On-line Assessment for the Stroke Order of Chinese Characters Writing

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Abstract: The purpose of this research is to develop an on-line assessment for examining the stroke order of Chinese character writing by computerized model. Using this on-line assessment system, it is more convenient for teachers or students to use in the classroom or outside class. The system can also provide immediate feedback on the input character in terms of its key information of stroke order and some global structure relations between strokes so it could accurately identify character writing problems such as wrong stroke order and incorrect stroke. This on-line system solve the problem for a teacher to know students‘ writing order of a Chinese character and assist teachers to assess Chinese characters writing. In addition to the assessment, this system can help students to learn the stroke order of Chinese characters writing efficiently.

Keywords: on-line assessment, stroke order, Chinese characters writing

Introduction

Chinese is getting important during this century so how to learn Chinese is one of the important things in the world. Chinese is totally different from pin-ying character writing system, such as English, Spanish and more than ninety percent of modern Chinese characters are from phonetic-ideographic characters. That is the reason why it is not easy to learn Chinese especial for its reading and writing even for a native Chinese speaker.

How to use correct stroke order to write Chinese is very important for writing Chinese characters correctly and beautifully because the stroke order is considered to be one of kernel factors [1, 2] in writing therefore some research has survey the stroke order of Japan school students' kanji writing [3]. The stroke order of a Chinese character includes two parts to consider, one is to know every stroke of a character and the other is to know the writing order of each stroke in this character and the order of each stroke will affect the fluency of the continuing strokes writing, the structure, and overall shape. It is important and necessary to teach the stroke order of a Chinese character when students start to write.

Each Chinese character has its own individual stroke order therefore teachers must teach by writing each stroke on the black board so that the students may follow. To ensure that the students memorize each Chinese character, there is some homework for students to practice at home then the teacher will collect the homework and grade it.

How to use computer technology, especial Internet, to help teachers' work and students' learning anytime and anywhere is the most important work we face now. Many educational tools for Chinese characters writing are developed [4, 5, 6] but most of them do not provide capabilities to diagnose students' writing character skills at stroke order. A stand-alone computer-based assessment for the stroke order of Chinese characters writing was proposed by Chen [1].

Therefore, the purpose of this study is to develop an on-line assessment system for assessing strokes and its writing order of Chinese characters to aid teachers diagnose their students' writing and know their learning condition in order to help teachers' teaching for writing Chinese characters. Using this system, teachers can reduce their teaching load and a learning mechanism is also provided for students to learn anywhere and anytime.

1. Development of stroke order assessment system

Based on the previous work, this on-line assessment model is still based on both the theory of "five indexing system of Chinese characters" [8], and the rules of stroke order published by the Taiwanese Ministry of Education [9].

Architecture of on-line assessment system

The architecture of this on-line assessment system is shown in Figure 1. Through Internet several kinds of equipments can be connected to this system. Instead of typing on a keyboard, the learner inputs the characters through a hand writing input device. The system records the movement of each stroke firstly and then breaks each character into different strokes and fetches important features of each stroke, finally compares the information of each stroke to the data base. The algorithm to recognize each stroke is developed and finally the assessment results are displayed. The flowchart of this on-line system is shown in Figure 2.

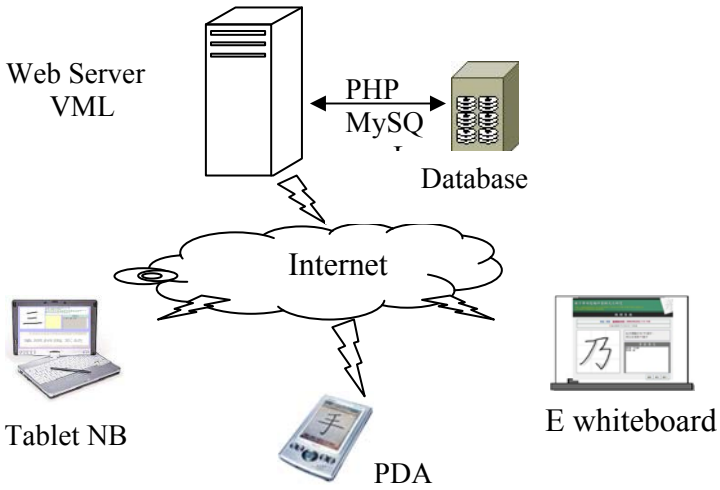


Figure 1 Architecture of on-line assessment system

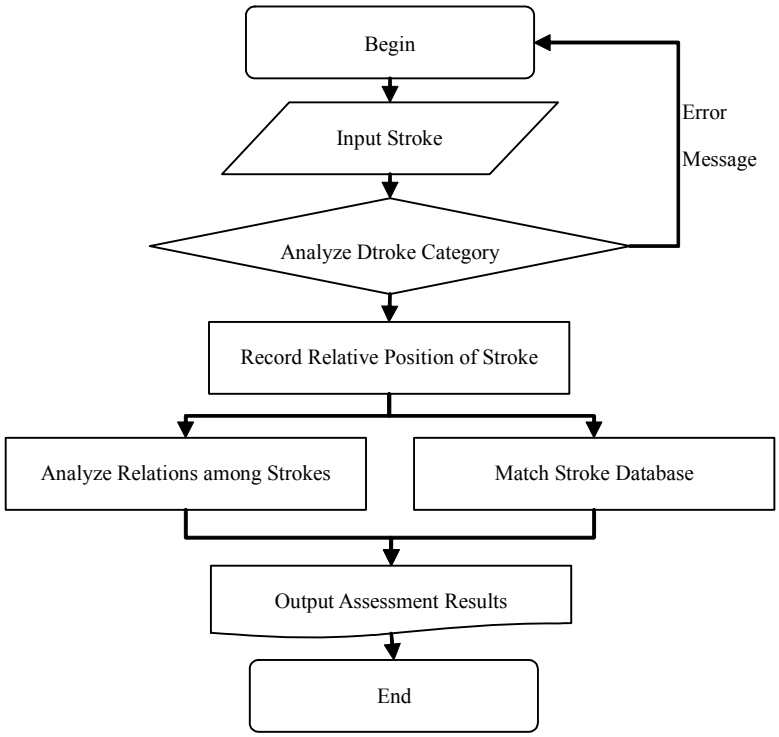


Figure 2 Flowchart of assessment system

Interface of on-line assessment system

As Figure 1 depicts, this on-line assessment system is implemented with PHP and MySQL on Apache web server. Several major interfaces of system modules are described in the following subsection.

Interface of login module

Before you login the system, you need to link the join member page is shown in Figure 3 and select you area, school, level, class and sign your name. After confirming identification, the user can login this on-line assessment for the stroke order of Chinese characters writing system and the login interface is displayed in Figure 4.

Figure 3 Join member page

Figure 4 Main page

Interface of input module

When system at the input page, you can use the input device (like mouse or touch pad) writing down the strokes and system will analyze and display the class of stroke real-time on the result area is shown in Figure 5. You can undo your actions or clean all of your actions when you click the tool bottoms.

Figure 5 Input page

Interface of assessment module

When an examinee finishes the test, the system will display the assessment list is shown in Figure 6. You can click the detail link to open the overall assessment of the word is shown in Figure 7.

Figure 6 Overall assessment lists for teachers

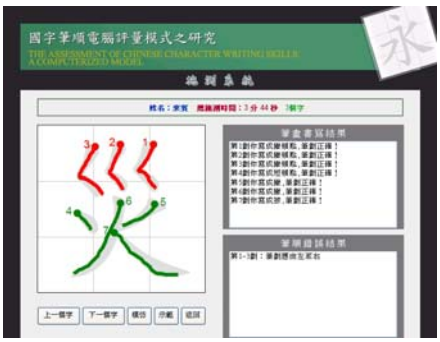


Figure 7 Overall assessment of "災"

Interface of performance module

When a student finishes writing a Chinese character, the system will evaluate the character using 5-star is shown in Figure 8. The fewer hollow stars mean the higher score.

Figure 8 Overall assessment lists for students

Stroke order recognition algorithm

There are several features extracted from Chinese character writing and most of feature extraction procedures are based on our previous work. We described some important and different one in the following.

Stroke category analysis

The system analyzes the slope of the lines and a stroke can be classified into a proper stroke name published by the Ministry of Education [9]. Take "正" as an example which is shown in Figure 9.

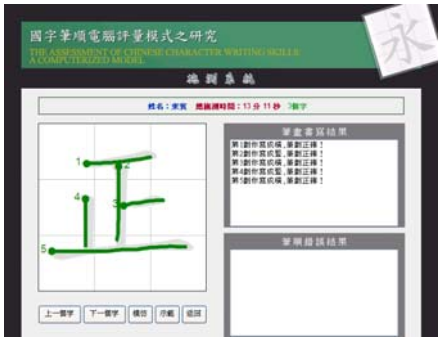


Figure 9 Results for the stroke order recognition

Error detection of writing order

When a student write a stroke the system will response and display a number beside the stroke, which means the writing order of this stoke. An error detection procedure of writing order is proposed in this on-line system when a user writes wrong order on those same strokes.

2. Experiment results and discussion

Some experiment results for feature extraction and overall assessments are discussed in the following.

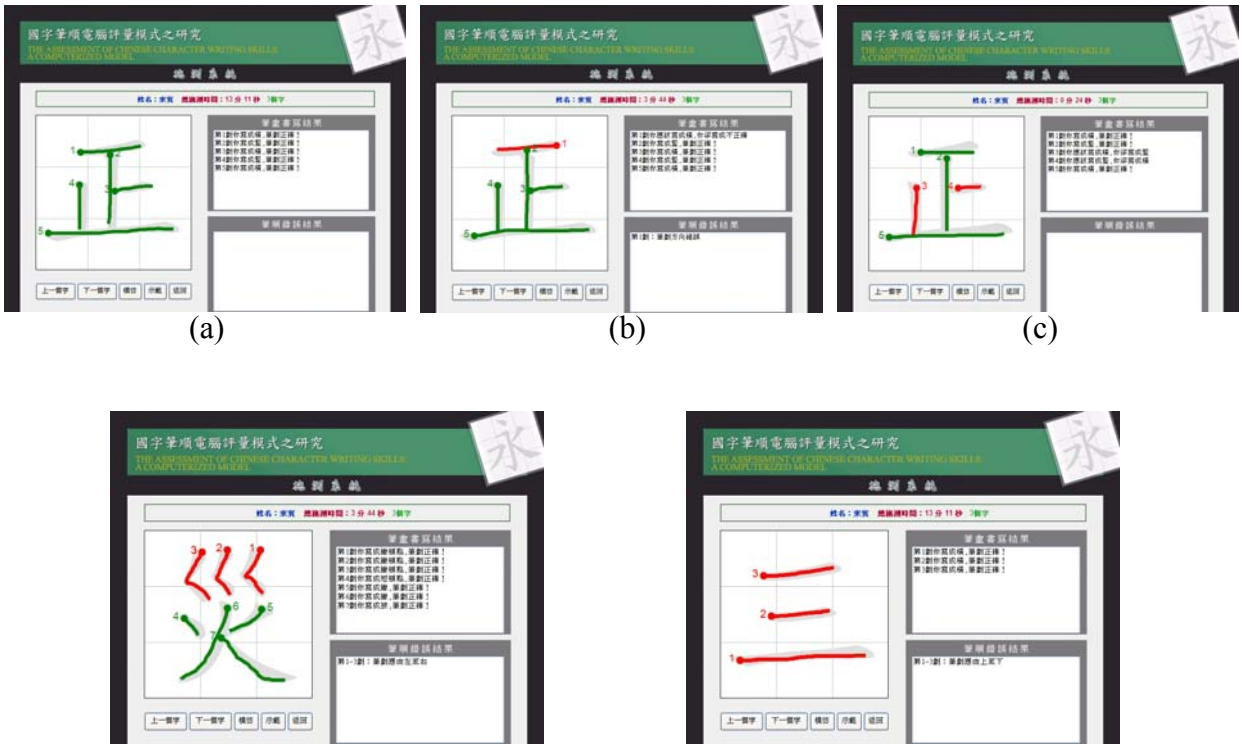
Experiments for stroke order recognition

We only show the results related to stroke and writing order here. The system inspects whether each stroke the examinee writes is correct or not and also gives some explanation. Take "正" as an example, and its correct writing is shown in Figure 10(a).

Appearance is correct, but the writing direction is wrong: shown in Figure 10(b), the first stroke should go from left to right, but the examinee wrote it from right to left. The system displays: "The first stroke héng, Incorrect Stroke Direction!"
Wrong stroke: as in Figure 10(c), the third stroke héng is written into a shù stroke. The system displays: "The third stroke héng you wrote it as shù and it is incorrect!"

It examines the relationship between the strokes, whether or nor the strokes be in their position. It is an important key for whether or not the Chinese character is written correctly. Take "災" for an example and the incorrect writing is shown in Figure 10(d).

It should be in their position, but it is not: shown in Figure 10(e): there is nothing wrong in each stroke of "三", but the second stroke and the third stroke should be under the first stroke but it is not. The system displays: "The second and third stroke héng the shapes are correct, but you did not write upper the first stroke and you should write them under the first stroke!"



(a) (b) (c)

(d) (e)

Figure 10 Results for the stroke order recognition

Results for the overall assessment

When a student finishes writing a Chinese character, the system will evaluate the character using 5-star. The displayed message includes examinee's name, the testing time, number of test words, the names of each stroke, individual assessments of each stroke, and error message. If a character is written by the wrong types of strokes, the system will present the wrong usage assessment in red as a warning to user. If the total number of strokes is wrong or a character is written in a wrong order, the system will output a "wrong" message. Taking the character "災" as an example, the system result is as displayed in the Figure 7. When an examinee finishes the test, the system will display the assessment list and there are two types of lists, one for student's edition and the other for teacher's version which are shown in Figure 8 and Figure 6 respectively.

3. Conclusions

The main purpose of this prototype system is to assist teachers real-time assess the stroke order of students' hand-writing. It solves the problem the paper-based test fails to accomplish by recognizing the stroke order and the total number of strokes. It also helps teachers know their students' learning condition, and reduce their teaching load.

Addition to being an assessment tool, the system can also be expanded as a learning assistant tool for learners. Furthermore, the system can also be adapted to the character set of other countries which have fixed strokes for each character.

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