

## THE DEVELOPMENT OF MOBILE AUGMENTED REALITY FOR LAPTOP MAINTENANCE (MAR4LM)

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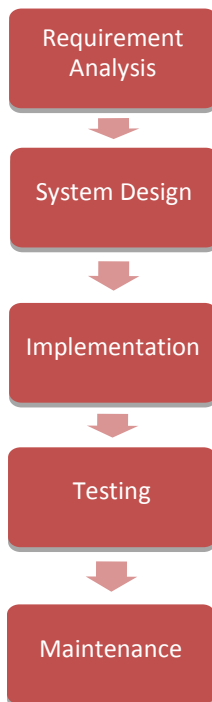
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### Graphical abstract



### Abstract

Currently, laptops have become a necessity to most of the people as laptop provides mobility and helps in doing the task that a normal desktop PC can do. However, the malfunction of the laptop hardware will distract the user work and decrease the productivity. By utilizing Augmented Reality (AR) that combine real world and virtual world, a laptop maintenance application can be made in reality. The objective of this paper is to discuss on how to develop Mobile Augmented Reality for Laptop Maintenance (MAR4LM) applications. This AR application specifically develop for smart phones based on the android platform. Therefore, this study presents a way to understand and discuss the process of using this new technology on the android platforms. This application has been proven in increasing the understanding of the users about their laptop and doing maintenance on their own self. In addition, laptop maintenance tasks will become straightforward, easy to use, interactive, and easily available anywhere and anytime.

Keywords: Mobile AR, AR, Laptop maintenance, Unity 3D, Android

### Abstrak

Pada masa kini, komputer riba telah menjadi satu keperluan bagi kebanyakan orang kerana ia boleh dibawa kemana-mana dengan mudah serta mampu membantu dalam melakukan tugas yang PC biasa boleh lakukan. Walau bagaimanapun, kerosakan kepada perkakasan komputer riba akan mengganggu kerja-kerja pengguna dan mengurangkan produktiviti. Dengan menggunakan teknologi Realiti Luasan (AR) yang menggabungkan dunia nyata dan juga dunia maya, aplikasi penyelenggaraan komputer riba boleh dibuat dalam secara realiti. Objektif kajian ini adalah untuk membincangkan bagaimana untuk membangunkan aplikasi Realiti Luasan Mudah Alih untuk Penyelenggaraan Komputer Riba (MAR4LM). Aplikasi AR ini dibangunkan khusus untuk telefon pintar yang berasaskan platform android. Oleh itu, kajian ini mengenengahkan cara bagaimana untuk memahami dan membincangkan proses dalam menggunakan teknologi baru ini pada platform android. Aplikasi ini telah terbukti dalam meningkatkan pemahaman pengguna mengenai komputer riba mereka dan boleh melakukan penyelenggaraan dengan sendiri. Di samping itu, tugas-tugas penyelenggaraan komputer riba akan menjadi mudah, mudah untuk digunakan, interaktif, dan mudah didapati di mana sahaja dan bila-bila masa.

Kata kunci: AR Mudah Alih; AR; Penyelenggaraan Komputer Riba; Unity 3D; Android

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## 1.0 INTRODUCTION

Augmented Reality (AR) is a field of computer science, which is represented by a special form of Human-Computer Interaction (HCI). The main concept of AR is to augment a user's perception of the reality with additional information. This additional information can be computer-generated, or simply information that humans cannot perceive directly with their senses [1]. Currently, mobile devices are becoming a perfect platform for AR. In this sense, AR brings an opening to investigate new ways for the interaction that happens between virtual and actual world [2]. In AR system, users pay much attention to their surroundings when having interaction with application of AR and the virtual content supplemented to it [3]. Recently, mobile devices are produced with the integration of camera, full color presentation as well as powerful processors and 3D graphics. Other than that, they also provided with accelerometer and compass. Increase in portability and mobility has encouraged users to make use of mobile devices not only to contact people through calls, but these devices also have become users' individual helpers, navigator, tourist guide, and others [4]. Even though the popularity of mobile applications has been rising, there are few researches on the utilization of AR in realistic settings that can be obtained [5]. Numerous studies have demonstrated that the efficiency of industrial assembly and maintenance tasks has improved by AR [6, 7]. As might be seen, AR technology has demonstrated to be helpful for assembly and maintenance tasks, yet up to this point Mobile Augmented Reality (MAR) has not been used in these tasks. This is a new and unique work which is the first illustration of using AR in laptop maintenance tasks and viewing the specification details, delivered to a mobile phone, and it additionally gives a user investigation of the AR interface.

The past decade has been an immense growth in the level of demands and the interest in mobile computing. Users are purchasing less desktop computers, but have been buying new mobile technology at a tremendous rate. Within the last decade, laptop sales have exceeded those of desktop computers in many markets and the worldwide popularity of smart phones has outdo them both [8, 9]. So far, however, the laptop has one major drawback which is sometimes, because of the configuration and size of parts, relatively there are just little possible things to do for maintaining or upgrading. In addition, the laptop can be damaged if an internal upgrades done with poor knowledge or care, also these upgrades are either impossible or not manufacturer recommended. Some internal upgrades, such as memory, hard disks, display and keyboard are usually impossible without referring to the computer technician. In addition, many people think that upgrading or maintaining a laptop only can be performed by the manufacturer or a computer shop. However, there are some problems that could be inexpensively and easily fixed by the users. Since

portable devices and mobile phones are getting further advanced, it can be utilized for this purpose which is to introduce a new and more advanced technology for upgrading or maintaining a laptop. The focus of this study is to discuss on how to develop an application of AR in a smart phone based on android system. This application were used to help people in choosing their laptops by giving them more explanation about the brand specifications as well as help them in maintaining their laptop. The application were called as Mobile Augmented Reality for Laptop Maintenance (MAR4LM).

## 2.0 RELATED WORKS

Many researchers have investigated the utilization of AR for assisting with real world assembly tasks. The augmenting of wire harness assembly was one of the latest of these efforts in Boeing [10], by using a wearable PC along with Head Mounted Display (HMD) attached. Another new augmented maintenance and assembly solutions have been used based on portable PC hardware, for instance BMW's car maintenance system is based on AR [11]. Among the first to utilize handheld devices were Geiger [12], in an application supplying augmented operation instructions for household appliance. Currently hand held (ultra mobile) PCs are a common choice for portable AR assembly applications, for example the ULTRA system [13]. The latest, mobile phones have not been yet used for maintenance tasks although AR applications. The bluetooth has been utilized to send phone camera images to a remote server for processing and graphics overlay in the first AR-Phone [14], taking a few seconds for every image. Since then, [15] created the first illustration of an AR application running completely on the mobile phone, while [16] ported the ARToolKit library over to the Symbian phone platform. Since that time there have been different cases of mobile based AR interfaces [17].

Laptop malfunction happen simply say the inability the laptop to perform normally whether it hardware or software, laptop malfunction happen almost all the time, a studies conducted by Square trade research on each brands of laptop, explain that in over three years, one of every three laptop have a risk of being malfunction [18]. Another studies conducted by storage craft shows that different hardware failures can also occurs when using a laptop [19]. In the studies, it explains that hardisk failure is the main cause of laptop malfunction. [20] in his article, explain software and hardware problem of a laptop can be monitored and maintained before they can become a real problem to the user. AR is a technology that allow user to interact with real world with virtual world elements [21]. It's have been used to assist human[22] studies on using AR to do car maintenance by using marker places on specific part of the car. Another studies by [23] explains how AR have been used in multiple area of maintenances and supports, also explain the details on how AR is being used. These

studies lead to explain that AR can be used for laptop maintenance and also help user understanding of user laptop.

### 3.0 THE DEVELOPMENT METDOLOGY

The development of Mobile Augmented Reality for Laptop Maintenance (MAR4LM) involved five majors stage as it follow waterfall software development life cycle. The process begins with the requirement analysis, system design, implementation, testing and maintenance. The mobile application was developed based on multimedia elements included such as video, audio, animation, graphics and image to become more attractive and alive. The software's used in the development consist of Unity 3D. In addition the Android SDK, JDK and Unity Extension 3.0.9 has to be installed on the PC in order to build an Android Application Package (APK) file. Then the APK file can be used in mobile platform as applications for MAR4LM. Figure 1 show how each phase of the development is conducted.

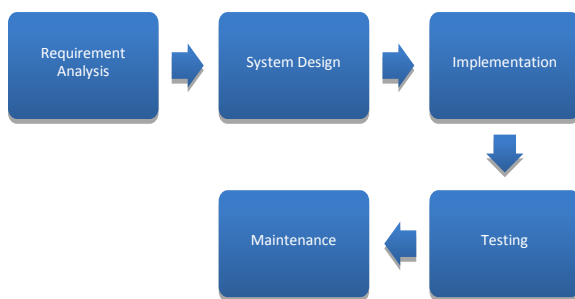


Figure 1 Phases of waterfall methodology

#### 3.1 Requirement Analysis

A suitable title for the project was chosen and the objective, problem statement, project background, scope were identified. The title of this project was MAR4LM, which aims to explain what the mobile application is going to do. The schedule for the project was planned as well. All possible requirements of the courseware to be developed were captured in this phase and documented in a requirement specification document. A survey was conducted during this phase in order to know the requirements of user towards educational courseware. The sample size of respondents were 50 students from Universiti Utara Malaysia as well as Kedah residences (users).

#### 3.2 System Design

The requirement specifications from first phase were studied in this phase and system design was prepared. System design helped in specifying hardware and system requirements and also helped in defining overall system architecture. This project focus on the

trouble shooting laptop. Audio, video, that related to the topic were embedded in order to help user understand the process to be more interesting. Besides that the layout of modules, low fidelity prototype design were prepared. For low fidelity prototype, functional and non-functional requirement is identified. Then, Unity 3D are used to design the interface and combined also using Unity 3D. Then the file were exported into an APK file that able to be installed on mobile that have android OS.

#### 3.3 Implementation

A temporary prototype were develop by following the system design phase. Alteration were made based on information from multiple sources. For instances, Expert Evaluation and User evaluation. Redesigning the interface, contents, background image and buttons for the application in order to make it more consistent. When MAR4LM start and come over the targeted part, if the image marker exists in the mobile screen, it will display the target video on the screen from target resources. Corel PhotoImpact and Video studio 12 were used to create and modify the required videos, images, photos, and icons. Figure 2 shows the overall structure of the MAR4LM based on Qualcomm Vuforia SDK. It has Qualcomm Vuforia's SDK (QCAR SDK's) marker detection module to detect the image marker. Also, it has a video player module to play video file when marker is detected. All contents of this application produced by Unity 3D to build in forms of APK file to work on the android.

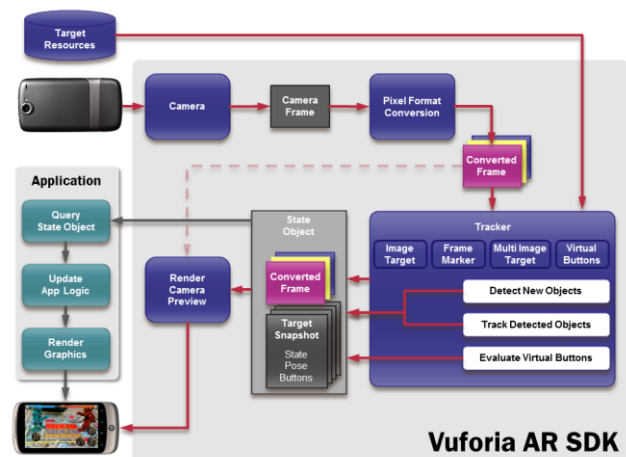


Figure 2 Data flow diagram of the SDK (source [24])

#### 3.4 Testing

All the units developed in the implementation phase were integrated into a system after testing of each unit. The entire unit is combined such as the Keyboard Replacement, Display the specification details of the laptop, Screen Replacement, and RAM and Hard Disk Drive Replacement in into one APK and made it functional. Then, post integration the entire system was tested for any faults and failures. Once the functional

and non-functional testing was done, expert evaluation was conducted to utilize the knowledge of user experience professionals in evaluating the effectiveness of the APK. As well as, the feedback of the weakness and acceptance of APK can be identified before tested by target users. After resolving errors, based on the suggestion from expert, user evaluation was conducted to know the general acceptance of user on the use of courseware as well as statistics on users' opinions about interface and retrieval features.

### 3.5 Maintenance

If there were some issues arises in the user environment, those issues corrected and the product were improved with better functions and performances. Maintenance was done to deliver these changes in the user environment. For example, more instruction were given to user as a guide and the buttons were corrected by using suitable metaphor in order to enhance the usability of APK.

## 4.0 MOBILE AUGMENTED REALITY FOR LAPTOP MAINTENANCE (MAR4LM)

The MAR4LM is developed to help the users in understanding their laptop specifications detail and doing maintenance by themselves. It's utilized the package that would able to be installed on mobile devices. This application can helps user in understanding how each hardware on a laptop can be replace by the user if any issues arises. It was developed using the standard design principle which contains a rich set of application interfaces. The Graphical User Interface (GUI) in android mobile apps are significantly important during the development of the application. It provides user with options such as data entry, reading, and show video and sound. Furthermore, MAR4LM contains several parts which are splash screen, introductory screen, laptop specification details, keyboard replacement, RAM and hard disk replacement, and screen replacement. The first parts was splash screen which shown in Figure 3 were appearing as the background image when the application is started. This screen will be disappeared after 8 seconds. The second parts was introductory screen which shown in Figure 4, it provides the main instructions to the user. There is an OK button appears at the bottom must be pressed to go to the next step.



Figure 3 Splash Screen

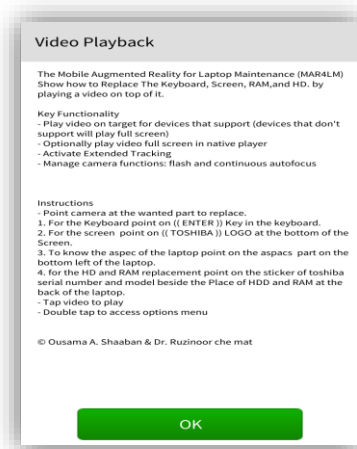


Figure 4 Introductory Screen

The third part is a laptop specification details as shown in Figure 5. This image was appeared on the mobile screen after holding the mobile up against the specification part to detect the image target. The user must press on the start button to start the video of the specification details as shown in Figure 6.



Figure 5 Specification Details detect



**Figure 6** Specification Details video played

The fourth parts was keyboard replacement as shown in Figure 7. This image were appeared on the mobile screen after users holding the mobile up against the keyboard to detect the target image. The user must press the start button to start the video to show how to replace the keyboard as shown in Figure 8.



**Figure 7** Keyboard replacement detect

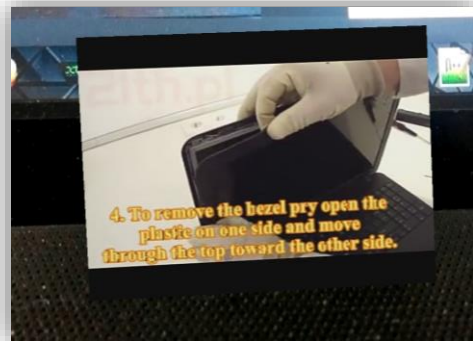


**Figure 8** Keyboard replacement video played

The fifth parts was screen replacement as shown in Figure 9. This image were appeared on the mobile screen after holding the mobile up against the TOSHIBA logo at the bottom of the screen. When the start button press by the user, the application displayed a video that show how to replace the laptop screen as shown in Figure 10.



**Figure 9** Screen replacement detect



**Figure 10** Screen replacement video played

However, this application currently only work with single laptop model which is TOSHIBA. For other model of laptop, the applications need to be customized according to the model. When all of the model being customized to the applications, it can be used by the users to helps them in finding the good laptop and also helps them in doing their own laptop maintenance based on their model of the laptop.

## 5.0 CONCLUSION AND FUTURE WORKS

The development of MAR4LM application has been elaborated and discussed details in this paper. As everybody know that understanding the laptop maintenance is important for the user itself. By doing their own laptop maintenance, it's allow the user to save time and also extra cost of sending the laptop to the computer shops. That is why, this application being



developed to help, especially the laptop users on how to do their own maintenance and checking their laptop specifications easily using AR technology. The objective of this paper is to discussed on how to develop MAR4LM with a good platform, since most of the users have access to the mobile devices easily which required the APK file. The applications are develop by using several software such as Unity 3D, Android SDK, JDK and Unity Extension. For future, when all of the laptop model being customized with this applications, the authors hoped that this MAR4LM application can be used by all of the laptop users as their important tools for understanding about the laptop specifications while buying a new laptop. It's also useful for helping the laptop user in maintaining their own laptop anywhere, any time, and any place without depending on the computer shop.

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