SCIENCE APP FOR O/L STUDENTS USING AUGMENTED REALITY

Project Id: 2020-160

Project Proposal Report

IT17107624 – De Silva K.V.P.W

B.Sc. (Hons) Degree in Information Technology Specialising in

Software Engineering

Department of Software Engineering

Sri Lanka Institute of Information Technology

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DECLARATION

I declare that this is my 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 my 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

Signature:

……………………………….   …………………………

Wendy De Silva   Date

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor:

………………………………….   ……………………..

Ms Uthpala Samarakoon   Date

ABSTRACT

Chemistry carries a considerable weightage in the O/L syllabus and is much more a practical based subject. But some schools are not having the ability to give a proper practical experience for their students. Also the concepts taught in chemistry are somewhat hard to understand because of the abstract nature of chemical concepts and the inability to understand the language (formulas) used in chemistry. The study on acids is a major component of the science syllabus and almost most of the concepts relevant to that topic are described in note basis. The survey we conducted shows that most of the O/L students are having difficulties in understanding concepts related to acids. The intension of this research is to propose a solution which would support O/L students on their practical aspects even without the need of proper lab equipment and to make students feel more interested in learning acids. Today's young generation is very keen to learn new technologies and they are experts in using mobile phones. Mobile Augmented reality is an effective technology used in many fields and specially using it for elearning purposes will provide students an engaging experience and also it will be an interactive way to teach even difficult concepts in a more understandable manner. The proposed component is to support chemistry by covering the content related to acids using augmented reality. A mobile application will be developed using augmented reality to provide a practical experience for students along with the ability to learn on acids in an interesting manner.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1 INTRODUCTION

1.1 Background

According to the statistics of the National examinations department [1] the amount of students who have passed science at their G.C.E ordinary level examination is comparatively low than other compulsory subjects. Even among the passed students only a very low amount of students have been able to score higher grades. The O/L science syllabus is categorised into Biology, Chemistry and Physics. Among those chemistry is somewhat a hard area for students to understand because of the depth of it's concepts. After doing a survey we were able to find out that among the topics discussed under chemistry most of the students are facing difficulties in learning about acids because according to the syllabus they have to memorise some formulas and reactions related to acids included in the syllabus. So responses given in the survey depicts that it would be worthy if there is an effective way to understand the concepts easily.

After investigating the responses given in the survey I have decided to focus on the lesson based on acids and my component will cover the entire content related to acids using Augmented Reality. This will help students to grab the content in an attractive manner. Augmented Reality is a growing field of technology. Currently it is being used in many fields like medicine, eLearning etc. It is really helpful in eLearning because even harder concepts can be taught in a way which students can grab it easily.

Augmented reality will convert 2D images and detailed text based descriptions into 3D models and attractive animations which would make students feel interesting in studying.

Nowadays the young generation is very familiar in using mobile phones and they are very keen to embrace new technologies. So definitely this application will be popular among O/L students and it will be a guide to improve their knowledge. My component will be supportive for O/L students to learn well

about acids included in their science syllabus. This will also guide them to score higher grades in science because even harder concepts will be presented in a more simplified manner

1.2 Literature Survey

The statistics of O/L results of previous years published by the national examinations department [1] shows that the amount of students who were able to pass science at their O/L examination is comparatively low than other main subjects. Also even among the passed students the amount of students who have scored higher grades are unsatisfactory.

The prevailing education system in Sri Lanka is a method which is based on face to face interaction between the teacher and the students. Most of the time due to lack of proper resources science teachers are not having the ability to use visual aids at their lessons. In most of the schools science lessons are done only using oral communication. There are so many drawbacks in teaching chemistry for O/l students using this traditional approach.

In an online newspaper article [4] Gina Truman describes the drawbacks of traditional science education system. According to her, teacher is the only source of education. Students won't take any effort to learn new things by themselves. Also if schools are not having proper lab facilities students are not getting a proper practical experience. This method is not successful in learning a subject like chemistry which is a highly practical subject and also it needs student interaction rather than just learning theory. Students will not get the opportunity to be familiar with the practical aspects of chemistry. Sometimes traditional learning might make students feel boring and tired in learning chemistry and also it will be a reason for students to feel chemistry as a burden. So it would be effective if an interactive solution can be proposed for students to learn chemistry while engaging in practical approaches.

There are so many researches carried by several people to discuss the weaknesses in the prevailing education system of Sri Lanka.

I.M Kamala Liyanage discusses in her research[5] that most of the students who fail O/L are from low equipped schools. She shows that there is a visible disparity across regions in educational attainment of students. She says that most of the students who fail O/L is due to less facilities in schools, not having well qualified teachers in rural schools. All these things have affected the quality of education in Sri Lanka. This has become a main reason for poor students to have low interest in science and specially the chemistry content relevant to O/L. It would be useful for such schools if we can introduce an augmented reality application as it would be helpful for them even though they are not having proper facilities or teachers.

As the world is moving towards digitalization most of our day to day activities are having an digitalized impact. So education also should not have an exception. Specially as chemistry is a more practical based subject it would be better if chemistry can be taught in a digitalized manner with the support of a new technology which is able to provide students an engaging experience.

Dr Jayarathne discusses in his report[6] the way how science can be taken to rural areas. He says that an interactive nature similar teaching method would be supportive to learn science. He says that active participation in the subject will improve students' knowledge. Augmented reality can provide this nature similar teaching approach.

Several researches have been carried out to eliminate the use of augmented reality in chemistry education.

Research paper [7], shows how interactive augmented reality is when teaching chemistry. It shows how atomic structures can be augmented into 3D models and also the use of using AR in demonstrating acids is also discussed. It shows that students will be engaged in the subject interactively and also the paper

discusses how students can learn chemistry using AR even though they are lacking proper facilities.

1.3 Research Gap and Research Problem

1.3.1 Research Gap

Currently there are no existing augmented reality based mobile applications to study on acids focussing on the G.C.E ordinary level syllabus. But there are some applications which are having some similar features of our application which are not relevant to acids. The research proposed in research paper [8] is based on acids but it is marker based and it demonstrates only the 3D model of the formation of molecules in acids. It doesn't demonstrate any reactions and productions done by acids.

Table 1.1 : Comparison of existing systems

	Chemical bonds Visualization [7]	Mobile AR on learning chemistry [8]	Molecular kit [9]	Proposed Solution
3D Molecular Shapes with animations	✓	✓	✓	✓
Augmented demonstration of reactions	✗	✗	✗	✓
Converting text to augmented videos	✗	✗	✗	✓
Based on acids and specific to the local O/L syllabus	✗	Based on acids but not specific to the syllabus	✗	✓

All the systems compared in Table 1.1 are using AR markers as there targets. But our proposed application will be using the O/L text book as the target. This will be more easier for students rather than using AR markers.

1.3.2 Research Problem

Examination department's statistics of previous years [1] show that the G.C.E ordinary level science results are comparatively low than other main subjects. Most of the students have been unable to score higher grades for science at the O/L examination.
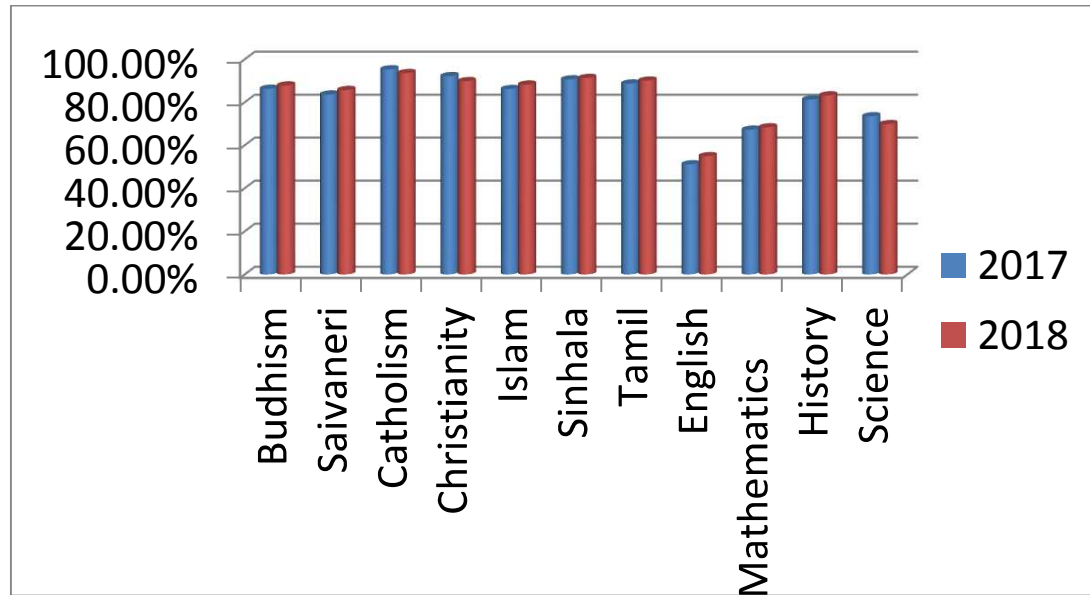

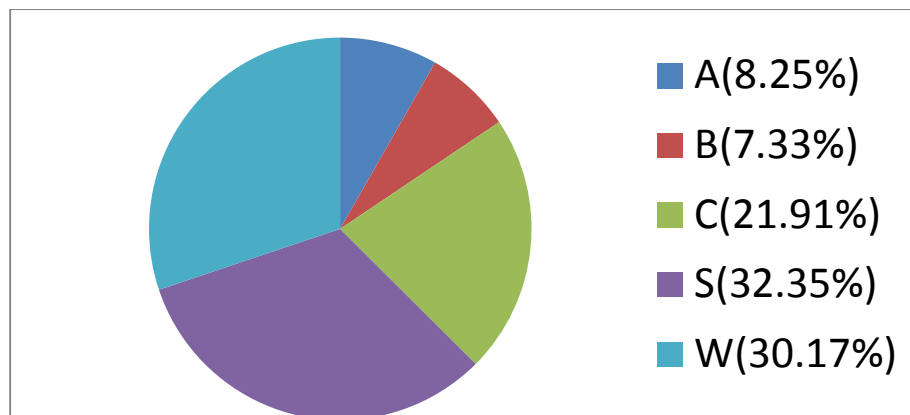Figure 1.1: Passed percentage of compulsory subjects during previous two years [1].

Figure 1.2: Science results of 2018 by grades [1].

Figure 1.1 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.

Problem Specific to the Component

As a result of the survey we conducted among O/L students we were able to find out that most of the students prefer to learn about acids using 3D technology, among the content which belongs to O/L chemistry.
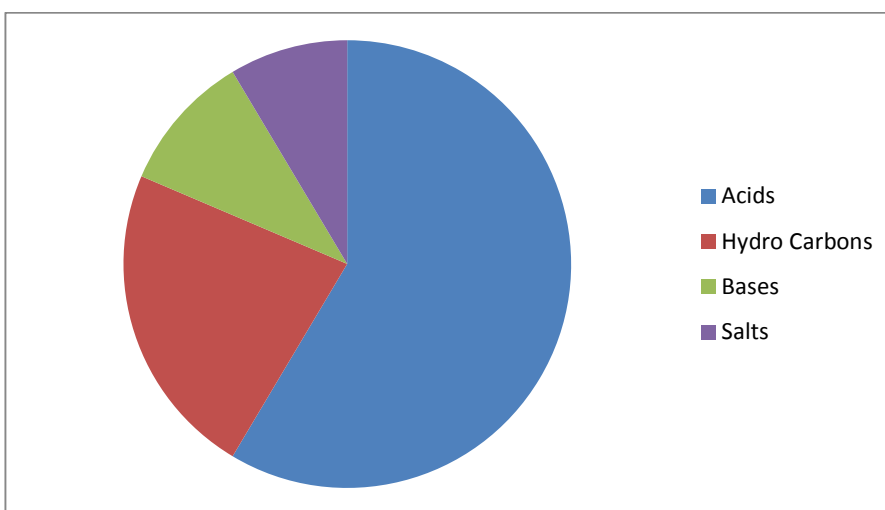
Figure 1.3 : Desire of topics to be learned using 3D technology.

Figure 1.3 shows that most of the students who participated in the survey would like to get 3D support on learning about acids. As a requirement for the G.C.E O/L examination students have to memorise reactions of acids with elements and productions done using acids. This is hard for students and they would like if there is an interactive method for them to keep all of these concepts in their mind. The

productions done using acids are described using detailed descriptions in the text book so students are feeling bored in reading those and sometimes the content presented might not be clear enough for them to understand. The proposed solution will convert these detailed text based descriptions into effective animated videos. So students will be able to understand the concepts more clearly.

Rather than having 2D structures of the formation of acids in acidic compounds it would be more effective if students can learn those with the help of 3D models.

The proposed component will solve above discussed issues by providing AR support for O/L students.

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. This component will support that task by providing augmented reality support to learn about acids.

2.2 Specific Objectives

- Demonstrate 3D models of the formation of acids in acidic compounds.
- Demonstrate productions done by each acid using animations.
- Convert detailed text based descriptions on reactions of acids with elements into 3D models and animations.

3 METHODOLOGY

Augmented reality support to learn about acids.

The proposed component is a solution for the problem discussed above. The component is using augmented reality to cover the content relevant to acids included in the O/L syllabus. The component will be developed in a manner which can provide students an engaging experience on the content and also students will be able to get a practical experience even without using any lab equipment.

According to the task performed the component is sub divided into three sub components.

- Visualisation of acidic bonds using augmented reality.
- Animated demonstration of the specific acid with a selected element.
- Converting descriptions on productions done by acids, into augmented videos.

A mobile application will be developed to fulfil above mentioned tasks using Unity. Unity is a real-time development platform which can create 3D visualisations.

Step 1 -:

The target of the AR application is the grade 11 science text book(This component targets on acids.) . Once a student plays the app, he/she can capture a formula of an acid given in the text book. The application will extract the features of the captured image and it will be matched on a suitable 3D model stored in a Vuforia database. The matched 3D model will be displayed on top of the captured image.

Eg :
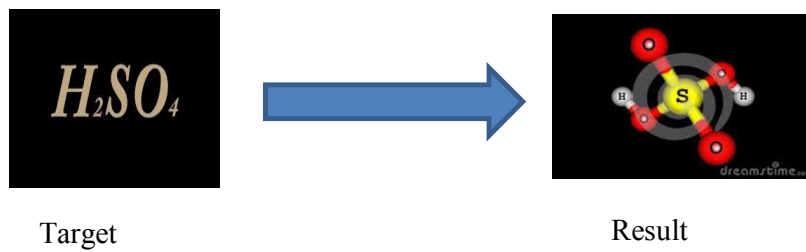
Target   Result

When a student captures the above target the given result will be displayed along with options for below step 2 and step 3.

Step 2

If the student wants to understand a reaction of an element with the specific acid he can choose an element and then the application will display an augmented 3D animation on how the reaction happens naturally. It would be interactive than just memorising an expression on the reaction.

Once a student selects an element the backend of the application will identify the student's selection and the specific acid and the element will be analysed through the application and it will be matched with a suitable animation of the reaction stored in the database. The animation will be played.

Step 3

When a student selects the option to demonstrate productions done by a particular acid an augmented video will be played for the student to understand production clearly.

3.1 High Level Architectural Diagram

Student   Mobile UI   Target (Science Text Book)

Augmented Reality

Formation of acids in acidic compounds

3D models

Productions done by acids

Reactions of acids with elements
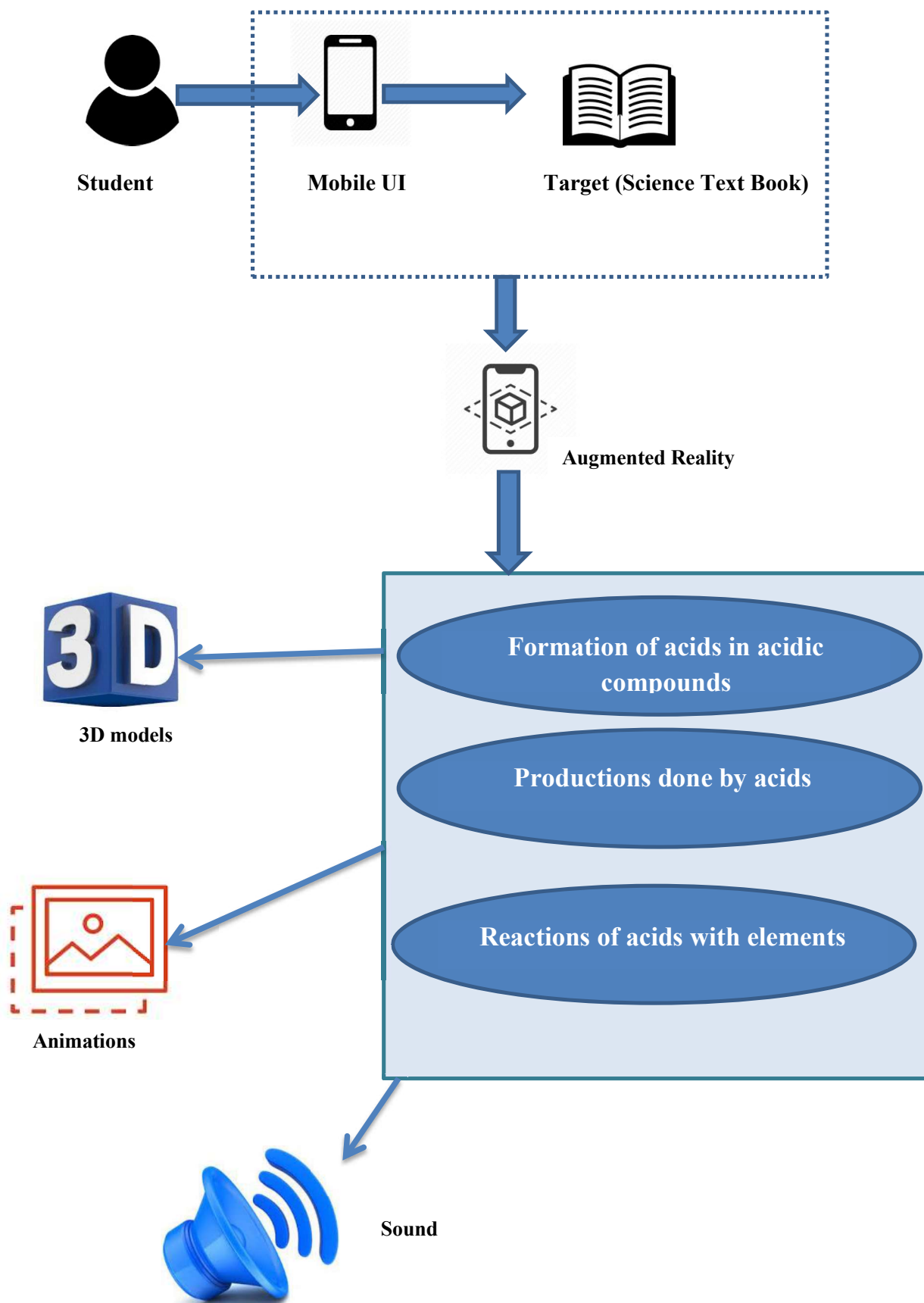
Animations

Sound

Figure 3.1 : System Architecture   11

3.2 Work Break down Structure

I have categorised my project task in to four sub parts as the initial task, documentation , development and testing. Initial tasks are the steps which we took as a group to come up with a suitable research. Documetation work is going to be carried out at different stages of the project. Development are the main tasks which are done in order to come up with a proper solution. Testing is also playing a major role in the project. It will support to come up with an error free solution.
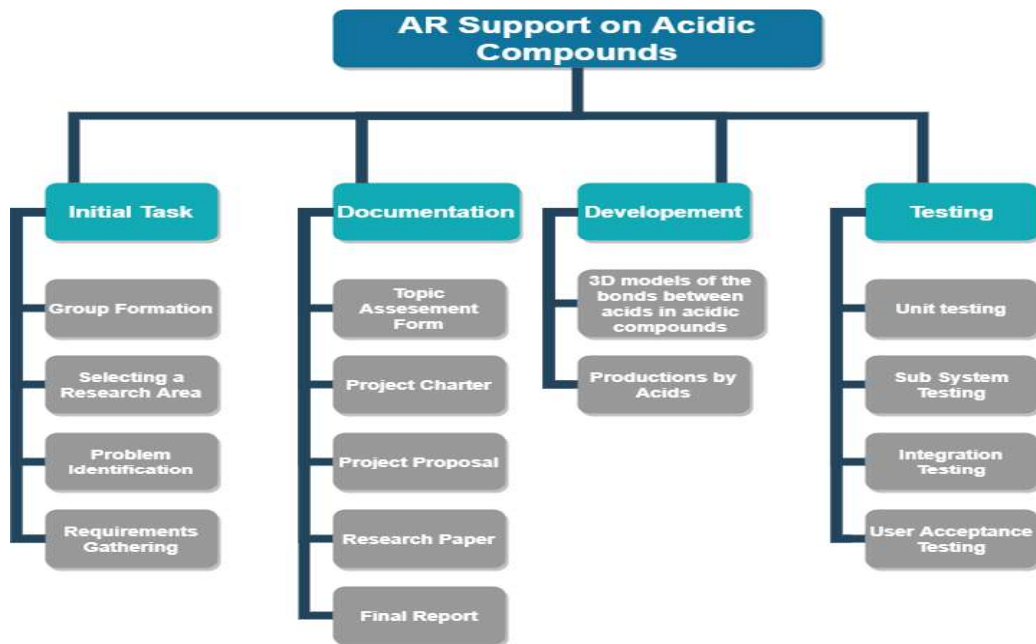
Figure 3.2 : Work Break Down Structure

Figure 3.2 depicts how my task will be carried under the four stages mentioned above. At the end of developing each and every unit it will be tested to ensure that the unit is error free and to minimise the cause of severe errors at latter stages of the project. After my component is completed it will be tested before integrating with other components and once all the components are integrated the entire system will be tested. User acceptance testing will also be conducted at the end of the overall development to ensure that the solution has reached its user requirements.

3.2 Gantt Chart

I have planned all my project work to be completed within scheduled time lines. It will support me to manage my task properly and I will be able to meet deadlines without any trouble.

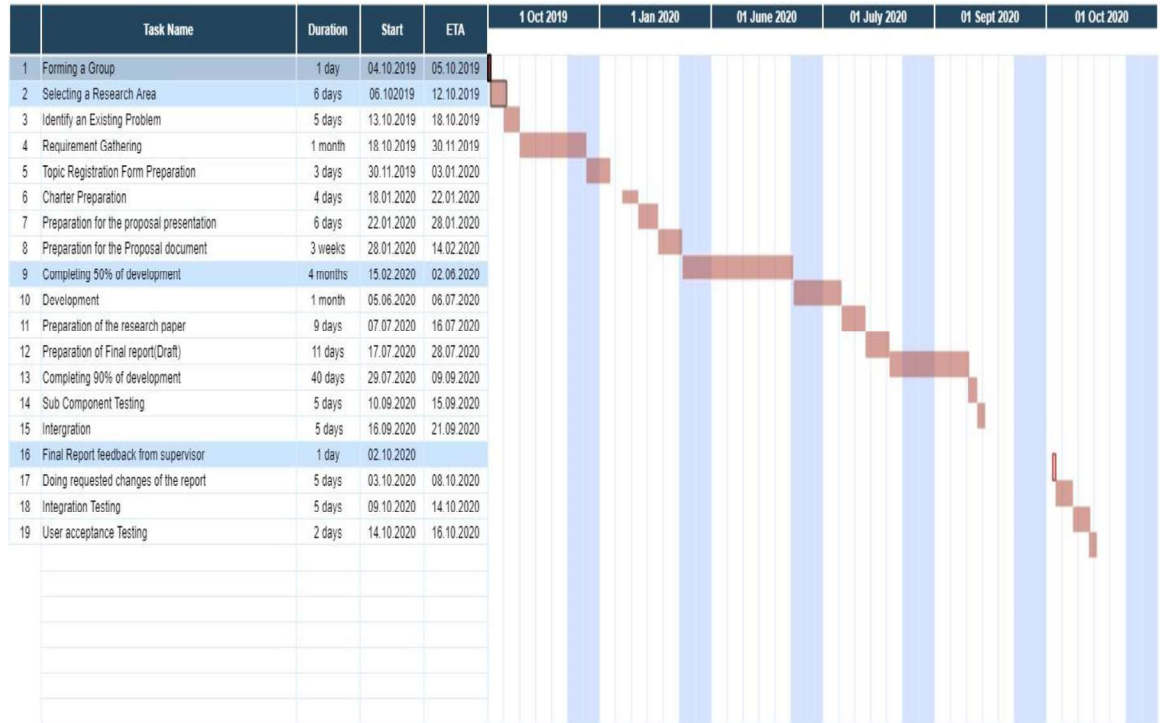|	Task Name	Duration	Start	ETA
1	Forming a Group	1 day	04.10.2019	05.10.2019
2	Selecting a Research Area	6 days	06.102019	12.10.2019
3	Identify an Existing Problem	5 days	13.10.2019	18.10.2019
4	Requirement Gathering	1 month	18.10.2019	30.11.2019
5	Topic Registration Form Preparation	3 days	30.11.2019	03.01.2020
6	Charter Preparation	4 days	18.01.2020	22.01.2020
7	Preparation for the proposal presentation	6 days	22.01.2020	28.01.2020
8	Preparation for the Proposal document	3 weeks	28.01.2020	14.02.2020
9	Completing 50% of development	4 months	15.02.2020	02.06.2020
10	Development	1 month	05.06.2020	06.07.2020
11	Preparation of the research paper	9 days	07.07.2020	16.07.2020
12	Preparation of Final report(Draft)	11 days	17.07.2020	28.07.2020
13	Completing 90% of development	40 days	29.07.2020	09.09.2020
14	Sub Component Testing	5 days	10.09.2020	15.09.2020
15	Intergration	5 days	16.09.2020	21.09.2020
16	Final Report feedback from supervisor	1 day	02.10.2020	
17	Doing requested changes of the report	5 days	03.10.2020	08.10.2020
18	Integration Testing	5 days	09.10.2020	14.10.2020
19	User acceptance Testing	2 days	14.10.2020	16.10.2020

Figure 3.3 : Gantt Chart

Figure 3.3 shows the way how I have scheduled my research work throughout the year.

13

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 3D models of the formation of acids in acidic compounds.
- Converting equations into animations of those reactions.
- Ability to convert detailed descriptions on productions of acids into interactive augmented videos.

4.2 User Requirements

- The ability to learn on acids in an interactive manner.
- An easy way to learn advanced concepts.
- Ability to study about productions of acids without reading detailed notes.
- Easy method to memorise reactions.

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 for the lesson on acids in O/L science syllabus	• 3D demonstration of formation of acids in acidic compounds. • 3D animations on the reactions of acids with elements. • Converting descriptions on productions of acids into augmented videos and animations.

5 REFERENCES

[1] Department of Examinations, Sri Lanka,"Performance of candidates,G.C.E.(O/L)Examination," *Department of Examinations, Sri Lanka*,[Online].Available: https://doenets.lk/statistics [Accessed: Jan.25,2020]

[2]IEEEDataPort,"How to Cite References:IEEE Documentation Style",Online: https://ieee-dataport.org/sites/default/files/analysis/27/IEEE%20Citation%20Guidelines.pdf [Accessed: Jan 25,2020]

[3]Educational Publications Department, *Science Grade 11* . Sri Lanka . 2015

[4] Gina Truman,**"**X Pros & Cons of Traditional Education, " *Daily on Web* October 17,2017. [Online], Available : https://www.dailyonweb.com/News/X-Pros-Cons-of-Traditional-Education.html [Accessed Feb. 20,2020].

[5] I.M Kamala Liyanage , *Education System of Sri Lanka.*

[6] Dr K.P.S.C Jayaratne "Sri Lanka – Country Report, "in *Expert Goup Meeting on Scientific and Technological Culture* , Singapore , 1997.

[7] Christyowidiasmoro and Surya Supeno, "Chemical Bonds Visualization using Particle Effect and Augmented Reality, " in *2014 Proc. IPTEK conf* , vol.1.

[8] Apichon Nachairit, Niwat Srisawasdi , "Using Mobile Augmented Reality for Chemistry Learning of Acid-base Titration," in *23rd International Conference on Computers in Education*, China, 2015.

[9]myinteracademy.(2019).MoleculeKit(Version2.2.1)[Mobileapplication] Available : https://play.google.com/store

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
    ii.   Respiratory system
    iii.   Urinary System
    iv.   Blood Circulatory System
    v.   Reproductive System

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
    ii.   Plant respiration
    iii.   Reproduction

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

    i.   Plant cell structure
    ii.   Plant tissue organization

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

    i.   Starch production during photosynthesis
    ii.   Need of light energy for photosynthesis
    iii.   Need of CO_2 for photosynthesis
    iv.   Need of chlorophyll for photosynthesis
    v. O_2 production during photosynthesis

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

    i.   Water Cycle
    ii.   Hydrogen cycle
    iii.   Nitrogen cycle
    iv.   Carbon cycle

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?