CHAPTER 4

Development of An Interactive AR Computer Lab

*Aidilynn Balqis[1], Balqees Humaira[2], Nur Aqilah Maisarah[3] & Muhammad Fazrulhelmi Ahmad[4]**

[1-4]Department of Information Technology,
University Tun Hussein Onn Malaysia,
Pagoh Higher Education Hub, KM 1,
Jalan Panchor, 84600 Pagoh, Muar, Johor, Malaysia.
*Corresponding Email: mfazrul@uthm.edu.my

4.1 Introduction

Information technology is the research and application of methods to operate computers and other information transmission devices for processing, storing, and making available a wide range of data, including text, numbers, images, sounds, and graphics [32][33]. In the present day, Information technology has become a central instrument in decision-making, automation processes, effective communication systems, data management as well as innovation across all domains. The rapid growth in the Information technology sector is driven by trends such as cloud computing, the Internet of Things (IoT), and advances in artificial intelligence, with an emphasis on cybersecurity.

To address educational challenges, we utilise a WebAR (Augmented Reality) system to enhance the learning process for

students studying computer hardware. Traditional approaches to teaching computer hardware often lack engagement and practical, hands-on experience, which can hinder students' learning outcomes and retention rates. Our goal is to develop an immersive and effective learning solution by creating a user-friendly website that enables users to interact with 3D models of computer components in augmented reality. Studies have shown that AR can significantly improve learning outcomes and retention rates as compared to conventional methods (PwC, "Seeing is Believing," 2020)[34]. With AR technologies also incorporated, this will be an awesome way for students in school to know about computer hardware. The integration of WebAR technology in educational contexts offers a promising solution to enhance the learning process by creating an immersive and interactive environment. This approach addresses the limitations of conventional methods by enabling students to interact with 3D models of computer parts, thereby improving their understanding and retention of complex concepts. Studies have demonstrated the effectiveness of AR in significantly enhancing learning outcomes and engagement, making it a valuable tool for modern education.

4.1.1 Literature Review

This literature review discusses the global trend towards the incorporation of Augmented Reality (AR) technologies in education, aimed at making computer hardware learning better understood and applied. The rest of this paper is divided into three main sections: theoretical background for AR in educational contexts; empirical studies about AR’s positive impact on learning outcomes; and a methodological gap that calls for more investigation into practical uses and benefits of AR in computer hardware education.

4.1.2 Interactive web

Knowledge sharing on interactive web through digital technology has changed how students learn as it provides dynamic and engaging encounters that enhance user engagement and

retention. Such applications as WebAR assist teachers to make immersive educational environments accessible from standard web browsers without requiring specialized apps or downloads. They are designed to facilitate interaction with 3D models in real-world environments, allow adaptive learning pathways customised to each learner's needs, and provide immediate feedback [35].

4.1.3 Augmented Reality

Augmented Reality (AR) technology overlays digital content onto the physical world, thus transforming educational paradigms by providing interactive and immersive learning experiences. For example, when teaching computer hardware AR may enable students have a "hands-on" experience using virtual simulations of actual hardware; this enhances their understanding and retention because they can interact with 3D models within realistic settings [36].

4.1.4 Computer component

The basics of each computer component are crucial to the principles taught in Information Technology school, still, it is highly challenging for conventional instruction to provide vital application experiences. In an effort to fill this void, this project will apply WebAR in order to provide an immersive environment in which students can interact with the computer components in 3D mode. It is likewise ascertained that effectiveness and engagement can be more effectively achieved if the cognitive models are presented in augmented reality format where the learners can actually visualize and interact with them [37].

4.2 Methodology

For designing the Interactive AR Computer Lab, we adopted the Waterfall Model, a structured approach where each phase sequentially follows the previous one. Our research was conducted through a systematic process involving literature

review, needs assessment, prototyping, and evaluation. The choice of the Waterfall Model was based on its clear and systematic progression through defined phases, ensuring a methodical development process aligned with project requirements and objectives.

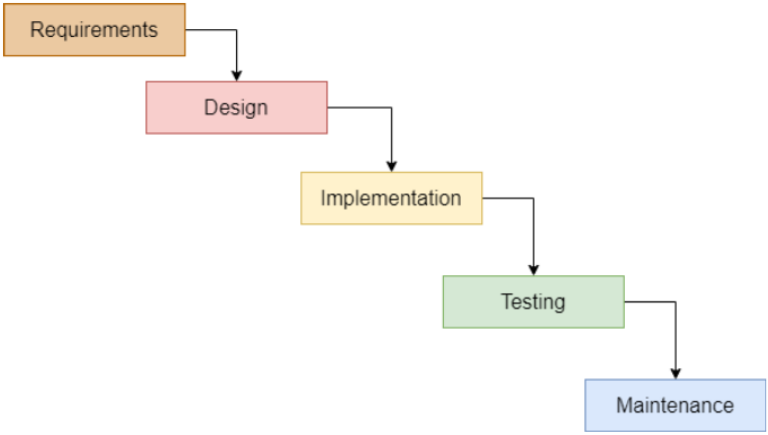

Figure 4.1: Waterfall Methodology

4.2.1 Requirement Analysis

Coming from the plan that was created on the basis of the primary findings of the analysis, further research and stakeholders' interviews were aimed at gaining better understanding of the necessary functions to be implemented in the framework of the Interactive AR Computer Lab. This entailed determining the components of AR that allow for user engagement, the nature of the application determining AR's domain, and other features required for an intuitive interface. Holding a detailed understanding of the requirements of the product helped in guaranteeing that the end product can sufficiently satisfy the stakeholders.

4.2.2 Design and Development

Finally armed with clear understanding of all the projects specifications it was time to Design and Develop solutions. To achieve this we prioritized on the sites appearance and layout so that all users would be able to easily interact with it. At the same time, we implemented advanced AR features, which enable the user to move through the futuristic digital world and effectively learn the basics of computer components and their functions. Also, we created custom information texts, instructional videos, and games, which included simple but useful text descriptions of moves and controls.

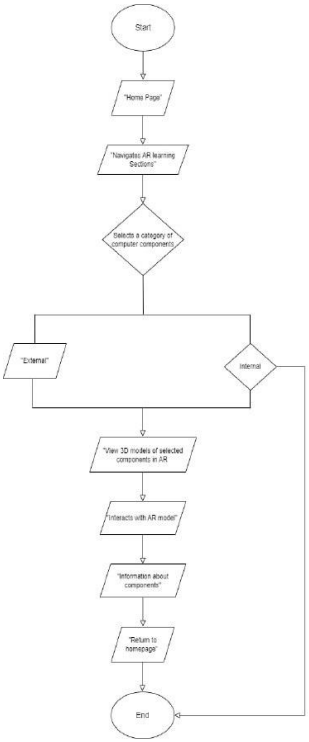

Figure 4.2: Development process for our website

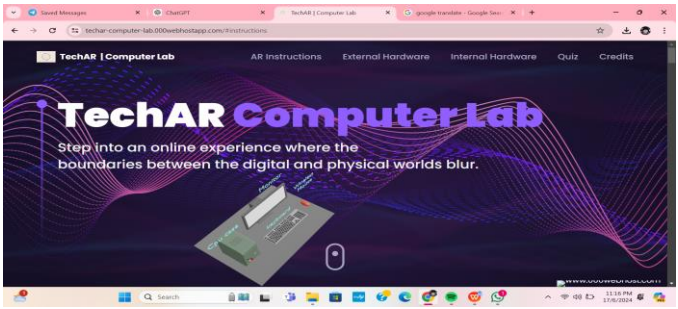

Figure 4.3: Screenshot of the product homepage

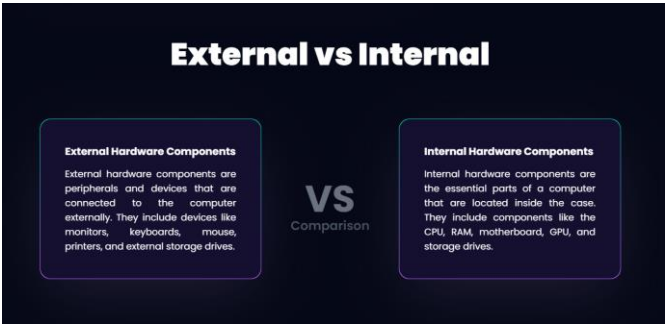

Figure 4.4: Screenshot of the product External/Internal Comparasion

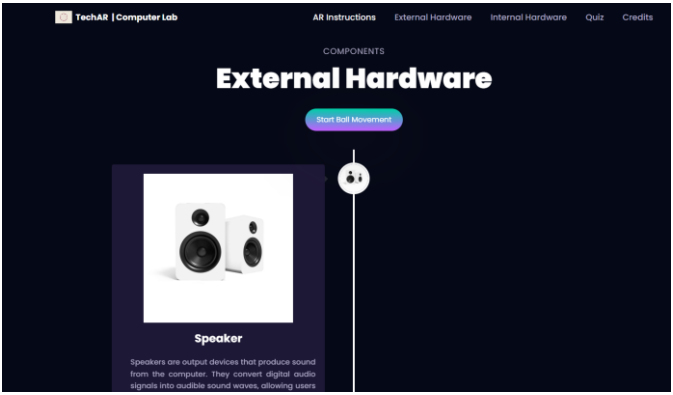

Figure 4.5: Screenshot of the product External Hardware Interface

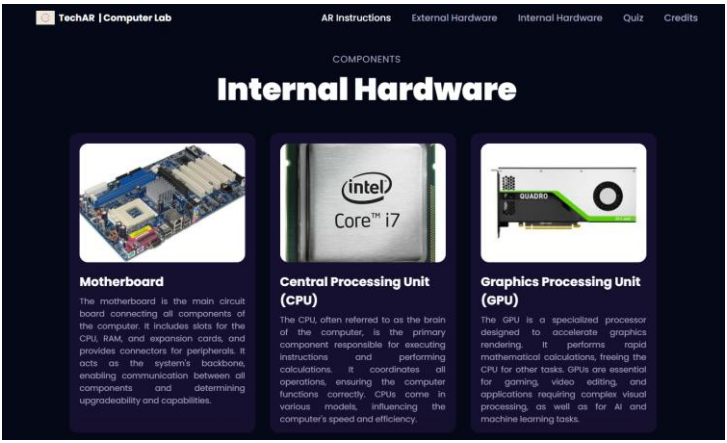

Figure 4.6: Screenshot of the product Internal Hardware Interface

Figure 4.7: Example of Scan Images for User

Photos that are hosted on our website serve as markers for users to aim their camera at in order to create 3d graphics for them on our techAR website if they in order to learn on. People can basically capture these images with their gadgets that have a camera function and with the help and support of our unique AR software. When searching or browsing, the application immediately creates an animated 3D figure based on the scanned image for a user's exploration, enabling them to study different parts of computer hardware in depth and from multiple angles.

4.2.3 Implementation Phase

The implementation phase translates the web AR platform design into an educational functional product for supporting students in working with computer hardware. It is important to configure the development tools, 3D models, and AR functionality at this stage. In addition, it will be followed by learning aids like tutorials and quizzes. Afterwards, testing and stakeholder collaboration are done rigorously for functionality assurance and user satisfaction, supported by comprehensive documentation for sustainability and knowledge sharing purposes.

4.2.4 Testing and Quality Assurance

It was very important to go through the tests and provide high quality platform to the users with fine features and possessing necessary stability and performance. Some of the tests conducted were functionality testing whereby we affirmed primary operations, usability testing whereby we examined user experiences and task interactions, and performance testing to measure server reaction and systems capacity. This made it possible to check for any flaws that may have been present in the products before delivering the unit to the end-consumer market, as we worked to provide the best quality product.

4.2.5 Deployment and Maintanance

After giving the lab the test it was ready for usage and release to the public as the Interactive AR Computer Lab. The adapted goal as a result of the shift is to sustain and further enhance the platform through post-deployment maintenance. This entailed constant observation of the users, especially in relation to their feedback, alongside reporting and fixing of complications that emerged from bug checks from time to time, as well as making ongoing optimisation to include added or advanced features to support the functionality and ease of use over time.

4.3 Findings

The goal of the evaluation is to assess how often and in what way the users of the “TechAR – Computer Lab” website engages with the services provided by the website. Collecting this feedback is important for measuring the usefulness of the current platform and its overall comprehensibility for the target audience. Through the proposed “TechAR - Computer Lab” website, the authors plan to improve the learning of concepts regarding computer’s hardware by applying augmented reality (AR) technology as a means of making the educational experiences diverse and exciting for students and professors. Upon the end of development stage, the “TechAR - Computer Lab” website had been assessed by three experts chosen among the information technology lecturers of the Universiti Tun Hussein Onn Malaysia (UTHM). Also, there is a feedback form to capture the perceptions of students at the University of Technology and Multimedia (UTHM) and other users. There were 26 participants to the survey, and their responses on the performance of the website cross-sectional with a variety of opinions. This was developed by creating a feedback collection survey using Google Forms. Thus, to address these research questions, the authors developed a comprehensive self-completed web-based questionnaire in order to capture a range of aspects of the website, such as usability, quality and quantity of content, operation of AR, and general levels of satisfaction. The link to the questionnaire was then shared on WhatsApp with the experts and users to allow easy access to its content through their mobile devices. The feedback that was received from the survey showed the key highlights and the areas of improvement on the ‘TechAR - Computer Lab’ website.

These findings are based on a user feedback survey to evaluate the interactive computer lab AR app located on the TechAR website. It was meant to gauge satisfaction from users across various dimensions of usability, functionality, and the value of education. The methodology requires 26 respondents who answer a structured questionnaire with 12 questions. Key findings include 56.4% of users who are satisfied with the overall user experience, and an overwhelming 85.7% of users reported that

the app met or exceeded their expectations regarding functionality. Positive sentiment was also noted regarding stability; only 67.9% indicated minor issues of crashing or freezing. Another effective aspect was the interaction with 3D models according to 74.6% of the respondents. Loading time received mixed feedback, where 64.3% were satisfied or at least indifferent. Visual design and clarity of the AR visuals drew positive reactions in 64.3% of users. Notably, 85.7% of participants said that the app was easy to learn. A majority, 64.3%, showed satisfaction with the user interface of the application. Besides, 78.6% showed satisfaction about the app's overall performance on their devices. The participants were very satisfied with the educational content: 89.3% were satisfied, and 82.1% would recommend the app to others. In summary, while the Interactive Computer Lab AR app has really bright sides in its usability and educational value for evaluating it at the end, there are many prospects for its improvement in both areas.

Table 4.1: Min For User Survey on Our Techar Website

No.	User feedback survey on TechAR Website	Response					Min
		Highly Dissatiesfied	Dissatisfied	Nuetral	Satisfied	Highly Satisfied	
1.	How satisfied are you with the overall user experience of the Interactive Computer Lab AR app?	0%	0%	14.3%	39.3%	42.9%	0.143
2.	How well did the app meet your expectations in terms of functionality?	0%	7.1%	0%	32.1%	53.6%	0.071
3.	How would you rate the app's performance in terms of stability (e.g., crashing or freezing)?	0%	0%	32.1%	39.3%	25%	0.25
4.	How effectively were you able to interact with the 3D models within the app?	0%	0%	25%	28.6%	46.4%	0.25
5.	How satisfied are you with the loading times of the app?	0%	0%	28.6%	35.7%	32.1%	0.286
6.	How appealing did you find the visual design of the app?	0%	0%	21.4%	14.3%	64.3%	0.143

7.	How satisfied are you with the clarity and quality of the AR visuals and models?	0%	0%	14.3%	21.4%	64.3%	0.143
8.	How easy was it to learn how to use the app?	0%	0%	14.3%	39.3%	46.4%	0.143
9.	How satisfied are you with the app's user interface?	0%	0%	14.3%	21.4%	64.3%	0.143
10	How well did the app perform on your device?	0%	7.1%	14.3%	39.3%	39.3%	0.071
11	How satisfied are you with the educational content provided by the Interactive Computer Lab AR app?	0%	0%	10.7%	25%	64.3%	0.107
12	How likely are you to recommend the Interactive Computer Lab AR app to others?	0%	0%	17.9%	32.1%	50%	0.179
Sum							**1.929**

4.4 Conclusion

From the case of the Interactive Computer Lab AR app, it has been substantiated that augmented reality can help students to increase the interest in the field of computer hardware studies due to the app's engaging WebAR environment. It turns students into end users of ideas through the use of tangible 3D models of computer parts that actual students can play around with alongside the use of the technologies in the classroom. At the real estate agency, Goh & Co., we followed a systematic method for developing the educational platform that was user centered, making usability, stability and performance the top priority; 26 respondents agreed with the effectiveness of the app in disseminating education contents and increasing user interest.

Most of the stakes holders had a favorable impression of the app by exhibiting enhancements in learning outcomes and retention of the learners Though, areas such as stability and the rate at which the app loads were seen to be areas of strength that needed to be developed more.. Evaluation regarding the effectiveness of the educational application will also be ongoing, with frequent updates to advance the app and keep the learning aspect intact. Interactive AR Computer Lab is one such model that demonstrates how essential tools in education assist learners in embracing the best technology to upgrade old learning strategies in computer hardware classes.