

**SCIENCE APP FOR O/L STUDENTS USING  
AUGMENTED REALITY**

Project Id: 2020-160

**Project Proposal Report**

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Software Engineering

Department of Software Engineering

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## DECLARATION

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Signature of the supervisor:

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.....

Date

## **ABSTRACT**

After investigating the G.C.E ordinary level results of Sri Lankan students for past few years we were able to identify that the pass rate of science is comparatively low than other compulsory subjects and even among the passed students most of the students have scored average grades. An unsatisfactory amount of students had been able to score higher grades. This is because science is a hard subject due to its abstract and complex nature. The main intension of this research is to uplift science results by providing an attractive way for studying science. So the research is targeting to attract students towards the subject by using visualisation techniques. The research is involved in developing a series lessons related to the O/L syllabus using different techniques relevant to augmented reality. The survey conducted on behalf of the research proved that most of the O/L students would like to learn science using 3D technology instead of traditional approaches. The availability of 3D models, animations and conversion of detailed descriptions into augmented videos by the application will enhance the science knowledge of students.

Key words : Augmented reality , visualisation techniques , G.C.E ordinary level.

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# 1 INTRODUCTION

## 1.1 Background

According to the statistics of national examinations department [9] the science pass rate of science subject at the G.C.E ordinary level examination is comparatively low than other compulsory subjects.

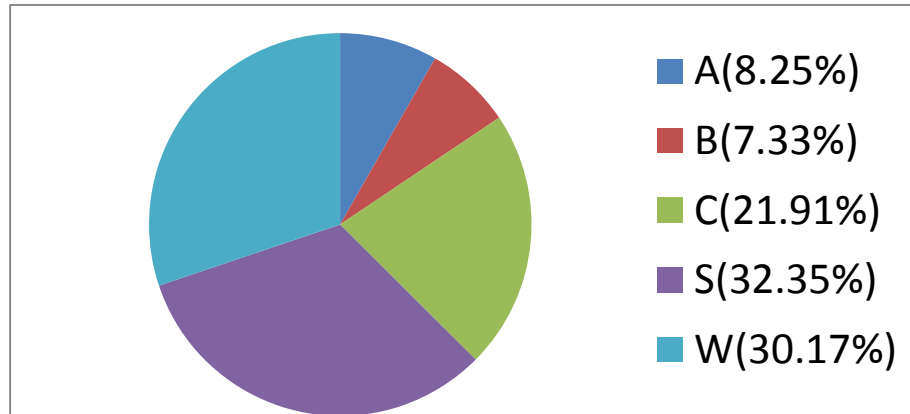


Figure 1.1: Science results of 2018 by grades [9].

Figure 1.1 shows that even among the passed students most of the students have scored average grades. Only few have scored good grades for science. This is because the science content has become more advance with the introduction of the new syllabus[3]. The concepts of science being hard have been a result for getting low grades. Moreover Science is a practical subject and lack of proper practical experience will make it hard to understand the subject. Schools in rural areas are not having proper lab facilities and even some urban schools are lacking good lab facilities . In such situations it will be a huge disadvantage for students in scoring higher marks.

Augmented reality is a growing field of technology. Augmented reality based mobile apps are an effective mode in elearning as it is having the ability to demonstrate even complex concepts in an attractive way. Once the student points her device's camera on some content of her text book which the app can recognize, the app will display 3D models, animations, videos or further clarified descriptions.

Using an Augmented reality based mobile app for science it will be easy to catch the attention of students and motivate them as complex concepts will be converted into innovative practical illustrations. Learning with augmented reality will make it enjoyable for school children. It will also help students to handle their homework with less support. Also students can gain a practical experience rather than just learning only theory. Augmented reality will provide a practical experience for students even without the need of any lab equipment.

The main objective of this research is to develop an augmented reality based mobile application to support the science subject of O/L students.

## **1.2 Literature Survey**

Today, technology has become an important part in everyone's life, making it nearly impossible to survive in any field without it. Education is one of those fields which use technology for its development and enhancement in order to obtain the desirable outcome. Combining technology and education has opened new opportunities for immersive learning environments, and it has brought education to a level which makes it more beneficial and effective for the students. Among different kinds of technologies which are been used for the educational advancements, Augmented Reality (AR) has become one of the most popular technologies these days. It is being used as a new medium to combine aspects from ubiquitous computing, tangible computing, and social computing. Moreover, it has its own characteristics and benefits that are promising to support learning and make students more interested in learning. Since AR brings lots of benefits to the field of education, many research studies have been carried out to emphasize its true usage in this field.

Rita Layonaa, Budi Yuliantob, and Yovita Tunardi together have carried out a research to develop an AR application for human body anatomy learning in order to make it easier for students to understand the content clearly. For collecting data for the research, a questionnaire has been distributed among 48 junior and senior high school students of a higher education institution in Jakarta, Indonesia. As mentioned in the research, this application enables students to learn human body anatomy with



3D object interaction, and previously it was taught using textbook and mannequin, and therefore, students have faced a difficulty in understanding its content. As a solution, this application has provided the three-dimensional practice form for the students to visualize the anatomy of a two-dimensional body shape. Similarly, another research has been carried out to develop an AR mobile application to learn railway transportation. As mentioned in this research, this AR application has been tested among 18 users, and as per the results gained from the testing process, using the AR application has made its users to learn boring and difficult subjects in a more interesting way [1].

Another research has been carried out about applying augmented reality technology using a marker-based approach in E-learning system for transmitting virtual objects into the real-world scenes. According to this research, there are two approaches for transmitting virtual objects into the real world scene; Marker-based and Monitor-based registration approach. Finally, the research has indicated that a subject which is explained using several pages can be eliminated by replacing it with a small marker [2]. In another research carried out by Kamalika Dutta, the benefits and the detriments of AR with regard to e-learning have been emphasized. Furthermore, this research has explained some relevant aspects which are need to be considered in order to identify the true benefits of the AR technology in order to improve the learning processes [3]. Similarly, V. Camilleri and M. Montebello have emphasized in their research that the industrial-age approach has added barriers between the “classroom” setting and the real world, and AR is one of those powerful technologies which can break these barriers. Moreover, the following advantages of AR have been mentioned in the research [4].

- Flow in balancing inactivity and challenge.
- Repetition allowing learners to repeat their experimentation until they are satisfied with the outcomes.
- Experimentation in encouraging learners to try and learn in the process.
- Experience which is more engaging than other digitally mediated technologies.

- Doing through practice.
- Observing through an essential communication platform.
- Motivation stimulated by the people's own active part.

Apart from the above mentioned researches, another research has presented four applications developed using augmented reality for e-learning; two has focused on collaborative work of students and the other two on biology and geography. As mentioned in the paper, the use of images, 3D models, sounds and animations are the important factors in AR which get the attraction from the students, and it is effective more than the classical teaching methods. The paper has explained further that these augmented elements allow students to retain new information more easily, and tests designed as games contribute to reduce their stress. This paper has mainly focus on indicating the use of augmented reality in order to improve the communication and collaboration skills between children, especially autistic children, and the game-based evaluation of pupils in various teaching areas, allowing for a stress free testing environment [5].

According to the above mentioned facts, it is clear that AR is one of the most effective and powerful technologies which can be used to improve the field of education. Also it is evident that, in Sri Lanka, this technology is still not being used for the purpose of enhancing the education of our children. Therefore, implementing an AR application can be highly important for Sri Lankan students, and it can surely be useful to obtain the educational advancements, and encourage the students for learning

### 1.3 Research Gap and Research Problem

#### 1.3.1 Research Gap

Table 1.1: Comparison of existing work

Existing Research and Applications	Ability to visualize the text book objects using 3D images	Provide videos for better understanding of specific areas	Questions are represented as a game	Relevant to the O/L subject	3D models can be rotated and magnified
Human Anatomy Learning Systems Using Augmented Reality on Mobile Application	✓	✗	✗	✗	✓
Enhancing the Attractiveness of Learning through Augmented Reality	✓	Audio only	✓	✗	✓
Web based Augmented Reality Application for Human Body Anatomy Learning	✓	✓	✗	✗	✓
Increase The Interest In Learning By Implementing Augmented Reality	✓	Audio only	✗	✗	✓
Current Research	✓	✓	✓	✓	✓

Different countries have carried out different researches to enhance the educational level of their students using AR, but in Sri Lanka it has not been used. Therefore, a huge gap can be seen between the existing researches and the current research. Table 1.1 is a summarized comparison which shows the gap in order to emphasize the importance of carrying out the current research.

### 1.3.2 Research Problem

National Examinations department statistics of previous two years [9] show that the amount of students who have passed science is comparatively low than other main subjects.

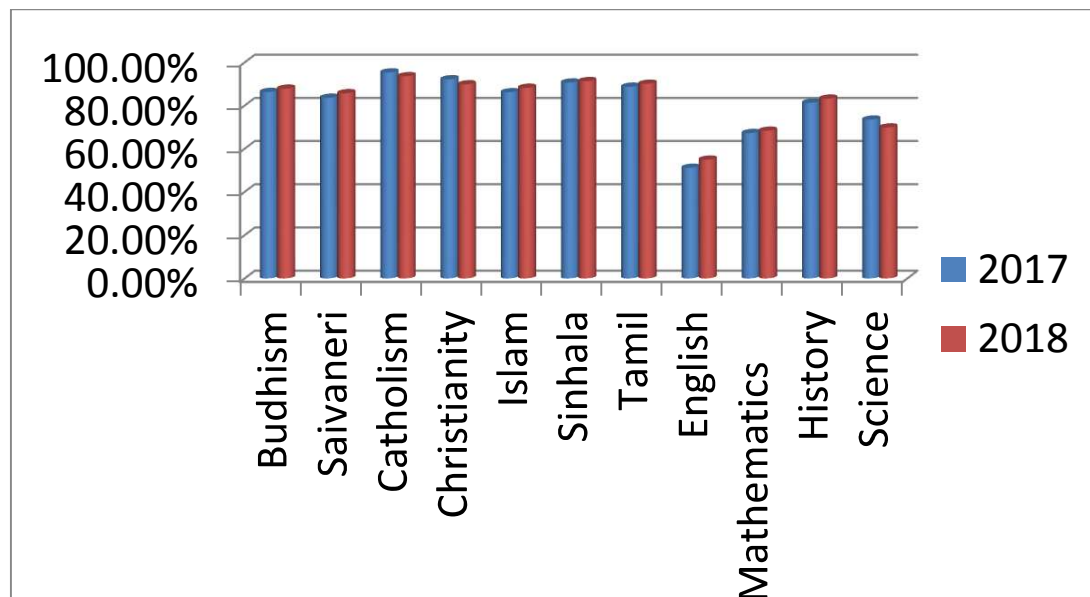


Figure 1.2: Passed percentage of compulsory subjects during previous two years [9].

Figure 1.2 depicts that the amount of students who have passed science is somewhat low than other major subjects and Figure 1.2 depicts that the amount of students who have scored higher grades at the ordinary level examination is low. Most of the students have scored average grades (c and s).

There are several reasons for the inability of most of the students to score higher grades in science.

- The concepts of science are complicated and hard to understand.
- Some students are not much interested in studying science.
- Lack of proper practical experience as some schools are not having proper lab facilities.

The survey we conducted in order to gather requirements for our research shows the value of using 3D technology in learning science.

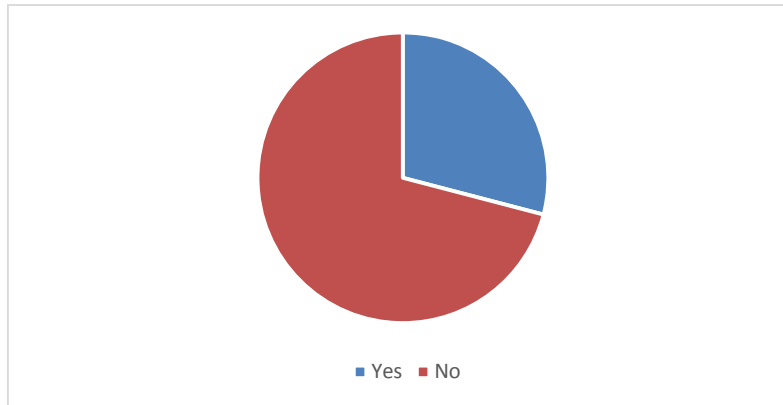


Figure 1.3 : Difficulties in studying Science

Figure 1.3 shows that about 71% of the students who took part in the survey are having difficulties in studying science.

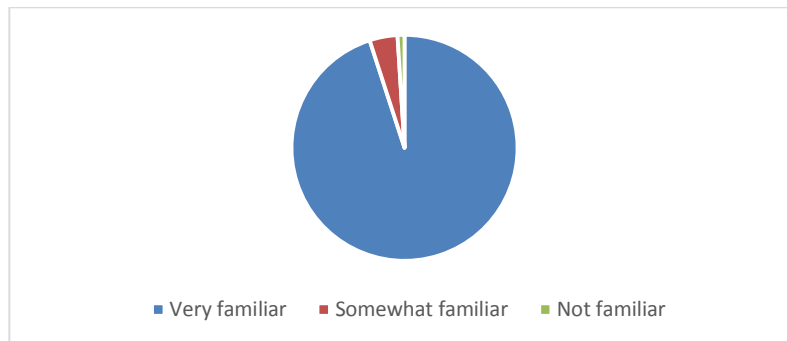


Figure 1.4 : Usage of Mobile phones among O/L students

Figure 1.4 shows that mobile phone usage is not a new thing for O/L students. So using a mobile application will not be a hard task for students.

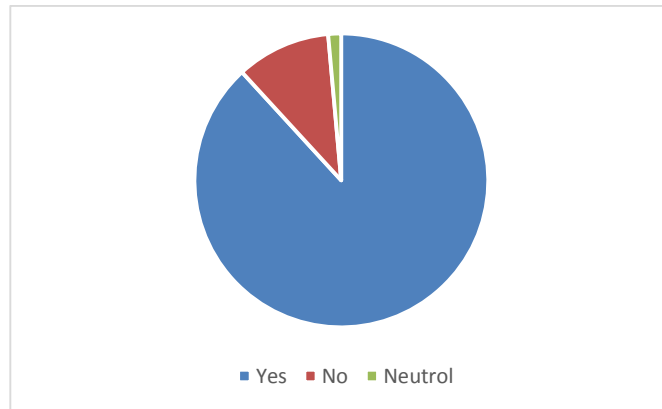


Figure 1.5: Students desire to use 3D technology to learn science.

Figure 1.5 shows that most of the students would like to learn science using 3D technology.

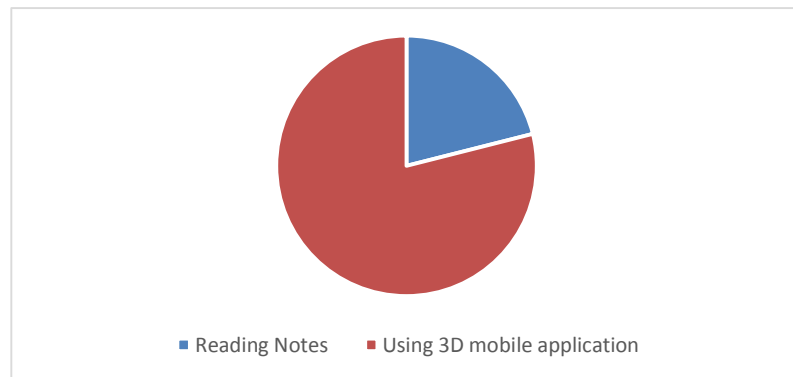


Figure 1.6 : Convenient way of Studying science

Figure 1.6 shows that most of the students are interested in using a 3D application to study instead of reading long notes. According to our survey results mentioned above we can ensure that our proposed application will definitely be a great support to uplift O/L results in Sri Lanka

## **2 OBJECTIVES**

### **2.1 Main Objective**

To improve G.C.E ordinary level science results by introducing an augmented reality based self-learning mobile application.

### **2.2 Specific Objectives**

- Generating 3d models on 2d images to make studying more effective.
- Focus on practical approach rather than just only learning theory.
- Instead of reading theory about processes of human body systems, plant bodies and other scientific procedures students can see those with their own eyes in action.

### **3 METHODOLOGY**

The proposed solution is a mobile application to support ordinary level students in Sri Lanka in their science subject. Augmented reality is the technology used in the app to teach even hard concepts in an interactive way. As a result of the survey we did we were able to find out the area which most students need support and our application is mainly focussing on those areas. The proposed mobile application is implemented as a combination of four major components. Those are,

- AR support on the study of the human body
- AR support on the study of plant bodies
- AR support on studying about acids
- AR support on the study of the biosphere.

#### **AR support on the study of the human body**

This component is developed to study the two main human body systems the digestive system and the urinary system. Once a student captures a 2D image of one of these systems using his mobile camera our application will identify the image and it will be matched with images stored in a vuforia database. If a similar image is stored in the database it will be matched with the identified image and a 3D model of the system along with animations of the processes will be displayed on the captured image.

#### **AR support on the study of plant bodies**

This component will be helpful for students to learn about plants using augmented reality. Once a student captures a given image of a plant tissue or cell, the application will extract it's details and those details will involve in searching for 3D demonstrations of the internal structures of the cell or tissue from the vuforia database and a suitable 3D demonstration will be done on the captured image. If a



student captures a description on the photosynthesis process it will be converted to a meaningful augmented video.

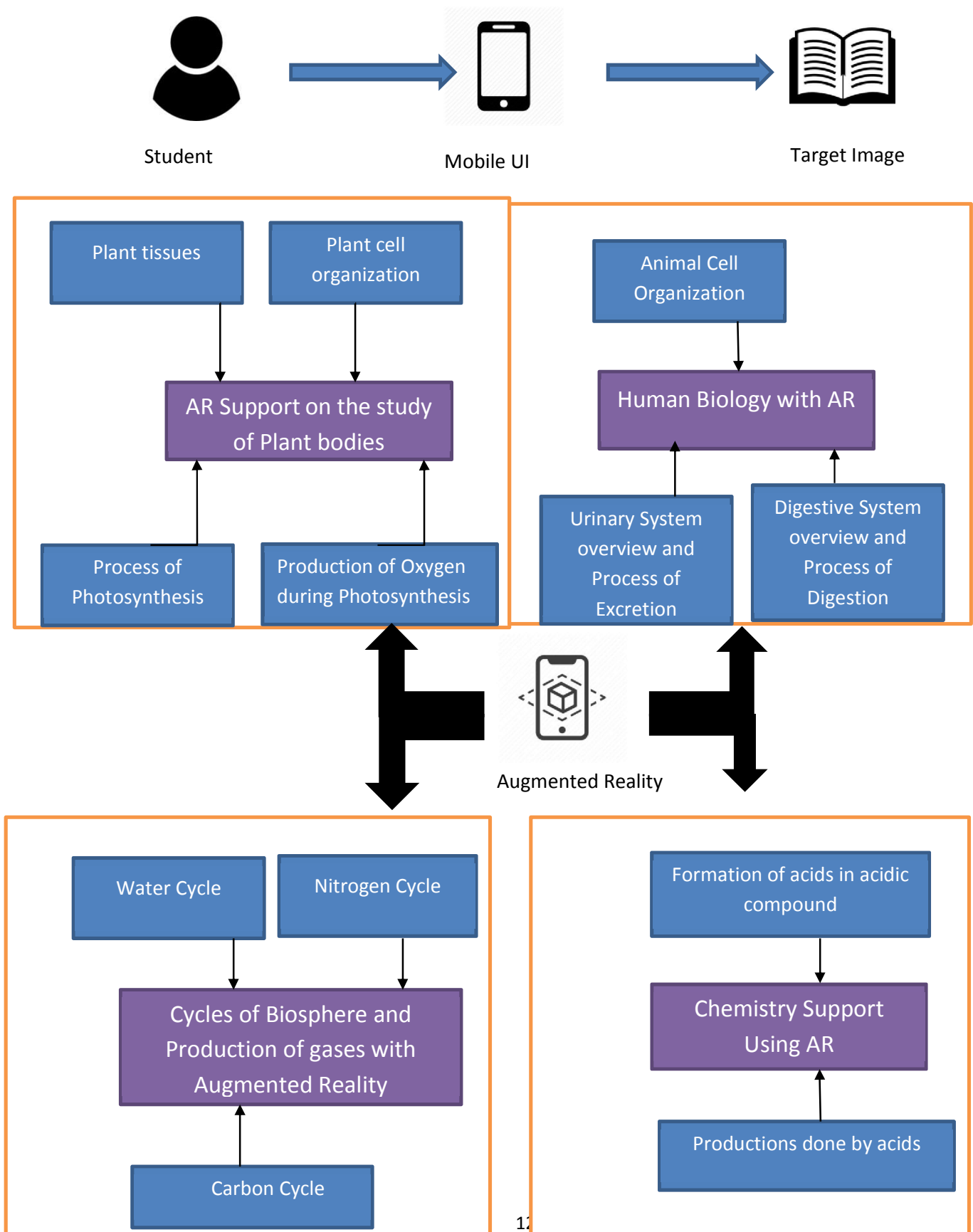
### **AR support on studying about acids**

If a student captures an image of a formula of an acid which is included in the syllabus our application will identify it and it will be matched with a suitable 3D model stored in a vuforia database. Then a 3D model of the molecular formation of the acid will be displayed on the captured image. Furthermore animations on reactions of the acid with specific elements and videos to demonstrate the productions done by acids will be displayed if the students chooses to do so.

### **AR support on the study of the biosphere**

Once a 2D image of water, carbon or nitrogen cycle is captured and identified by the application, it will search for a suitable 3D model from the vuforia database and a 3D model for the specific cycle will be displayed for the students. The application will also include the animations in order to give a clear demonstration for the processes of the cycles. Moreover, there will be clickable objects for the complicated stages or steps in the cycles. If a student wants to further analyse a cycle, he/she can click on these clickable objects for further learning. For those objects, data will be extracted from the database and it will be displayed to the students as an audio, image, or as a video depending on the content of the selected object in the cycle

### 3.1 High Level Architecture



### 3.2 Work Break Down Structure

Our research task was divided into four stages as initial task, documentation, development and testing.

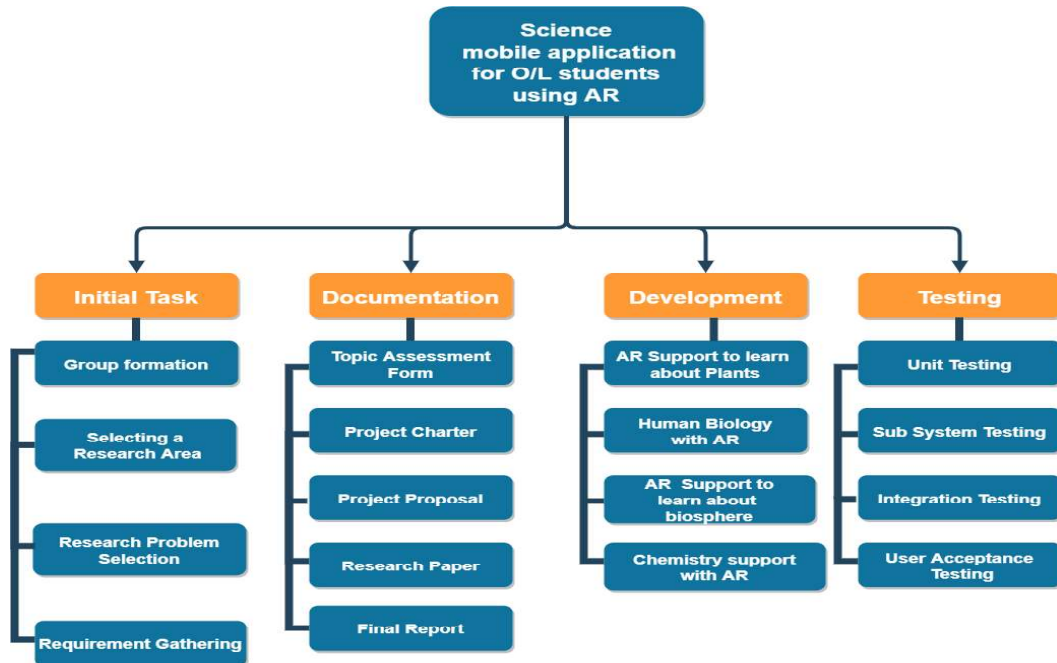


Figure 3.2 : Work Break Down Structure

Figure 3.2 shows how we have categorised our task into the above mentioned four stages. Formation of the group, Selection of a research area and the problem was the initial steps taken before starting the project. The four categories which belong to the development phase will be done by the four members of our group. The final phase is on testing which is based on Unit testing, Sub system testing, integration testing and user acceptance testing. Unit testing will be done by individual members at the end of developing each and every unit to ensure that all the units are error free and it will be helpful to avoid severe errors at later stages. Once all the four components are integrated the entire system will be tested.

### 3.2 Gantt Chart

At the beginning of the research, we as a group planned our task to be completed within specific time periods. So it will benefit us to complete our tasks on time and it will support us to meet deadlines without any trouble.



Figure 3.3 : Gantt Chart

Figure 3.3 shows the way which we have scheduled our tasks

## **4 PROJECT REQUIREMENTS**

### **4.1 Functional Requirements**

- The ability to convert 2D images into 3D models by just only capturing by the phone.
- The ability to demonstrate processes of the human body systems, plant bodies and cycles in the biosphere.
- Ability to convert detailed descriptions into interactive augmented videos.

### **4.2 User Requirements**

- The ability to learn science in an interactive manner.
- An easy way to learn advanced concepts.
- Ability to study science without reading detailed notes

## 5 DESCRIPTION OF PERSONEL AND FACILITIES

Table 5.1 : Description of personnel and facilities

Member	Component	Task
IT17107624 De Silva K.V.P.W	AR support on studying about acids	<ul style="list-style-type: none"> <li>• 3D structures of the formation of acids in an acidic compound.</li> <li>• Animated Demonstrations of the productions done by acids</li> </ul>
IT17106252 U.S Hettihewa	AR support on the study of plant bodies	<ul style="list-style-type: none"> <li>• 3D demonstration of plant cells and tissues.</li> <li>• Photosynthesis process</li> <li>• Production of O<sub>2</sub> during photosynthesis</li> </ul>
IT17157988 Liyanage P.M	AR support on the study of the human body	<ul style="list-style-type: none"> <li>• Demonstration of the animal cell</li> <li>• Human body systems using AR</li> </ul>
IT17098588 N.M.W.K.P.C Naranpanawa	AR support on the study of the biosphere	<ul style="list-style-type: none"> <li>• Demonstration of cycles in the biosphere using AR</li> </ul>

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# AUGMENTED REALITY SCIENCE APP FOR O/L STUDENTS

*We are a final year project group at Sri Lanka Institute of Information Technology (IT17107624 – De Silva K.V.P.W, IT17106252 – U.S Hettihewa, IT17157988 – Liyanage P.M, IT17098588 – N.M.W.K.P.C Naranpanawa). The purpose of this questionnaire is to gather requirements for our final year research project. Please spare few minutes from your busy schedules and be kind enough to respond to this survey. Further, we will assure that all correspondence, including completed survey forms will be kept confidential and secure.*

1. What is your expected grade for science at the O/L examination?
  - i. A
  - ii. B
  - iii. C
  - iv. S
  - v. F
2. Are you facing any difficulties in studying science?
  - i. Yes
  - ii. No
3. How familiar are you in using mobile phones?
  - i. Very familiar
  - ii. Somewhat familiar
  - iii. Not familiar
4. Do you think that a mobile app with 3D technology will support you to study science more effectively?
  - i. Yes
  - ii. No
  - iii. Neutral
5. Which way will be more convenient for you to study science?
  - i. Reading notes
  - ii. Using a mobile app with 3D technology
6. Number the following according to the order you think that 3D technology will be benefited most study (1- most benefited, 4 – least benefited)?
  - i. Acids
  - ii. Bases
  - iii. Salts
  - iv. Hydrocarbons


7. Number the following according to the order which is hard for you to study (1-most , 4 - least)?

- |      |                          |                      |
|------|--------------------------|----------------------|
| i.   | Digestive System         | <input type="text"/> |
| ii.  | Respiratory system       | <input type="text"/> |
| iii. | Urinary System           | <input type="text"/> |
| iv.  | Blood Circulatory System | <input type="text"/> |
| v.   | Reproductive System      | <input type="text"/> |

8. Which of the below topics on plant processes, you feel difficult in your studies?  
Number according to your preference. (1-most difficult, 3-least difficult)

- |      |                   |                      |
|------|-------------------|----------------------|
| i.   | Photosynthesis    | <input type="text"/> |
| ii.  | Plant respiration | <input type="text"/> |
| iii. | Reproduction      | <input type="text"/> |

9. Number the following according to the order which is hard for you to study (1-most , 4 - least)?

- |     |                           |                      |
|-----|---------------------------|----------------------|
| i.  | Plant cell structure      | <input type="text"/> |
| ii. | Plant tissue organization | <input type="text"/> |

10. Which of the following experiments do you feel difficult from your science syllabus?  
(1-most, 5-least)

- |      |   |                      |
|------|---|----------------------|
| i.   | Starch production during photosynthesis         | <input type="text"/> |
| ii.  | Need of light energy for photosynthesis         | <input type="text"/> |
| iii. | Need of CO <sub>2</sub> for photosynthesis      | <input type="text"/> |
| iv.  | Need of chlorophyll for photosynthesis          | <input type="text"/> |
| v.   | O <sub>2</sub> production during photosynthesis | <input type="text"/> |

11. Number the following cycles according to the order which is complicated for you to understand? (1 – most, 4- least)

- |      |                |                      |
|------|----------------|----------------------|
| i.   | Water Cycle    | <input type="text"/> |
| ii.  | Hydrogen cycle | <input type="text"/> |
| iii. | Nitrogen cycle | <input type="text"/> |
| iv.  | Carbon cycle   | <input type="text"/> |

12. According to you, what kind of benefits you can gain by using a mobile app with 3D technologies to study your O/L science syllabus?

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