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USING TEXT FROM THE BOOK SPINE AS A MARKER FOR AUGMENTED REALITY IN LIBRARY BOOKSHELF MANAGEMENT SYSTEM

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***Abstract*:** *Looking for the book in the library may seem to be a hard work for patrons but in fact, it is even harder for librarians, who have to organize the book so that it is convenient for the patrons. Usually, when patrons took the books out from the shelf they tend to put them back to the shelves without seriously put them back exactly where they belong which cause problems to the next patrons who use OPAC searching for the book. So it is the job for the librarian to carefully check for misplacing books and this process is usually been done manually. To speed up the process, some researcher suggesting that Augmented Reality technology can do the job. Augmented Reality (AR) is the process of integrating computer generating objects and real-world environment. Since AR need the exact location to place the virtual object, these can be done by 2 techniques i.e. marker-based AR and markerless AR. Using the marker-based AR, the markers have to be created and attached to the books. For medium and large libraries, where there are more than half million books, this is a tedious work and need a lot of money. To avoid this situation, we have conducted an experiment in which the image on the book spine is used as a marker, so no need in attaching anything else on the book. Image processing technique is used to localize the call number on the book spine and optical character recognition is introduced to get the text out. These image and text are then used as a marker for AR. Results from the experiments showed that text on the book spine can replace markers for bookshelf management in the libraries.*

Keywords: *Bookshelf Management, Augmented Reality, Book Spine*

Introduction

When the library user or patron wants to find a book, he or she will search for the book by using OPAC. OPAC stands for Online Public Access Catalogue which is the application that helps the patron to search for the book while we can provide some searching criteria such as author's name, year of publication, book's title, and keywords. The search result is information of the books that satisfy the criteria. From this result, we will get the call number for each book. The patron will use this call number to find the book on the shelf. The librarian put the book on the shelf according to the book's call number. The call number is a book identifier that the librarian will provide this unique value to every new book before it can be placed on the bookshelf. Library of Congress Classification (LC) is the popular classification using in many libraries in order to provide a call number for each book as shown in Figure 1, in this research LC has been used.

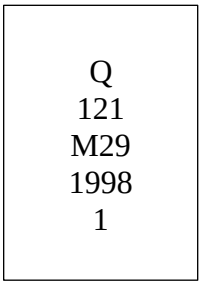

Figure 1: LC call number

Normally, librarians will put the return books back to the bookshelf as soon as they can. When these books were back on the shelf, the books should be placed in ascending order so the patron who looking for a specific book can easily retrieve it. But during library office hour, any patron can take the book off the shelf and might return that book back on the shelf. By doing this, the book might have been placed in an incorrect location so it is an unpleasant job for the librarian to scan the bookshelf to find the misplaced books. And if the librarian cannot find the misplaced books, there might be some complains from the patrons that they cannot find the books that the OPAC shows that are available in the library.

In this research, we propose a tool to identify misplaced book on the shelf by using call number of each book on the shelf. This call number is in text format and divided into a set of number and will be used as input for this research.

Related Work

Augmented Reality (AR) provides the environment of superimposed information that can be displayed with a real-world object. The applications using AR technology can be found in many areas such as education (Saidin et al, 2015), manufacturing (Chi et al, 2013), healthcare (Barsom et al, 2016) and library (Boonbrahm et al, 2014). In each area, the objectives of applying AR might be different, but most of them are focus on the superimposed information that will help in training.

For the library, AR can be used to provide extra information for either librarians or patrons depends on the tasks that they are involved. But both patrons and librarians are involved in the same task of finding books.

Besides using the call number to identify a book, libraries prefer some other type of information which can be identified automatically. In the past, most libraries used the barcode technology to identify the book and use a barcode scanner to capture the data. Due to some disadvantages of barcode system, some libraries have moved to RFID technology. These book identifiers are useful for the librarian at service desk where patrons borrow or return the books. But it cannot be designed to use at the bookshelf and even if it can be done, the cost of the RFID itself is expensive. At the bookshelf, the librarian job is to make sure that the books were placed on the right bookshelf and in the right order.

Methodology

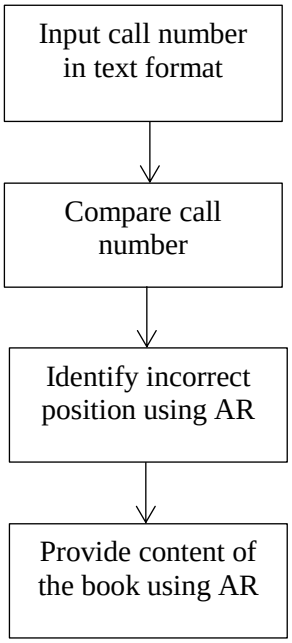

Figure 2: Process component

We propose the system that identifies the misplaced books on the shelf which consists of 4 processes as shown in Figure 2. The first process starts with obtaining call number of each book. The call number itself is divided into 5 parts which are book subject 1, book subject 2, first cutter, year of publication and copy number. This information are used in the second process to evaluate the correctness of the position of the book by adding the tag to it when it is compared with another book and so on as shown in Figure 3 and Figure 4. After the comparison process, the incorrect position is then highlighted for the user can easily identify which books should be removed from the shelf. The final step is providing more information for each book in case that the user may want some information before removing the book.

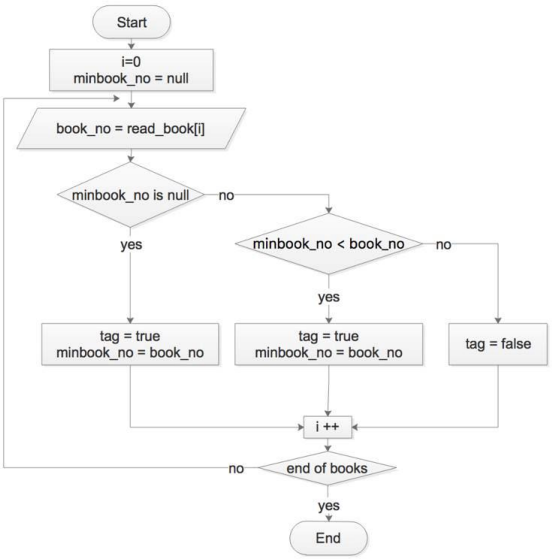

Figure 3: The comparison of call numbers from two books and put the tag identify the correctness

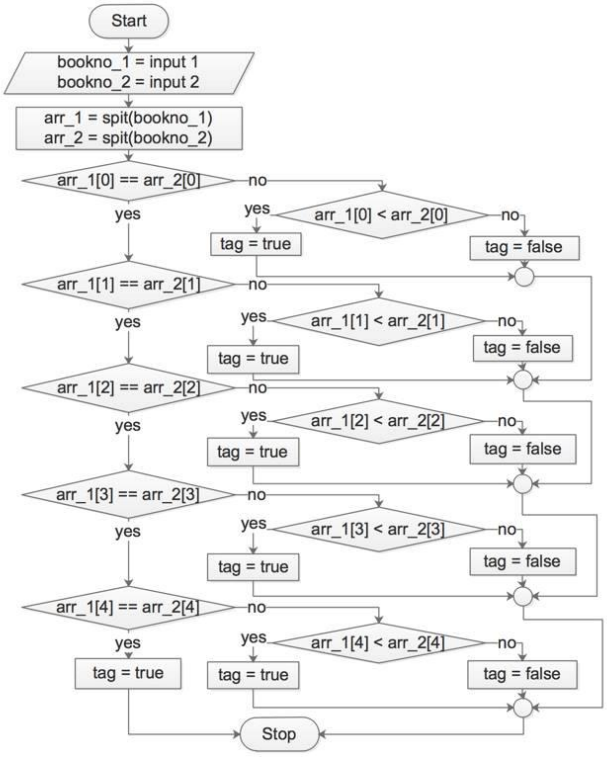

Figure 4: The comparison of call numbers according to the part of call number

Experimental Setup

In this research, Android tablet was used for book spine scanning. Image processing software and Optical Character Recognition (OCR) were used for subtracting the call number from book spine and converted them to text respectively (Sewata, 2016). AR application was created using Unity 3D game engine and Qualcomm's Vulforia AR platform. The application will compare the call numbers and display the result on the tablet. Output display will show which books were misplaced. With the application, user can also get more information about the book by selecting the icon showing the call number of the book.

Result and Conclusion

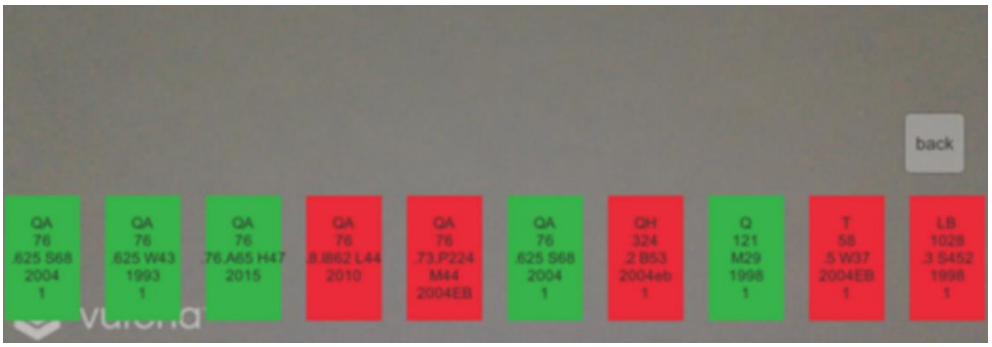

Figure 5: The information of correct and incorrect position

The experiment was tested by using 10 books on the shelf where the books were placed in different order in 35 test cases. The cases included the scenarios that there were no misplaced book, one misplaced book, and two to nine misplaced books. When it is found that the position of the book is incorrect, the superimpose information will be highlighted with red color and if the position is correct the color will be green. As shown in Figure 5, starting from position 0 to 9, from left to right, the incorrect positions are 3, 4, 6, 8 and 9 respectively. From this result, if a user wants to get more

information before removing the book from the shelf, the additional information can then be retrieved as shown in Figure 6.

Figure 6: Additional information of the selected book

From these 35 test cases, we then use confusion matrix as shown in Figure 7 provides the value of TP, TN, FP, and FN. The accuracy is calculated from (TP+TN)/(TP+TN+FP+FN) and it is equal to 100. The graph in Figure 8 shows the results of each test case that the algorithm can provide the correct results.

Class		Position identifying	
		Correct	Incorrect
Actual position	Correct	58.29	0
	Incorrect	0	41.71

Figure 7: The confusion matrix of misplaced book identification

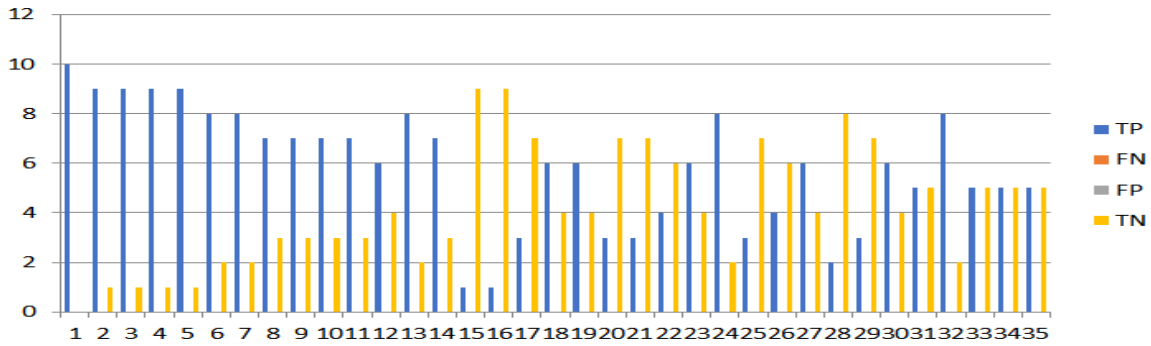

Figure 8: The results of each test case

This experiment was conducted under the assumption that the position of the first book is correct. In real life situation, it is possible that when someone returns the book to that position, this position might be the incorrect position. From the same 35 test cases with the different solution based on the assumption that the first position might not be the correct position since someone might put the misplaced book in that position. The confusion matrix in Figure 9 shows the result of the second experiment providing the accuracy of 0.76 which is lower than the first experiment and the values of each test case were shown in Figure 10.

Class		Position identifying	
		Correct	Incorrect
Actual position	Correct	52.57	18.29
	Incorrect	5.71	23.43

Figure 9: The confusion matrix of the second experiment

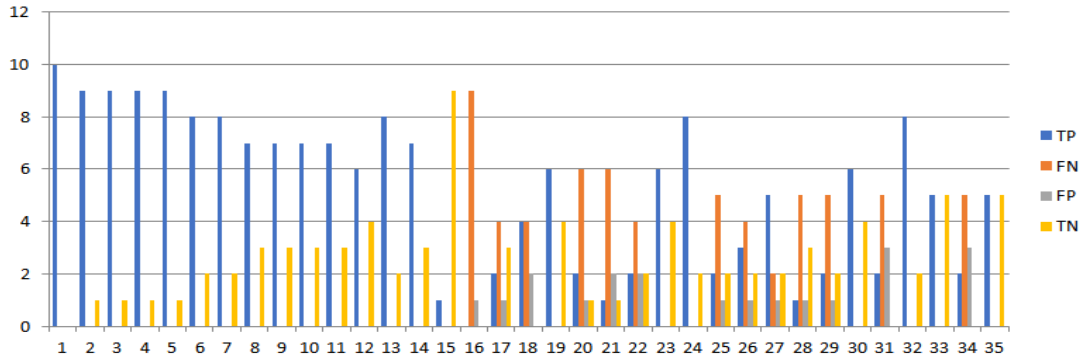

Figure 8: The results of each test case from the second experiment

From these experiments, we can see that the call number itself can be satisfied to be used as a marker for a book. It is unnecessary for the library to have two book identifiers which are call number and printed marker to put on the book spine. However, to identify the incorrect position of the book on the shelf, there were some cases that FP was high such as case 31 and 34. With such result, the application cannot help the librarian to identify the misplaced books because it showed that the position of the books was already correct. So it is required to add the extra feature to handle this scenario.

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