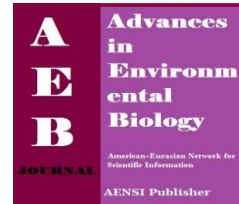




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Bookshelf Management Using Augmented Reality

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ABSTRACT

In the library, books are shelving by call number that based on classification standard. When books are returned from the patrons or when the books are taken from the shelf to read in the library, these books have to be put back on the shelf so other people who search for the books by using OPAC can find it as displayed in the system. Managing bookshelves in the library is quite a tedious job especially putting books into the right location on the shelves or checking the shelves for misplacing books. Usually these jobs are done by manual. In order to speed up the process, augmented reality is used as a helping tool. Augmented reality is the technique of applying virtual objects such as text, 2D or 3D objects on top of real image making it possible to display information of the books on top of the real books without touching the books. Better than that, it can display information on many books at the same time making it possible to track the misplaced books among the rest of the books on the shelves or telling which books have the same author. Using this technique need only tablet or smart phone, making it convenient not only for the librarian but also for user searching for the book as well.

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INTRODUCTION

Library plays an important role in the educational institute. It contains collections of book to support learning process of the institute. During the day, books can be removed from the shelves by members who want to read or borrow the books and these books have to be placed back into the shelf after usage.

Putting the books back on bookshelves generally time consuming and there are groups of people who waiting for this job done. For the patrons or library members who want to find the books that they want, they have to pick them straight from the shelves. When there are a lot of returned books, it will take couple of hours to put these books back to shelves. If the library have a lot of books, that means there are a lot of shelves for these books that the librarians have to wander around to put every books back to the shelves. Moreover, sometimes the book that placed back to the shelf might be placed in the incorrect position. It will results that we cannot find the book easily for we don't know where this book is actually placed.

Today, the libraries use either barcode or RFID to identify the books. With barcode, identification of the book can be done correctly using scanner but it can be done one book at a time, so it is not convenient. Using RFID is very convenient because many book can be read at the same time and misplace book can be identified easily. The problem with using RFID in the library is the cost of RFID itself which is still too high especially for the big libraries with millions of books. With the marker-based Augmented Reality Technology, identify the misplaced book can be done easily using smart phones or tablets.

Augmented reality (AR) is the technology that placed virtual objects on top of real space. The virtual objects can be text, picture, video or 3D models. Augmented reality can be categorized into 2 types i.e. marker-based AR and markerless AR. Marker-based AR uses physical-world symbols (2D printed image, for example) as a reference point for virtual model or image to be overlaid on top of real space. Markerless AR, by contrast uses a combination of an electronic devices' accelerometer, compass and location data (such as the Global Positioning System – GPS) to determine the position in the physical world that the virtual model or image can be displayed over the real scenery. For the case of bookshelf management, marker-based AR will be implemented.

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2. Literature Review:

Library has been using barcode for identify books for a long time because of the financially setup. Unfortunately, the limitation in security and the inefficient in data reading make some libraries move to others system such as RFIDs even though they are more expensive. Shien-Chiang Yu [3] analyzed feasibility studies regarding to the structure and application of the RFID system. He stated that the first thing that should be considered is applying RFID to specific collections in order to economize on the expense. Employing RFID systems for book's inventory, security, and gathering data for statistics calculation is possible. There were the studies on using RFID such as Juels, Ari. [2] surveyed recent technical research on the problems of privacy and security for RFID and Shian-Chiang Yu [4] investigated how to extend RFID applications using the limited funds and budgets in libraries. He would like to know whether RFID can replace barcodes and magnetic strips for security control and collections management or not. He found that the application not only estimated the benefits in advance and lower the risk of failure setups, but it also provided innovative library services.

The fact that RFID is still expensive, make some researcher looking for a new way to identify books. With the advancement of mobile devices and computer graphics make it possible to use augmented reality as a new way to identify the books. Chen, D. [1] develop a new mobile augmented reality system for book spine recognition. With this systems, the book's identity, prices from different vendors, average user rating, location within the enclosing bookshelf can be identified. In this research, we have investigated how to use AR in bookshelves management i.e. reduce shelving time, checking inventory and etc.

3. The Methodology and Model:

In order to understand how to identify the book located on the shelf in the library, we have to understand how they were classified. The correct position for each book is based on call number on the books. Call number is a list of characters that describe the book. It is given by librarian when obtaining a new book item. Call number has unique value. For the Library of Congress Systems (LC), the number or character string is divided into six parts, one part per line.

The first two lines contain book's subject where the first line is alphabetical data and second line is numerical data. The third line is cutter line which contains data that can be mixed between alphabetic and numeric. The fourth line is year of published. The fifth line contain volume, while the last line contains copy number or item number.

On each shelf the book is placed ordered by call number as shown in Figure 1. Firstly order by the first line and second line of call number. Then it is order by the value of cutter which is in the third line. If the value of the cutters are the same, the year of published on the fourth line is then used to compare.

Since it is possible to compare from the first line to the sixth line, the maximum comparison is six times while for best case the comparison is done just once on the first line.

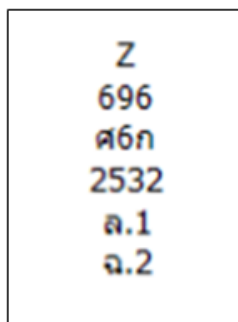


Fig. 1: Call number.

4. The experiment:

In order to use augmented reality marker to replace barcode or RFID, we have designed 2 sets of markers representing 2 bookshelves as shown in Figure 2.

Each set have markers with different call number representing each books. For example set A represent one categories and each marker represent each book with specific call number (Figure 3).

If the book is shelved correctly as shown in Figure 4 (a), the display on smart phone or tablet (both Android and iOS) will show the green color which mean that they are in correct shelf and correct order. The display also show the call number of each book as well (Figure 4 (b)).

If the books are shelved in wrong order the display will show as in Figure 5

If the book are in different categories and also different order, display on devices can tell as well (Figure 6).

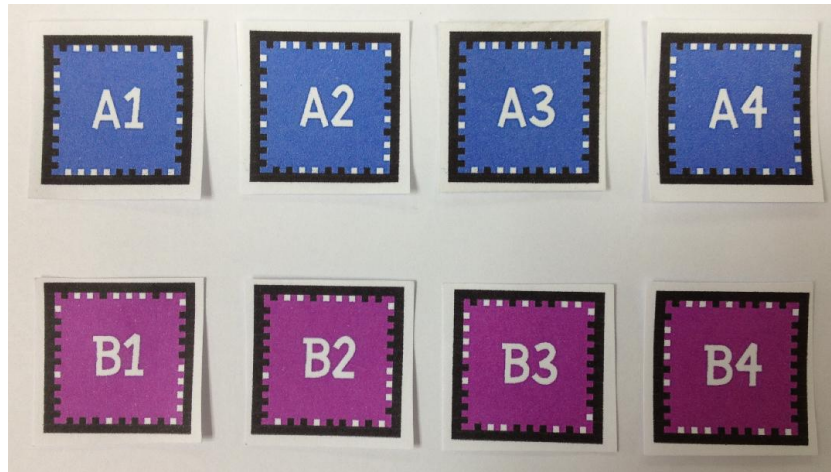


Fig. 2: Example of 2 sets of markers, each set represent different categories.



Fig. 3: Example of markers in the same category but have their own call number.

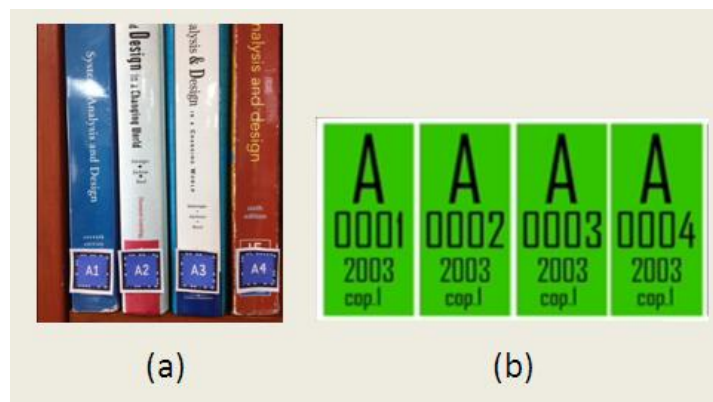


Fig. 4: Actual bookshelf (a) and the display on device (b).



Fig. 5: Actual bookshelf (a) and the display on device (b) with red color means misplaced.

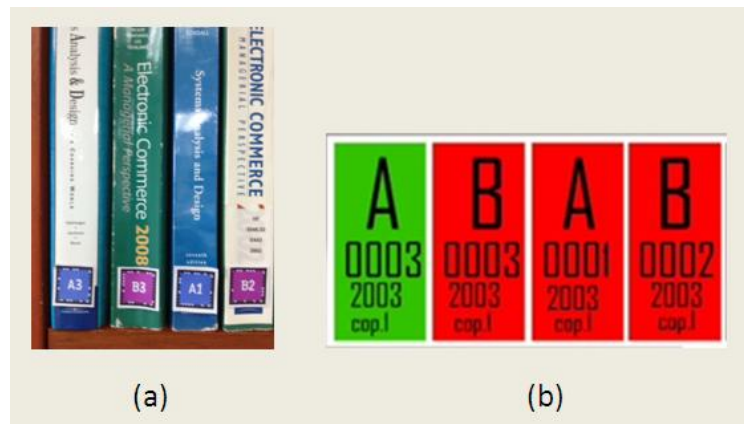


Fig. 6: Actual bookshelf (a) and the display on device (b).

5. Summary and Conclusions:

By using AR marker to replace barcode or RFID, we have found that searching for the books that were put in the wrong shelf or shelving the books in wrong order can be seen easily through the display device. The problem that we have found is that the marker must be big enough for the tablet or smart phone to identify them. If this system was used with all big book such as medical books, this problem will not occurred. From the investigation, we also recommended that this system is best suitable for the bookshelf that have the book that all look alike such as thesis which cannot be identified easily using our own eyes.

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