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Context-aware Library Management System using Augmented Reality

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Abstract

Mobile augmented reality has fuelled up the recent technological advances of smartphones technology. There are many areas in which mobile augmented reality is being used such as Navigation, Military, Medical, Gaming, Entertainment, library management etc. Augmented Reality is an emerging technology of Virtual Reality, involves knowledge about sensors, image recognition, computer vision, human-computer interaction, virtual reality, and many other areas. The key technologies include displaying, registration and tracking, interactive etc. The current world of augmented reality in Library management are lacking in context-awareness. Hence in this paper, we planned to focus on one of the major issue of automating Library application with the augmented reality software and we propose architecture for accessing the library books index data fetched from the unique visual code marker attached to each library book spine. Thus, simplifying the task of searching for a book and determine the proximity to the desired book. This implementation shows mobile augmented reality is a promising tool for library management.

Keywords: Augmented Reality, Library management, Marker detection.

Introduction

Smartphone devices are being used in the field to support a variety of occupations and scenarios. Due to the limited capacity of the human short term memory, we can only manipulate six or seven items concurrently [1, 2]. One particular domain in which this problem is evident is the library. In a library, contextual information is very important as books are organized in shelves based on subject. Further, books are constantly being moved, loaned, or misplaced. A library user without any additional support may find the task of searching for right books difficult, especially in larger libraries.

Presence of large numbers of books in a particular category, increase the difficulty of finding the book. Additional problems such as incorrect sorting of the books or books being misplaced within the library can also prove challenging. On the other hand, librarians are tasked with the job of stack maintenance. Stack maintenance refers to the re shelving of material that has been removed from a shelf, or shifting existing material within a stack to make room for new materials.

Research in the field of mobile Augmented Reality (AR) and agent programming may provide a solution for context-aware library management. AR is a novel technology that can be used to enhance a physical environment by overlaying virtual content through a visual interface [3]. While the technology has been available since the 1990s, the rapid advances in mobile technology over the past decade have provided powerful and convenient platforms for AR applications [4]. The major benefit of mobile devices for AR is that the technology is ubiquitous and easily accessible to consumers. An immediate benefit of AR technology for library management is that it can be used to replace the catalogue number with a simpler unique marker, for example a shape or a colour. Current catalogue numbers require users to scan a shelf and read several book spines to determine their proximity to the desired book. In contrast, an AR application could display a prominent marker over the spine of the desired book, thus significantly simplifying the task of searching for a book.

The aim of the research presented in this paper is to determine the benefits of a mobile library management system based on AR technologies. This paper is structured as follows. Section 2 provides the overview of AR and library management systems. Section 3 describes the research methodology. Section 4 explains framework of our proposed library management system. Section 5 describes the discussion of these results in terms of benefits and limitations. Finally, Section 6 concludes the paper.

Literature Survey

Augmented Reality:

An Overview.

Augmented reality (AR) can be defined as able to deal with the new information immediately direct or indirect therefore influence the physical real-world environment has been enhanced/augmented were by adding virtual computer-generated information to it [5, 6]. Also, the AR is defined by Azuma in 1997 [7]. AR brings the real and virtual items together in a real environment.

The goal of the AR is to make the life of the user easier through providing the virtual information to his adjacent environment as well as to any indirect view of the real-world environment like the live-video stream. The virtual reality or the virtual environment as named by Milgram engages users totally in an artificial world without seeing the real one. On the other hand, the augmented reality boosts the sense of reality through laying virtual items over the real world in real time. AR not only adds items in real word but also represents useful digital information in real world [5, 6].

AR-based Library Management system.

Libraries are another area in which the benefits of mobile AR have been considered. In a library, contextual information is very important as books are organized geographically based on subject and catalogue number. Further, books are constantly being moved, loaned, moved, or misplaced. Without additional support, a user may find the task of searching for books difficult, especially in larger libraries.

One of the important considerations for developing a mobile AR library management system is the simplifying the task of searching for a book and determine the proximity to the desired book. Commonly, books are organized in a vertical orientation with only the book spines visible to the library user. The method for tracking that has been used in library management is the use of markers. A study conducted in 2003 utilizes mobile AR on a touchscreen device to determine the current position of books on a shelf and aid users in returning books to the correct position on a shelf [8]. The system (named ARLib) uses frame markers attached to the shelves for tracking purposes. Further, the application stores a model of the library's shelves, positions of individual books and additional metadata. While ARLib can provide a good overview of the location of books, the system does have limitations. First, the application itself stores the entire model of the library so it may not be scalable to larger, real-world libraries. Another limitation is that the system does not know the actual location of the book only the position where it is supposed to be located. This means that if the book or other books are removed from the shelf, the information provided by the AR display may be confusing rather than helpful. A more recent mobile AR library management system that uses frame markers is ShelvAR, developed by the Miami University Augmented Reality Research Group [9]. ShelvAR exploits the markers' unique ID by placing a unique marker on the spine of each book. When the shelf is viewed through the phone's viewfinder, simple overlays indicate whether the books are in the correct position on the shelf. While ARLib uses markers for context-awareness, ShelvAR uses the markers to identify single books.

Fig. 1 Customized Visual code Marker 1and 2

Methodology

Visual code Marker detection.

The detection algorithm for the above code marker is depicted in the flow chart as shown in figure 2. The image is used to extract the Region of Interest (ROI) first. Then each ROI image is segmented properly and searched thoroughly. Afterwards, it is passed to the detection and identification module to look for a code marker and return the detailed location in image coordinates.

Displaying the Contents of the Corresponding Marker.
Given flowchart figure 3, shows how to create an image processing system which can recognize and interpret the Marker Code.

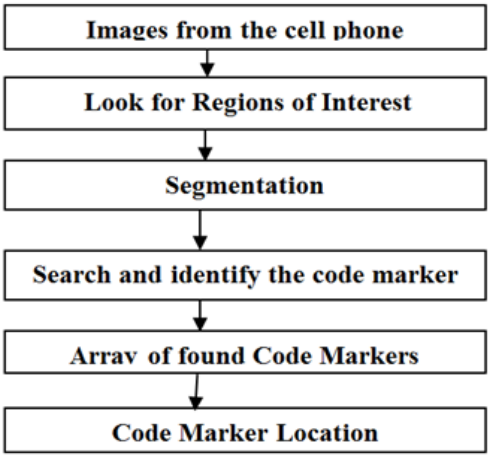

Fig.2 Overview flow chart for the whole process

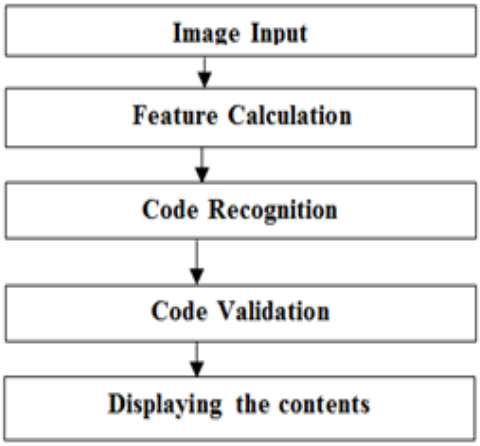

Fig.3 System flow for displaying the contents

The Customized Markers used on the Library Books will provide a unified way to identify the required data and further display the corresponding files attached to the Marker.

Framework
Our proposed framework for a library management system is based on mobile AR. This system processes two types of input data: library management system data and unique frame markers attached to book spine. Frame markers are further used by our

AR component to provide a visual connection to the environment, and display context-sensitive information accordingly.

In this project work, we present a digital image processing algorithm to detect visual code marker. The goal of the detection algorithm is to look for visual code marker on a 480x640 image captured by a camera phone or a 160x140 image captured by a Netbook webcam. The visual code marker that we consider is a 2-dimensional array. Array elements are black or white.

The markers are placed on the different books present in the Organizations' Library which are further scanned by the user using the Image Acquisition Device and the corresponding Contents' Page of the book will get displayed. The user can go through the contents of the desired book by placing the camera of the capturing device onto the Marker. The user can also check the Rating and the Feedback about the Book with the help of the Application made.

Fig. 4 Arrangement of Books with the Markers

Each book corresponds to a GUI (.fig file) in MATLAB. Each time the User points at the marker of the desired book, the marker is recognized in the database and the corresponding GUI file will pop up. Further, the user can scroll the Contents pages of the Book. The GUI of one of the books from the database is shown. The Database available in any library can vary from thousands to millions of books. Though making customized codes of such a large numbers of books may be cumbersome, but the availability of large number of symbols, alphanumeric, and digits will be helpful.

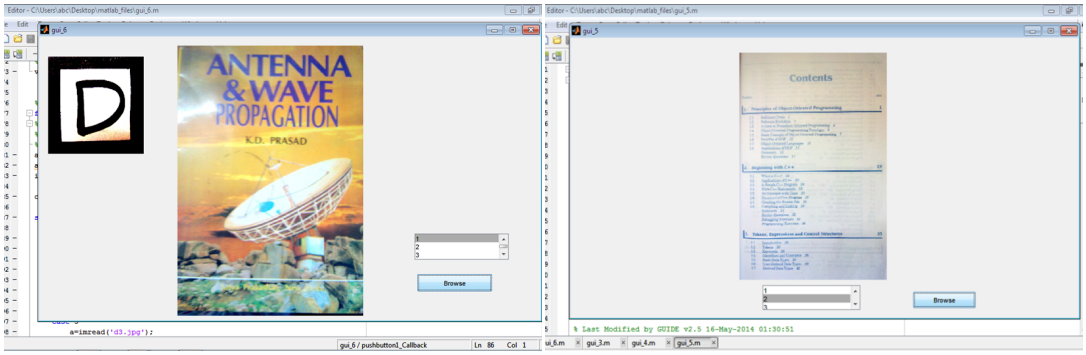

Fig.5 GUI – Example 1 and 2

Discussion

Benefits

There are benefits of using Library Management System supported by AR. It is accurate at providing information about the book in shelf in contrast to traditional method. This information can be highly valuable to both library users and librarians alike. While experienced library staff may have an increased ability to recognize a missing item. The library users will benefit from the speed of recognition provided while library staff may have an increased ability to recognize a missing item. Additionally, Library users can choose the best book by reading the reviews about the book. For this reason, we can conclude that the AR Based system assist in overcoming limitations in library-based tasks.

Limitations.

The fact that there are thousands of books present in a library, and a user must first locate the correct shelf before attempting to locate the desired book on that shelf. The search space of a real library is much larger, meaning that users are faced with hundreds of books on any given shelf, all contributing to the difficulty of finding a single book. In contrast, a small sample of 10-30 books may not prove to be difficult at all and result in faster response.

Deployment in real library.

Deployment and experimentation of this system was limited in scope. We used a very small subsection of a single library shelf (30 books), which in itself is not representative of a real world library. This prototype is not currently programmed to deal with hundreds of thousands of books, the technologies utilized (i.e. AR) are capable of scaling up to much larger sets of data. For example, marker systems (such as QR codes) can allow for hundreds of thousands of permutations, depending on the number of unique bits displayed in the marker. When using a mobile AR system it is possible for the user to view only a small amount of books at any given time.

Conclusion

In this paper, we aimed to implement the augmented reality to library management system. This was achieved through the design and development of a GUI. The final prototype will be able to assist with difficult searching for books task, determine the proximity to the desired book as well as provide context-sensitive information like content, author name etc. about books. It’s the faster method to achieve results, when compared to traditional methods and provided correct results all of the time, a better result than humans performing the task alone.

The project is architecture to implement an Application (Android Application for mobile/tablets and Windows for Laptops/PCs) to allow users especially students in Universities/Colleges to view the contents of the book without physically making contact with the book using Augmented Reality Technology. The Student needs to open the App using his/her Unique College ID Number. After successfully logging in, the user can access the device Camera (Capturing Device), scan the Code Marker on

the book and can View the Contents pages. After the implementation of the Application part, further provision for Rating and checking the reviews of the book provided by other students can also be implemented.

This implementation shows mobile augmented reality is a promising tool for library management. With further modifications, this system could provide an efficient alternative to the repetitive library tasks that are currently performed by humans.

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