Character Recognition System Based On Android Smart Phone

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ABSTRACT : *In this paper, we propose the character recognition method using optical character reader technology for the smart phone application. The camera within Android smart phone captures the document and then the OCR is applied according to language database. As some language is added to the database, the character of the various languages can be easily recognized. From simulation results, we can see the results of tests in English, Korean, Japanese, Chinese recognition.*

Keywords: Character recognition, Smart phone, Picture Quality

I. INTRODUCTION

Current OCR (optical character reader) technology [1-6] is widely applied to Zip recognition, product inspection and classification, document recognition, vehicle number recognition, drawings recognition, slips and checks automatically entering. OCR technology in the United States of America was finished in one-stage from starting in the 1950s to early 1970s. In the 1980s, two-stage neural network and VLSI design were progressed. OCR technology of Japan began to develop Zip automatic recognition device in the 1960s. Since 1966, Pattern Information Processing System project became the instrument of development by participating many companies.

On-lain OCR research to recognize at the same time with handwriting was the first attempt in 1959. There are many character recognition system such as mail sorter of Germany's Siemens, auto-inspection system of Japan's NEC, face, fingerprint recognition, document processing system of USA's National Institute of Science and Technology, the field of artificial intelligence, document pattern recognition / analysis, automatic processing of checks, number / word / string recognition of Canada Concordia University.

Most of the character recognition program will be recognized through the input image with a scanner or a digital camera and computer software. There is a problem in the spatial size of the computer and scanner. If you do not have a scanner and a digital camera, a hardware problem occurs. In order to overcome the limitations of computer occupying a large space, character recognition system based on smart phone is proposed. Character recognition software developed by smart phones with an emphasis on mobility and portability, spatial, hardware, financial limitations can be solved. But because the performances of smart phone and computer are different, the speed of massive character recognition is slow. Hardware speeds up the development of smart phones; this issue seems to be resolved as soon as possible. In this paper, the character recognition method is presented by using OCR technology and smart phone.

The organization of this paper is as follows. Section II provides the proposed character recognition method. Section III shows the simulation results of the proposed method about recognition rate for various languages. In Section IV, we summarize the main results.

II. PROPOSED CHARACTER RECOGNITION METHOD

In order to create a character recognition system based on Android smart phone, Tesseract-OCR [2] and Mezzofanti were used. Tesseract-OCR 2.03 version supports some languages such as English. From the 3.00 version, the Korean language is supported. It internally utilizes the image processing library called as leptonica. Tesseract-OCR is used in AOSP (Android Open Source Project) and eyes-free project. Mezzofanti is open-source Android Appication. It recognizes the characters in the image taken from the camera by using the Tesseract library. The app currently is in version 1.0.3 and uses Tesseract 2.03 version, so it has the disadvantage that does not support many languages recognition. Therefore, we implement Mezzofanti as Tesseract 3.0 version. Tesseract 3.0 is build to NDK and then the source code of the packages associated with the Tesseract is downloaded. Mezzofanti source should be modified. Eclipse or Ant is used to build Mezzofanti.

Mezzofanti application and dictionary and pre-learning data files have to be installed. Mezzofanti for Eclipse or Ant is to build, and installed in Android smart phone. Mezzofanti and Tesseract can add simply a language that is not supported by default; the database only for that language can be easily applied. Proposed system can support full mode and line mode. Full mode is to be recognized for the entire document, and lines mode can be recognized for one line of document. The case of the character misrecognized in results screen can be modified separately; it can increase the recognition rate.

Fig.1 shows the screen shots for the proposed recognition system based on smart phone.
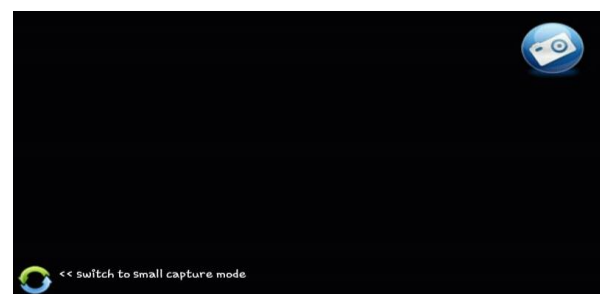
(a) Full mode

(b) Line mode

Fig 1. Screen shots for the proposed recognition system based on smart phone

button : Line mode and Full mode can be changed. In line mode only recognizes the letters inside the white area. Recognizing the character of the white areas, then move on to the results screen.

button : Recognize the letters of the screen.

The recognition result is shown as follows. Fig 2 shows original document with English language. After being captured by smart phone camera, the data is processed by binarization for object segmentation. Then we can see the recognition results on the screen of smart phone as shown in Fig. 4.
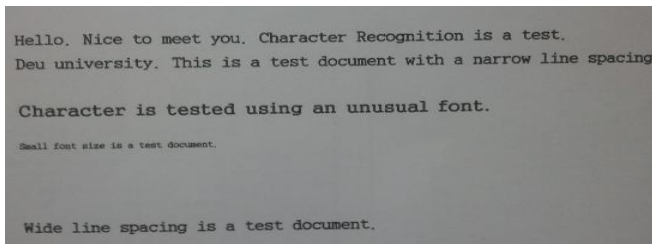

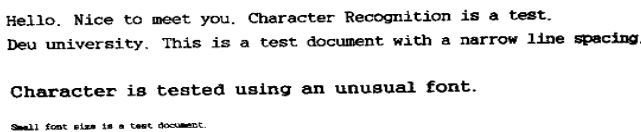Fig. 2. Example of original document for recognition
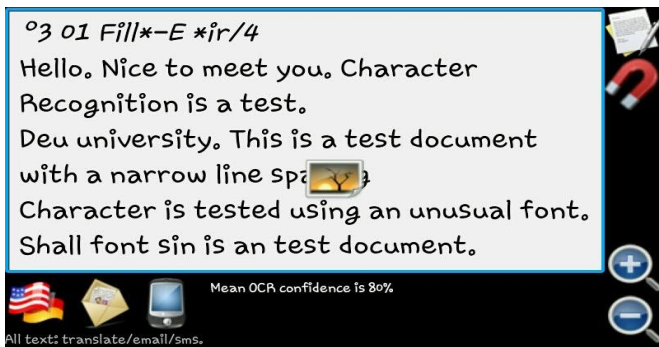

Fig. 3. Binarization of captured data

Fig. 4. Screen shot of an example of recognition result

III.   SIMULATION RESULTS

For performance of recognition, we simulate the proposed character recognition system to various characters such as English, Korean, Japanese, and Chinese.

We calculate the recognition rate (R) as performance criterion of recognition;

$$R = \frac{\text{Number of correctly recognized character}}{\text{Total number of character}}$$

1) English
English language was recognized relatively high. We can see the recognition rate from the Table I.

Table I. Recognition for English

Document type	Number of characters	Recognition rate
Courier	20	82.7 %
Dark lighting	10	13.1 %
Tilt	7	66.4 %
Special fonts	5	9.3 %
Small font size	5	54.2 %
Wide letter space	14	75.1 %
Narrow letter space	14	51.8 %

Because English is the completion character, this reason seems to affect recognition rates. Result of testing in a dark place is not good. The following test was tilted letters. If we exceed 30 ° inclined angle of characters, the recognition success rate was too low. So, the characters of 10 ° ~ 30 ° were tested. The case of a sentence of less than 30 ° was not recognized satisfactorily but recognized in some degree. Spatial fonts are required according to the shape in the font database. A relatively simple form of the character in the simulation of the character size was accurately recognized, but the case of 'Q, R, G, M' seemed to be difficult to recognize. A broad statement of the characters interval showed good result instead of relatively narrow letter spacing.

2) Korean
Table II shows the recognition rate for Korean language.

Table II. Recognition for Korean

Document type	Number of characters	Recognition rate
Courier	20	65.4 %
Dark lighting	10	5.2 %
Tilt	7	43.1 %
Special fonts	5	4.8 %
Small font size	5	44.2 %
Wide letter space	14	64.7 %
Narrow letter space	14	39.8 %

Test results showed good recognition results. Character recognition rate was high for relatively simple characters consisting of consonants and vowels. Character combination of Consonant + vowel + consonant into 3 pieces showed less recognition rate, depending on the form of the characters. According to the intensity of the light, the results were similar to the English test. Similarly, the slope of the characters beyond 30 ° was difficult to obtain good recognition rate. Some credibility to test unusual fonts could fall. Unusual font standards were vague. Recognition success rate was low. The end of characters are made up of straight lines gave satisfactory recognition results but special fonts were difficult to be recognized. Fonts and characters in order to recognize should be added to the database for each font. The sentence of a wide letter spacing was recognized without difficulty, but for a sentence of between narrow characters, depending on the spacing between the characters, the result was much different. Test showed slightly different

results, depending on the characteristics of each character. The character having the white space to the right of the letters such as " ㅏ, ㅑ " showed some results, but vice versa was somewhat different.

3) Japanese
Table III shows the recognition rate for Japanese language.

Table II. Recognition for Japanese

Document type	Number of characters	Recognition rate
Courier	20	58.8 %
Dark lighting	10	6.2 %
Tilt	7	31.5 %
Special fonts	5	12.1 %
Small font size	5	20.3 %
Wide letter space	14	49.2 %
Narrow letter space	14	35.9 %

The case of Japanese character is also tested under the same conditions such as Korean, English. Testing fonts are Times New Roman, Courier. Japanese forms a completion character as Hiragana and Katakana or a combination character as Kanji. So the recognition rate depends on the combination of recognized characters. Completion characters such as Hiragana and Katakana showed a high recognition rate. However, Chinese characters that are diverse in form had a problem to be recognized. Except in the case of the simple Kanji, Kanji gets complicated higher, recognition rate dropped accordingly. The number of Japanese Kanji was much smaller compared to the comparison of Chinese Kanji. Nevertheless, similar to the appearance of a lot of Kanji, this problem seems to have no other choice. Recognition results showed the same results that are similar to the previous simulation of Korean, English. Chronic problem was still at dark lighting, tilted characters. Specially it was difficult recognize the Kanji. Simulation according to the font size was also dropped quite a bit from the Kanji recognition. The spacing of letters has yielded good results in relatively, it still seems to recognition success rate varies depending on the form of the Kanji.

4) Chinese
Table IV shows the recognition rate for Chinese language.

Table II. Recognition for Chinese

Document type	Number of characters	Recognition rate
Courier	20	41.4 %
Dark lighting	10	3.8 %
Tilt	7	25.2 %
Special fonts	5	-
Small font size	5	11.3 %
Wide letter space	14	40.0 %
Narrow letter space	14	17.9 %

Recognition Chinese Kanji was tested under the same conditions for other languages. Chinese recognition test were progressed in Chinese Simplified character based on such as Times New Roman, Courier fonts. Tesseract database was used for Chinese Simplified testing. Chinese character forms of Korean similarly, but the number of combinations of letters surpasses number of characters for each of Korean consonants, vowels. Documents of Courier, wide margins between characters, and simple form were similarly recognized relatively good. Because Kanji is complex, even if successful, the recognition rate was not high.

IV. CONCLUSION

In this paper, character recognition system was implemented by using the Android smart phones. The implementation process of the system was described to recognize the characters in the document using the camera screen.

Photo data taken by a smart phone can be compared with the database of the system, then the characters can be recognized, the recognized character can be created to a text file to take advantage of the as applications of the Internet and pre-retrieval and various strategies Smart phones character recognition system does not need hardware such as a computer or a scanner. Therefore, there are the advantages that the recognition cannot be spatially restricted and simple character recognition is possible.

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