

Implementing Virtual 3D Model and Augmented Reality Navigation for Library in University

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Abstract—The library is an important place for searching data in the university in form of both hardcopy and digital. In case of hardcopy form, users need to locate books or media which consume long time in finding what they want. To enhance efficiency in finding books in libraries, this study applied 3D and augment reality technology in searching for books. By developing a model system with 3D and AR technology to locate books on the shelves in Suan Sunandha Rajabhat University's library, this study found that the accuracy rate of the system was 96.5% and satisfaction rates of users in using 3D and Augmented Reality in the library was good level.

Index Terms—Augmented reality, AR, virtual 3D, navigation for library.

I. INTRODUCTION

The university libraries are an important data storage place for students, teachers, and other staff. Currently, to retrieve information in the library, most users only searched for details of books including categories, names, authors, and borrowing status. Not only finding those data, users must locate books such as buildings and shelves where books were kept. Thus, 3D and AR technology are considered as an alternative ways to find books which is more efficient.

According to National Education Act B.E. 2542 Section 9 of Thailand which mentioned if educational technology was applied in the library, there must have had enough media to support. By applied proper and high quality technology in the library both normal and online services, researcher believed that developing 3D library and AR navigation help users to locate books accurately and quickly. Users can see where the books locate, as well as system working on websites is convenient for any users who are not familiar with the library. Thus, users can see the whole services of libraries through the simulation which imitate the environment of the library in form of 3D which works together with current searching systems.

When users can find books, the system will present in 3D, and work with AR technology so the system can bring users to book shelves quickly. This research is included: Section II discusses related works. The framework of this paper is described in Section III. The Results and discussions from the

experiments are presented in Section VI. Finally, the conclusion and future work are given in Section V.

II. RELATED WORK

Nowadays, virtual 3D model is the important for support user especially in library of university. Library is an important learning place for people to accept education or continuing education. Many researcher try to in 3D modeling and functional Design of Reading Room in a Virtual Library. The modeling of the library based on the 3DS Max software and the VRML language [1]. Creation of the term “augmented reality” was claimed by Thomas Caudell, a Boeing researcher [2]. Augmented reality in education and training, TechTrends [3]. Caudell and his colleague, David Mizell, developed a see-through, head-mounted display that guided workers on accurate wire placements as they built aircraft. Augmented reality gets to work. MIT Technology Review [4]. After formal adoption of the term, AR made its way into military training and the space industry in 1999, as researchers developed a wearable unit for soldiers and NASA produced a Hybrid Synthetic Vision system that enhanced visual navigation with map overlays during flight.

The last highly influential component of AR history involves Hirokazu Kato's. An alternative approach is through Augmented Reality (AR), the overlaying of virtual objects onto the real world. In the past many researchers have explored the use of AR approaches to support face-to-face collaboration. Projects such as Studierstube [5], Transvision [6], and AR2 Hockey [7] which allow users can see each other as well as 3D virtual objects in the space between them. Users can collaboratively view and interact with virtual objects using a shared virtual whiteboard. Some process had marker tracking and HMD calibration for a video-based augmented reality conferencing system [8]. Some researcher developed augment realization for Thai dress. The concept of augmented reality to bring help to promote and share knowledge about the Thai Phra Ratcha Niyom [11]. Moreover, creation of the ARToolkit is an open-source software library that uses video tracking to overlay computer graphics on a video camera.

After ten years, Kato's ARToolkit became more broadly accessible as it was ported to Adobe Flash, allowing the technology to be used on web browsers [9]. Open source augmented reality SDK. With this, AR exploded in popularity, becoming widespread in the broadcasting, health, and education sectors in addition to the others previously mentioned. Previously, NaLib which is a beacon assisted indoor navigation technique for smart libraries was developed

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III. FRAMEWORK OF VIRTUAL 3D MODEL AND AUGMENTED REALITY NAVIGATION FOR LIBRARY IN UNIVERSITY

There were 4 steps to develop 3D model and Augmented Reality navigation technology for university libraries as follows:

A Study and Gathering Data

This research studied carefully in the library's services, bookshelf management, inquiring about the type of work required by the library, as well as related document and researches. Submit your manuscript electronically for review.



Fig. 1. The example of library picture.

B Designing 3D Model and Augmented Reality Technology for the Library

The process of Designing 3D model and Augmented Reality technology for the library is divided into two parts:

1) System designing by drafting 3D virtual library system

- Augmented Reality system designing for Indoor navigation by using Unity and Vuforia SDK.
- Taking pictures in the building, adjusting regarding the requirement, and uploaded to Vuforia website. The example of Library picture was showed in Fig. 1.
- Developing in-building navigation system which determined the current location of the users according to the turn of users by pointing the camera to the marker point in the area such as signpost and room number. When users specified the desired destination, the system calculated the shortest part with Dijkstra Shortest Path Algorithm and displayed the arrow on the image taken from the camera, displayed at the marker location as if it were an actual object. The arrow head pointed to the calculated path. This allowed users to walk in the right direction.
- Map structure design by using basic information that was needed, which was the top-level diagram of each floor in the library building. In the development process, from the map of the node to the location of the node which could be classified as turn node or intersection, signpost node, and book node.

2) Mobile application design

This step was to design the database system and design a mobile screen which linked to 3D model and Augmented Reality navigation for university libraries by designing the user interface and the functionality of each part. There were three main sections on the main window: 3D Library, Picture from camera, and searching button.

C System Development

This research divided into two parts: 3D library by using Google Sketchup program and library navigation by using C# in developing the application. To develop the system, a researcher took pictures from Library in Suan Sunandha Rajabhat University. The Vuforia SDK plugin was used to help identify the markers that appear in the camera and used the Unity 3D engine to create realistic arrow images. This was inserted into the image where detected the markers and user Dijkstra's Algorithm for navigation. The use case diagram was showed in Fig. 2 and Fig. 3 showed virtual 3D model and augmented reality.

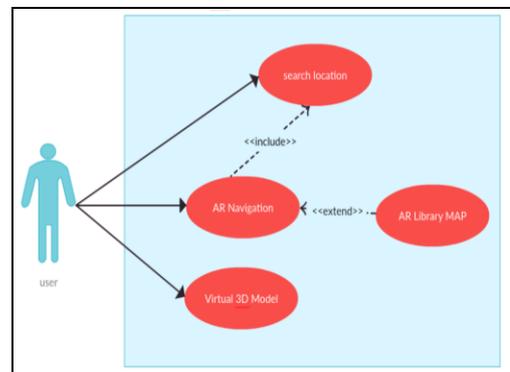


Fig. 2. The use case diagram of system.

D System Testing and Implementation

This research was conducted in two parts: system validation and measure the level of user satisfaction with the developed system. A researcher asked 50 system experts including students and other people to volunteer in assessment. The subjects were asked to rate the relevancy of the search results on a five-point scale:

- Score 1 is the level of satisfaction improvement
- Score 2 is minimum level of satisfaction
- Score 3 is medium level of satisfaction
- Score 4 is good
- Score 5 is very good satisfaction.



Fig. 3. Virtual 3D model and augmented reality.

IV. RESULT AND DISCUSSION

The result from the assessment in satisfaction in Virtual 3D Model and Augmented Reality Navigation for Library in University showed that system reliability and information was 4.30 and reliability was 0.59 which was in good level as shown in following tables:

TABLE I: THE RESULT OF THE ASSESSMENT

	Overall Average	Reliability	Criteria
Focus on quality of all services provided	4.17	0.27	good
Retrieving the Internet materials	4.35	0.12	good
Development of new services	4.52	1.54	Very good
Design and Structure	4.21	0.86	Good
Pictures and multimedia	4.04	0.43	Good
Designed for all levels of users	4.55	0.29	Very good
Total	4.29	0.35	Good

Therefore Virtual 3D Model and Augmented Reality Navigation for Library in University can support user for go to bookshelf.

V. CONCLUSION

This research has developed 3D virtual modeling and navigation with Augmented Reality technology for university libraries. The results show that the developed system was a tool to reduce the time spent searching books from the library. Providing users with an overview of library and navigation areas within the library, AR technology can display the user's location and direction of movement when the user navigated. Also, natural markers were made and configured in the system. In the future, the researcher will improve the efficiency of library services by introducing the system to the search system to facilitate users.

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