## 3. Chinese font editing system with GUI

The complete structure of the proposed font editing system is shown in Figure.1.

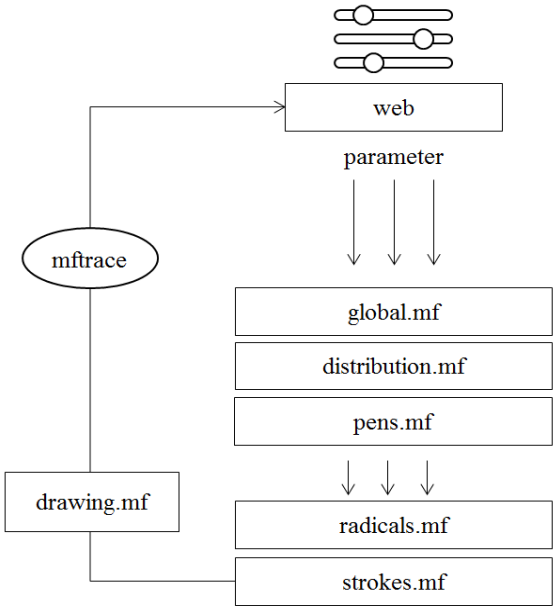


Figure.1 Structure of GUI based Chinese font editing system

### 3.1 Font styles

Figure.2 Various font styles

There are many features to determine various font styles, such as width/height of characters, weight and serif as shown in Figure.2. These features sometimes affect legibility of characters and they are required to generate variety of font shapes in design aspects.

### 3.2 Anatomy of characters

In typography, characters are divided into various anatomies (Cao, Y., 2012). These anatomies can be used as guideline in editing tools. Alphabets are constituted with their own anatomies as shown in Figure.3. However, Chinese have different concept of anatomies, because they are created by combining several radicals as shown Figure.4. Particularly, Chinese characters have 200 radicals consisting of 1 to 17 strokes (Duan, Q. and Zhang, X., 2015).

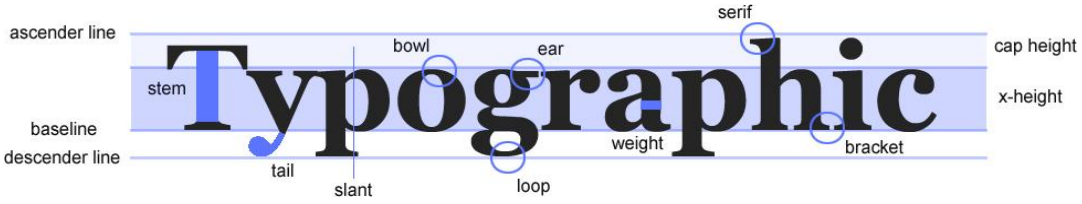


Figure.3 Anatomy of alphabet

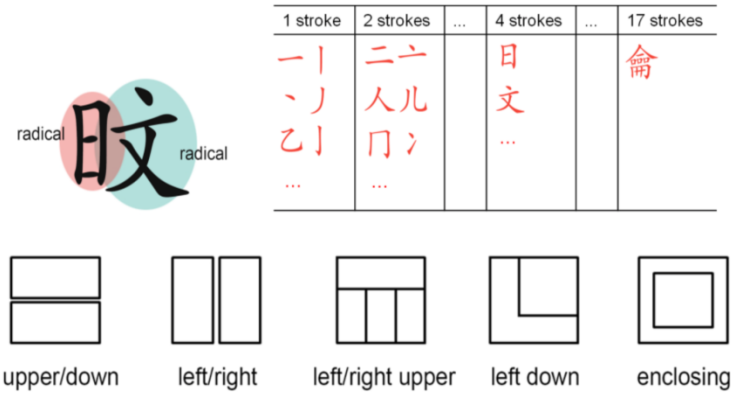


Figure.4 Anatomy of Chinese

Also, there are combining rules according to position of radicals such as left, right, upper, down, left-upper, right-upper, left-down, and enclosing. Thus, the same radical might have different anatomies depending on their positions. Exploiting these key points in Chinese characters, we classified parameters into two groups; parameters for defining overall font styles and parameters for affecting radicals only according to their relative positions.

### 3.3 Definition of parameters

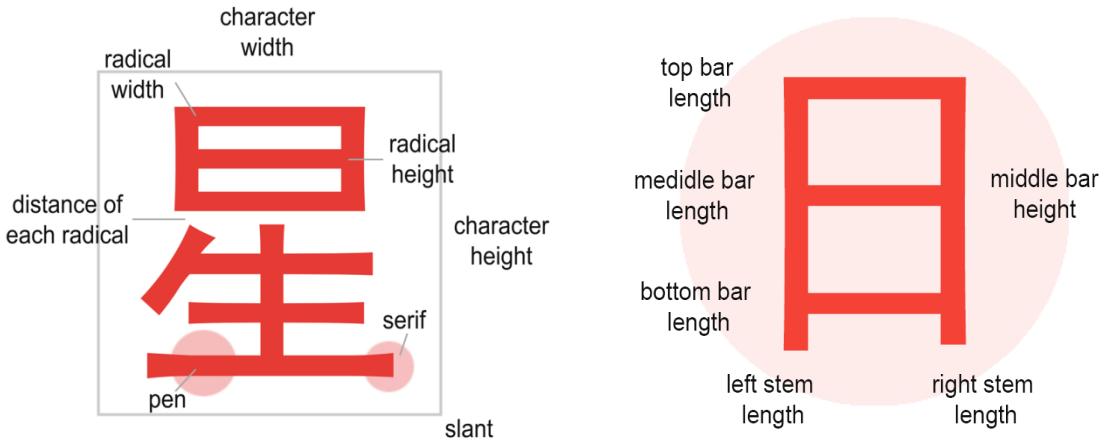


Figure.5 Parameter of character and radical

We defined font parameters based on anatomies of Chinese that determine font styles as shown in Figure.5. Some parameters are applied to all characters to determine font styles, whereas some parameters are applied to specific radicals to define its width, height, and distance between radicals depending on their relative positions. There are four kind of parameters that can be applied to all characters.

(1) Pen: METAFONT provides various shapes of pen such as circular, tetragonal, and triangular. The skeleton of character is to be filled with a selected pen. The pen can represent a thickness style of characters such as bold, light, etc., the style of font can be modified by changing width and height of a pen.

(2) Width/Height of characters: These parameters can change style of existing fonts to either thick or thin.

(3) Serif: Serif fonts are quite popular, for example, serif font increases legibility and san-serif font is more sophisticated.

(4) Slant: We need slant parameters that change straight fonts to italic fonts.

We also defined parameters for applying specific radicals as shown in the right side of Figure.5, such as width and height of each radical, and distance between two radicals. In Chinese, each radical is arranged to its predetermined position according to composing rules of characters. We have extracted parameters which affect specific radicals only. If these parameter values of radicals are changed, the modification affects all characters which have the same radicals.

### 3.4 Applying parameters to METAFONT

In order to apply parameters to our font editing system, we used METAFONT as a programming language. We implemented 6 modules to construct METAFONT and provided GUI for easy control of parameters.

(1) Global: Global module is used for storing input parameter values and it's also used for updating in real-time by applying the values to the prototype. The module is frequently referred to draw radicals in the font editing system. The same radical might have different parameter values according to their locations.

(2) Distribution: Distribution module is used for applying different parameter values to each radical according to their relative positions.

(3) Pens: Pen module defines the shape of the pen.

(4) Radicals: Radicals module defines the coordinates of the skeleton of the radicals.

(5) Strokes: Strokes module defines the coordinates of the skeleton of the strokes.

(6) Drawing: Drawing module combines skeletons defined in radicals/stroke modules, and draws the font with the pen defined in pen modules.

In order to apply the fonts to the web, we have to convert the METAFONT to the corresponding outline font such as Type1, Truetype, etc. For this reason, we use 'mftrace' which converts the bitmap font i.e. the output of METAFONT, into the corresponding outline font (Nienhuys, H. W., 1999). Finally, the result of modified styles can be displayed directly on the UI as shown Figure.6. Depending upon the prototype of Gothic styles, completely different styled fonts can be generated by changing the thickness of pen, and by changing the slant of the character. Different parameter values are applied to the same shape of radicals according to their relative positions; as a result, the same shape of radicals on the same relative positions is changed identically.


Figure.6 User interface

## 4. Conclusions

In this paper, we proposed a GUI-based Chinese font editing system, which is very easy to use for font designers, who don't have any subject knowledge and programming skills. Chinese font style can be changed with simple GUI controls, provided by Chinese GUI-based font editing system. Lots of repeated efforts were required to change font styles with existing outline font editors. In the GUI-based Chinese font editing system; the style of whole characters can be changed simultaneously by extracting parameters from anatomies of characters, and applying them to whole characters. In this way, our Chinese font editing system can reduce the complexity of designing fonts and can increase usability of METAFONT. This GUI-based Chinese font editing system enable designers to design fonts using METAFONT, based on the anatomies of characters. As it is implemented with HTML5, it can be used on tablets and smartphones as well as on PCs.

Our GUI-based Chinese font editing system is currently using parameters to change font styles. However, the work for extracting more parameters and applying them effectively is under progress. With this work, it is expected that more convenient and detailed font editing system will be provided to font designers in the near future.

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