UNIVERSITY OF LEICESTER

Department of Informatics
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CO7201 Individual Project

Preliminary Report

Interactive Augmented Reality Platform for Medical Education

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DECLARATION

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1. Aims and Objectives

Project aims:

1. Enhance Medical Education: The project aims to transform medical education by integrating augmented reality (AR) into learning environments. It introduces dynamic and interactive 3D simulations to go beyond traditional teaching methods, such as static images and physical models.
2. Improve Understanding and interaction: The platform uses interactive 3D models and simulations to improve students' comprehension of complex anatomical structures and medical procedures, leading to better retention of information.
3. Increase Accessibility: The project aims to make learning more accessible using AR technology. This technology allows students to explore medical concepts in a more engaging way without the constraints of physical presence in a lab along with virtual audio and video.

The primary challenges of this project include developing accurate and detailed 3D models, ensuring device compatibility across various platforms, and creating an intuitive user interface that facilitates interactive learning.

Project objectives:

1. Develop accurate 3D models: Create highly accurate and detailed 3D models of human organs that meet the operation requirement of AR.
2. Create an interactive and user friendly interface: AR technology allows for an immersive learning experience where students can visualise and manipulate 3D models of human organs, explore different anatomical layers, and simulate medical procedures. This interactive approach can lead to better retention of information and a deeper understanding of complex anatomical structures along with a user-friendly app interface.

Challenges:

1. Accurate 3D models: The primary challenges of this project include developing accurate and detailed 3D models.
2. Device compatibility: Ensuring device compatibility across various platforms, and creating an intuitive user interface that facilitates interactive learning

2. Requirements

Essential Requirements

1. **3D Model Visualization**: Develop accurate and detailed 3D models of human organs that can be viewed in augmented reality. These models should be anatomically correct and provide a high level of detail to facilitate in-depth study.

2. **Interactive Manipulation**: Enable users to manipulate the 3D models, including rotating, zooming, and exploring different layers. This functionality is crucial for understanding the relationships and complexities of human anatomy.
3. **Device Compatibility**: Ensure that the platform is compatible with a range of mobile devices, including smartphones and tablets running both iOS and Android operating systems. This broad compatibility is essential for accessibility and usability across different user groups.

Recommended Requirements

1. **Medical Procedure Simulation**: Implement features that allow students to simulate medical procedures. This functionality can enhance practical skills and provide a better understanding of procedural steps and anatomical interactions.
2. **Audio and Video Functionality**: Incorporate audio and video features to provide a richer educational experience. These features can offer additional explanations and demonstrations to aid in understanding complex concepts.

Optional Requirements

1. **User Feedback Integration**: Include a feature that allows students to provide feedback on the AR models and simulations. This feedback can be used for continuous improvement of the platform based on user experiences and suggestions.
2. **Collaborative Learning**: Develop functionality that enables multiple users to interact with the same AR model simultaneously. This feature can facilitate group study sessions and collaborative learning, enhancing the educational experience.

3. Technical Specification

The technical specifications of the Interactive Augmented Reality Platform for Medical Education involve several key components and technologies:

1. **Development Tools**: Utilising AR development tools such as ARKit (for iOS) and ARCore (for Android), along with the Unity game engine and Vuforia. Vuforia is an advanced augmented reality (AR) software development kit (SDK) that enables the creation of rich, immersive AR experiences. It allows developers to build applications that can recognize and track a wide variety of objects, including 2D images, 3D objects, and even environments. It supports multiple platforms, including Android, iOS, and Unity, making it versatile for various application needs.
2. **3D Models:** The 3D models should be in .obj or .fbx format, which are easily compatible with Unity software.

3. **Programming Languages**: Implement the platform using C# in Unity for scripting and development. Additionally, use Swift for iOS-specific features and Java/Kotlin for Android-specific features (if required).
4. **User Interface Design**: Design an intuitive and user-friendly interface using Unity's UI toolkit. The interface should facilitate easy navigation and interaction with the 3D models and simulations. One of the functionalities being the student should be able to touch and zoom the 3D model for better understanding. Also to include other design features like access to audio and video on the model screen itself for easy accessibility.
5. **Cross-Platform Compatibility**: Ensure that the platform supports cross-platform functionality, allowing users on different devices to have a consistent experience. This involves rigorous testing and optimization for both iOS and Android platforms.

4. Requirements Evaluation Plan

To evaluate the effectiveness and quality of the Interactive Augmented Reality Platform for Medical Education, the following criteria and methodologies will be used:

1. **Accuracy and Detail of 3D Models**: Verify the anatomical accuracy and detail of the 3D models through expert reviews by medical professionals. The models should accurately represent human anatomy and provide a high level of detail for educational purposes.
2. **Usability Testing**: Conduct usability testing with medical students to assess the ease of use and intuitiveness of the platform. This involves gathering feedback on the user interface, interaction methods, and overall user experience.
3. **Performance Testing**: Perform extensive testing to ensure the platform runs smoothly on a range of devices, including older models. This includes evaluating the load times, frame rates, and responsiveness of the application.
4. **Educational Effectiveness**: Measure the educational impact of the platform through pre- and post-usage assessments. This involves testing students' knowledge and understanding of anatomical structures and medical procedures before and after using the platform.
5. **Feedback and Improvement**: Collect user feedback on the AR models and simulations to identify areas for improvement. This feedback loop is essential for continuously enhancing the platform based on real-world usage and suggestions from users.

5. Background Research and Reading list

Background Research

The paper, by Kamphuis et al. (2014), explores the potential of AR in medical education. It discusses how AR can be used to overlay digital information onto the real world, allowing students to visualise anatomy, practice procedures, and interact with 3D models in a more engaging way. The authors acknowledge the need for further research to evaluate the effectiveness of AR in improving learning outcomes.

The paper, by Tang et al. (2020), provides a more comprehensive analysis. They conducted a systematic review of existing research on AR in medical education. Their findings support the earlier claims about AR's potential benefits, particularly in enhancing anatomy visualisation and surgical skills practice. However, the review also highlights the limitations of current research, including the lack of high-quality studies with robust methodologies.

The paper, by Dhar et al. (2021), focuses on the user experience and learning outcomes associated with AR in medical education. Their research involved surveying students who had used AR for learning purposes. The study found that students reported positive experiences with AR, including increased engagement and motivation. Additionally, the results suggested that AR use may lead to improved learning outcomes. However, it's important to note that this research relied on student perceptions, and further studies are needed to confirm a direct link between AR and stronger academic performance.

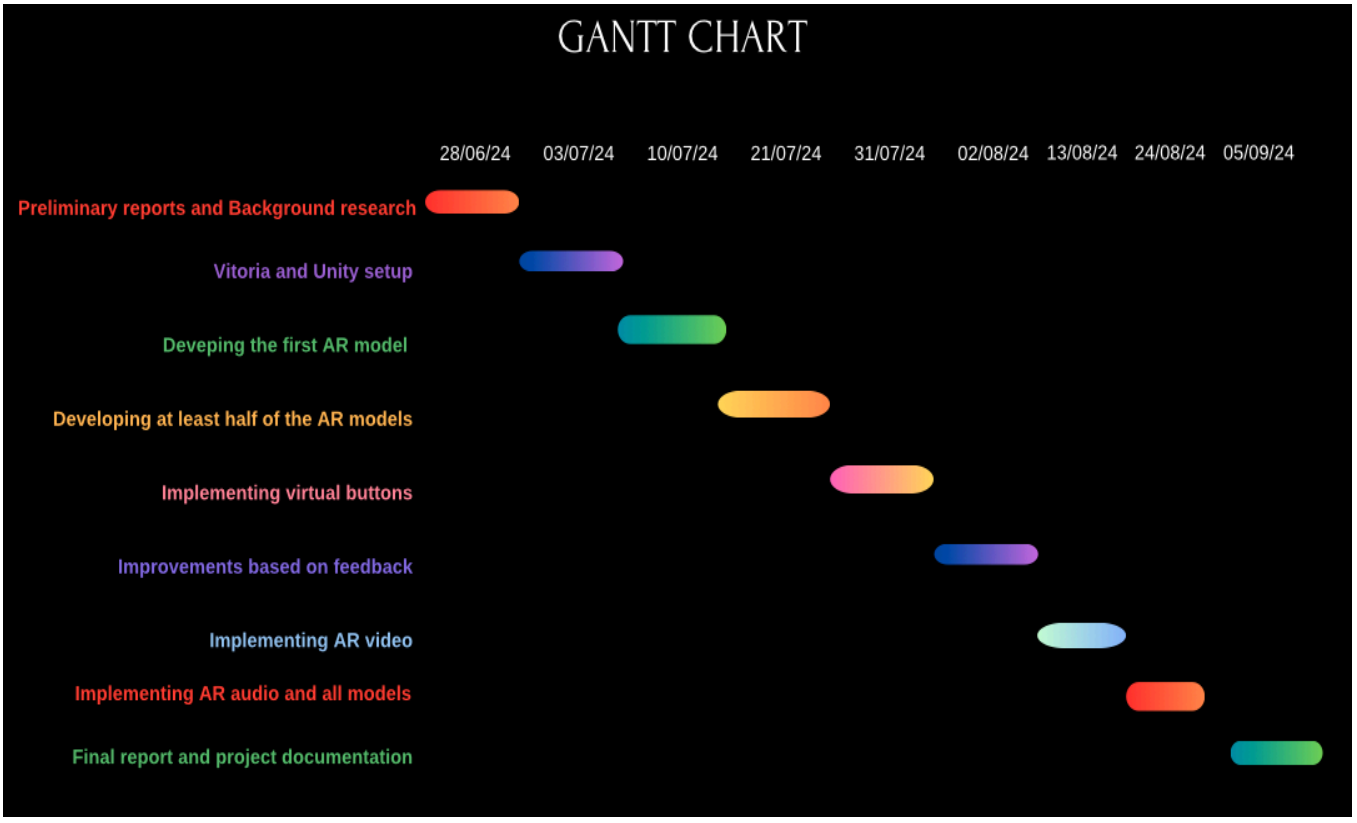
Research suggests AR in medical education holds promise for enhancing anatomy visualisation, surgical skills practice, and student engagement. While studies lack strong methodologies and haven't definitively proven improved learning outcomes, positive student experiences point towards a valuable educational tool. Future research should focus on high-quality studies, explore specific applications, and address cost and faculty training to fully realise AR's potential.

Reading list

1) Kamphuis, C., Barsom, E., Schijven, M., & Christoph, N. (2014). Augmented reality in medical education?. Perspectives on medical education, 3, 300-311.
2) Tang, K. S., Cheng, D. L., Mi, E., & Greenberg, P. B. (2020). Augmented reality in medical education: a systematic review. Canadian medical education journal, 11(1), e81.
3) Dhar, P., Rocks, T., Samarasinghe, R. M., Stephenson, G., & Smith, C. (2021). Augmented reality in medical education: students' experiences and learning outcomes. Medical education online, 26(1), 1953953.
4) Lee, K. (2012). Augmented reality in education and training. TechTrends, 56, 13-21.

6. Time-plan and Risk Plan

Start Date	End Date	Milestones
17/06/2024	28/06/2024	Preliminary report submission, background research for the project and finalise project requirements
29/06/2024	03/07/2024	Vuforia and Unity setup required for the project
04/07/2024	10/07/2024	Developing any one marker based AR model and testing the app.
11/07/2024	21/07/2024	Developing at least half of the marker based AR models required in the project
22/07/2024	31/07/2024	Implementing virtual buttons in the AR app
01/08/2024	02/08/2024	Make improvements based on feedback
03/08/2024	13/08/2024	Implementing AR video functionality
14/08/2024	24/08/2024	Implementing AR audio functionality and completing all models of the body
25/08/2024	05/09/2024	Final report and project documentation



Risk Plan

The following risks have been identified, along with their mitigation strategies:

1. **Technical Challenges**: Difficulty in developing accurate 3D models and ensuring smooth performance on all devices. Mitigation: Allocate additional time for model development and performance optimization.
2. **Compatibility Issues**: Ensuring the platform works seamlessly across different devices and operating systems. Mitigation: Conduct extensive testing on a variety of devices; use cross-platform development tools.
3. **User Acceptance**: Ensuring the platform is user-friendly and meets the needs of medical students. Mitigation: Involve end-users in the development process through regular feedback sessions, conduct usability testing.
4. **Resource Limitations**: Limited access to high-quality 3D modelling software or medical expertise. Mitigation: Utilise open-source tools where possible.
5. **Project Delays**: Potential delays in meeting project milestones. Mitigation: Develop a detailed project schedule with buffer time; regularly review progress and adjust plans as necessary.

7. References

1) Kamphuis, C., Barsom, E., Schijven, M., & Christoph, N. (2014). Augmented reality in medical education?. Perspectives on medical education, 3, 300-311.
2) Tang, K. S., Cheng, D. L., Mi, E., & Greenberg, P. B. (2020). Augmented reality in medical education: a systematic review. Canadian medical education journal, 11(1), e81.
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4) Lee, K. (2012). Augmented reality in education and training. TechTrends, 56, 13-21.
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7) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8281102/
8) https://www.bournemouth.ac.uk/research/projects/neuravatar-using-augmented-reality-medical-education