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Identification of Vehicle Plate Number Using Optical Character Recognition: A Mobile Application

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ABSTRACT

Resident's vehicles in some institutions have to be registered to maintain traffic safety. Penalties should be imposed if residents break traffic rules. Most of the time, the vehicle owner's information is difficult to access making the penalty registration process complicated. An effective penalty registration process is required to make the process easier for security officers to give notice to the residents who have committed traffic offenses. A mobile application is proposed to recognize vehicle owner information. The proposed application uses optical-character-recognition (OCR) technologies that can facilitate the process of recognizing vehicle's registration number in order to obtain owner information and use the information to enrol the penalty. The proposed application recognizes the vehicle registration number or sticker serial number to access the owner information. For evaluation of the proposed application, a user study was conducted by asking the users to use the application and answer the questiuonnaire. The findings revealed that average score of 77 of the respondents agree in terms of satisfaction and adoption of the application to be utilized in some institutions. The proposed application reduces the paper work of security officers and makes them more efficient.

Keywords: Database management system, Number plate recognition, Optical Character Recognition

INTRODUCTION

Violation of traffic rules and regulations especially in third world countries is an area of concern (Krishnakumar, 2014). In this context, identification of vehicle owners' information is a difficult task and to gain access to vehicle owner data quickly is important. To improve the efficiency of tracking vehicle owner's information, an application to automatically track vehicles plate number (ANPR) using

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optical character recognition (OCR) in real time is proposed here. OCR technology is used to detect the characters of the vehicle registration number and display the vehicle owner information on the screen.

Besides the function to perform current penalty check, a module and database are integrated into the application to allow the user to check previous penalty and obtain vehicle owner's information.

OCR or Optical Character Recognition automatically allows recognizing of characters through optical mechanism (Ravina Mithe, 2013). Using digital camera, OCR can convert various types of documents such as PDF files, images and paper documents. OCR often has defects such as distortion at the edges and dimmed light, making it difficult for most OCR applications to correctly recognize the text (Ravina Mithe, 2013). The application proposed here seeks to recognize vehicle plate number using OCR.

The Automatic Number Plate Recognition (ANPR) is a mass surveillance method that uses optical character recognition technology to capture images of license plates on vehicles (Badr, Abdelwahab, Thabet, & Abdelsadek, 2011). In 1976, ANPR was invented at Police Scientific Development Branch in UK. Over the last decade, ANPR gained much interest along with the improvement of digital camera and computational capacity. It automatically extracts and recognizes vehicle number plate's character from an image (Qadri & Asif, 2009). There are various applications that use ANPR system to recognize plate number in specific area such as automatic parking attendant and road electronic toll. This kind of application usually uses digital camera to track vehicle plate number.

Instead of digital camera, a mobile device can be used to recognize plate number. There are several mobile applications that are used to recognize plate number such as, UIT-ANPR, ANPReader and CheckCar Lite. Table 1 shows the applications of car plate number recognition.

Table 1
Comparison of ANPR applications

Applications / Features	UIT-ANPR	ANPReader	CheckCar Lite
Mobile Interface	Simple and less user friendly	Interesting and user friendly	Simple and user friendly
Content	Recognize plate number and display the character on the screen	Recognize plate number and display the character on the screen	Recognize plate number and display the save the data
Target User	Open to Vietnam and Europe surveillance	Open to UK surveillance	Open to UK surveillance
Databases	No	No	Yes
Language	English	English	English
Recognition Accuracy	Lack of accuracy	Accurate and faster	Accurate if mobile camera focus on the image
Internet Usage	Not necessary	Not necessary	Yes

Tesseract is an open source optical character recognition engine. It was developed at HP in between 1984 to 1994. Tesseract improved and modified accuracy in 1995. In 2005, tesseract has been released in open source by HP and available at http://github.com/tesseract-ocr (Ravina Mithe, 2013).

Tesseract works independently and developed as Page Layout Analysis Technology which search and find the zones for recognition on the document images. Hence Tesseract accepts input image as a binary image and can handle traditional- Black on White text and also inverse- White on Black text. Outlines of components are stored on connected Component Analysis. Nesting of outlines is done to form a Blob. Such Blobs are organized into text lines. Text lines are analysed for fixed pitch and proportional text. Then the lines are broken into words by analysis according to the character spacing. Fixed pitch is chopped in character cells and proportional text is broken into words to definite spaces and fuzzy spaces. Finally, Tesseract resolves fuzzy spaces. To locate small and capital text Tesseract checks alternative hypothesis for x-height (Ravina Mithe, 2013).

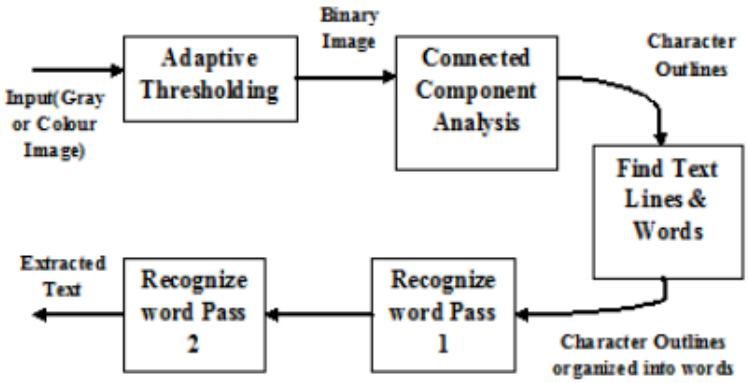

Figure 1. Architecture of Tesseract (Ravina Mithe, 2013)

GOCR is an OCR (Optical Character Recognition) program, developed under the GNU Public License. This engine converts scanned images of text back to text files. Joerg Schulenburg started the program, and now leads with a team of developers. GOCR can be used with different front-ends, which makes it very easy to port to different OSes and architectures. GOCR can open many different image formats, and its quality has been improving almost on a daily basis. GOCR is a simple and fast engine which does not require any training data and recognition process needs two passes. In first pass, entire document is called and in second pass the unknown characters are called (Dhiman & Singh, 2013). GOCR claims it can handle single-column sans-serif fonts of 20–60 pixels in height. It reports trouble with serif fonts, overlapping characters, handwritten text, heterogeneous fonts, noisy images, large angles of skew, and text in anything other than a Latin alphabet. GOCR can also translate barcodes.

ABBYY FineReader is an optical character recognition (OCR) software that provides unmatched text recognition accuracy and conversion capabilities, virtually eliminating retyping and reformatting of documents. Intuitive use and one-click automated allows tasks

to be completed in fewer steps. Almost 190 languages are supported for text recognition, more than any other OCR software presently in the market. FineReader converts scanned paper documents, digital images of texts and image-only PDFs into actionable formats such as Microsoft Word, Excel or searchable PDFs, enabling user to quote or entirely reuse text and table content without retyping.

FineReader software is powered by award winning ABBYY OCR technology. OCR, uses intelligent algorithms that convert images into editable text, preserving the original layout and formatting of the initial document.

There are many OCR applications which use tesseract OCR engine to recognize characters. This study explained some differences between them in the "Play Store" which used OCR technology to recognize characters. There are three applications: OCRTest, Character Recognition and Text Fairy. Table 2 below is a comparison between three OCR applications that have been reviewed.

Table 2
Differentiation of existing OCR application

Application / Characteristic	OCRTest	Character Recognition	TextFairy
Interface	Simple and straight forward	Interesting and user friendly	Simple and user friendly
Functionality	Translation	Recognizing vehicle registration number and display it on screen	Recognizing vehicle registration number and save it in database
Main Language	English	English	English
Accuracy of Recognition	Accurate	Accurate and fast	Accurate
Internet needs	Internet connection is not necessary	Internet connection is not necessary	Internet connection is not necessary

MATERIALS AND METHODS

OCR technology allows the conversion of scanned images of printed text into text or information that can be understood or edited with android mobile phones. Optical character recognition also has potential in converting images of handwritten, typewritten into machine-encoded text. Open source OCR software called Tesseract as a basis for Optical Recognition project is considered as the most accurate free OCR engine in existence. This paper uses Tesseract OCR engine to perform plate number recognition.

Automatic plate number recognition is necessary especially in maintaining traffic security. For this reason, this research proposed optical character recognition (OCR) system based on android mobile phone. This system allows the user to recognize vehicle plate's number and display the information of the owner in real time. A database is created for this application to store details of a vehicle's owner. In this paper, character recognition method is presented by using OCR technology and android phone with higher quality camera. Figure 2 shows the architecture of the mobile application to perform OCR task.

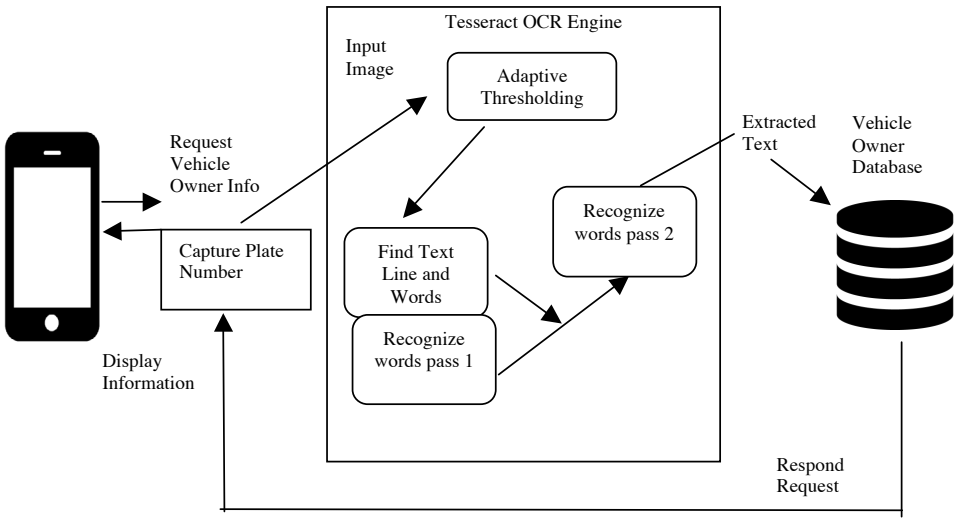

Figure 2. OCR application architecture

Figure 2 shows that a mobile phone will point at a plate number to request the vehicle owner information. When the number is recognized, Tesseract OCR engine will process character extraction activity and the result matched with the data that has been saved in the database and displayed on the mobile phone screen.

System development process will involve writing a program code using Eclipse Luna which involves the installation of software such as Android SDK, Sqlite, Android Development Tools and NDK. This application will use open source OCR engine which is OCR Test developed by Robert Theis. The source code is available from the web site Github. OCR test is a trial application for optical character recognition on Android. Proposed application uses Tesseract OCR engine containing OCR functionality which can convert the printed text to a digital text using Android smartphone (Theis, 2014). By default, OCRTest open source project does language translation. For the proposed application suggested in this paper, language translation functionality is not required. For this reason, we have reconstruct the OCR architecture which is instead of language translation, user now can visualize the data of car's owner after they recognize the plate number and match the recognized character with the data available in database. The main functions of the proposed OCR application are mentioned below.

To log into the system, the matrix ID and password will be given and once the user logs in the data will be checked with the database. Vehicle registration number recognition will occur when users point the device in the direction of the desired vehicle plate number. Character extraction will begin when the character segmentation is done. Once extraction of characters is performed, it will be recognized and digital writing will appear on the top left of the mobile phone screen.

When the recognition process has been successful, the set of characters will be sent to the database to match the characters obtained with the vehicle plate number registered in the database. Once the data is matched, details information of the vehicle owner will be displayed on the mobile phone screens.

The interface plays an important role to make user easier to interact with the application. Each interface has a different role. The proposed application provides user-friendly and creative interface which assists the user in accordance with the instructions and meet the criteria set by the application. Figure 3 shows the interface for the main function in application.

Figure 3. Application Interface

RESULTS AND DISCUSSION

This section presents the results obtained during the experimental process. Experimentation was done through questionnaires distributed to ten security officers at University Kebangsaan Malaysia (UKM). Through this survey, this research examined the adoption and satisfaction of users to use the device for tracking the vehicle owner information in UKM. Investigation results indicate acceptance of the application.

The solution to test the degree of satisfaction of users as well as the usability of the application used System Usability Scale (SUS) test, questionnaires consisting ten-item scale with five-value scale, five of them replied positively and the other five is negatively. SUS is a Likert Scale (Brooke, 1996). The results obtained from the questionnaire can be used to determine the quality level of the application in terms of usability. Table 2 shows the average score obtained from the experiment using SUS test.

Table 3
Experiment result

No.	Participant	SUS Score	Score (0-100)
1	Security officer 1	32	80
2	Security officer 2	31	77.5
3	Security officer 3	28	70
4	Security officer 4	30	75
5	Security officer 5	22	55
6	Security officer 6	34	85
7	Security officer 7	30	75
8	Security officer 8	22	55
9	Security officer 9	23	57.5
10	Security officer 10	33	82.5
11	Security officer 11	35	87.5
12	Security officer 12	34	85
13	Security officer 13	33	82.5
14	Security officer 14	35	87.5
15	Security officer 15	32	80
16	Security officer 16	30	75
17	Security officer 17	36	90
18	Security officer 18	34	87.5

From Table 1, an average score 77 was obtained. SUS scores have a range rate from of 0 to 100. In this paper, the calculation of SUS score in (Brooke, 1996) was used. The average System Usability Scale score is 68. If the score is under 68, it is considered below average and if the score is above 68, then it is considered above the average (Lewis & Sauro, 2009). Since the obtained result average was 77, the application acceptance was above the average and it was considered good. Based on the results it can be considered that the application provides a good result to gain user satisfaction and adoption to use this application. Eighteen security officers in UKM aged 35-55 years had to answer the questionnaire and most gave positive comments regarding the application.

CONCLUSION

This research presents a mobile application to recognize vehicle owner's information by tracking vehicle plate number using optical character recognition. The proposed application used a series of image processing techniques for identifying the vehicle owner's information stored in the database. Experimentation was performed for plate number recognition application which allows the user to determine vehicle ownership details. The proposed application however still needs to be improved in terms of speed and robustness.

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