3D INTERACTI AL EDUCATION

CARDIAC ANATOMY: MYOCARDIAL INFARCTION

RATHI THEVY A/P JEVANANTHAM

A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS

FOR THE AWARD OF THE DEGREE OF

BACHELOR OF COMPUTER SCIENCE (GRAPHICS AND MULTIMEDIA TECHNOLOGY)

FACULTY OF COMPUTER SYSTEMS AND SOFTWARE ENGINEERING

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2014

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this technical report and in my opinion, this technical is adequate in terms of scope and quality for the award of the Bachelor of Degree in Computer Science (Graphics and Multimedia Technology)

Name : PUAN SITI NORMAZIAH IHSAN

Position : LECTURER

Date : 9 JUNE 2014

Signature :

STUDENT'S DECLARATION

"I hereby declare this work of title "3D Courseware for Medical Education; Cardiac Anatomy: Myocardial Infarction" is the result of my own research except as cited in the references. The technical has not been accepted for any degree and is not concurrently submitted in candidature of any other degree."

Name	:	RATHI THEVY A/P JEVANANTHAM
ID Number	:	CD11001
Date	:	09 JUNE 2014
Signature	:	

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Thank you.

ABSTRACT

3D Interactive courseware for Medical education (Cardiac Anatomy: myocardial Infarction) is an educational courseware that will provide information about myocardial infarction, how it occurs and the complication that might cause to the organ and health tips to prevent cardiac related diseases in an interactive way. This could help the user to gain knowledge on cardiac related topics and help them to seek preventions. The aim of this courseware is to provide information on coronary heart disease through high quality three dimensional models and allow users to interact to obtain information included into this educational courseware. The objectives of this project to educate users on myocardial infarction with a details 3D models, is possible when 3D interactive courseware can utilized for lessons, to implement the use of 3D interactive courseware widely to make the knowledge reach everyone. This could create medical awareness among Malaysian regarding health issues since it's been developed as an interactive 3D courseware that provides the concepts appropriately for cardiac anatomy learners. The scope of the project are medical students, lecturers, pre-medical students, nursing students, patients or anyone who is looking for a basic Anatomy review to learn about anatomical details on their computers. The courseware could provide an accurate look at the anatomy of the most important organ in human body, Heart and specifically artery where the heart attack occurs. 3D Interactive courseware for Medical education would be an outstanding experience of learning for users. Quiz included in the courseware could be attempted by users to evaluate their understanding on coronary heart disease.

ABSTRAK

Perisian kursus untuk sakit jantung ini dibina untuk memdidik masyarakat Malaysia yang terdedah kepada masalah kesihatan berkaitan dengan jantung. Preisian ini dibangunkan dengan menggunakan Adobe Flash 6 ,Adobe Photoshop CS6,Adobe After Effect, Autodesk Maya serta beberapa software lain. Projek ini adalah berkisar tentang membangunkan sebuah aplikasi berunsur pendididkan yang dapat membantu para pelajar jurusan perubatan, para pendidik, masyaratkat umum serta pesakit untuk memahami ataupun menjadikan perisian ini untuk process pembelajaran and pendididan mengenai penyakit berkaitan dengan jantung. Objektif-objektif bagi projek ini adalah untuk memberi kesedaran dan meningkatkan pemahaman mengenai penyakit pembunuh di malaysia. Applikasi ini akan menyertai kempen-kempen yang sedia ada melalui televisyen, radio dan risalah untuk mendekati and memdidik masyarakat mengenai kepentingan kesihatan secara lebih dekat atau mesra.. Beberapa sesi temuduga secara tidak formal berkaitan dengan kesedaran kesihatan telah dilakukan dalam usaha untuk mendapatkan maklum balas secara langsung daripada pengguna. Aplikasi tersebut dijangka dapat memenuhi matlamat dan objektif yang disenaraikan di dalam projek ini.

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PART 1

INTRODUCTION

1.1 Introduction

Growing technology has contributed significantly to sedentary lifestyles and has made huge changes on simplifying people's life. The contribution has continues to expand the horizons to various fields gradually. Healthcare is one of the field where technology used by professionals to transform the field into an innovative field.

According to a recent online article published in Forbes magazine dated 24th January 2013, there are five ways technology in transforming health care identified. The first way is crunching data to offer a better diagnosis and treatment with the use of super computers to help physicians make better diagnoses and recommend treatments. The second way is helping doctors to communicate with their patients using mobile applications. The next way mentioned in this article is linking doctors to other doctors in order to share knowledge on medical practice or patient details. Similarly the forth way is connecting doctors and patients potentially to provide medical advices and to share medical condition of the patient frequently.

Eventually, the last way identified in the article published in Forbes magazine is helping patients to stay healthy by implementing applications where patients can get information about healthy living style.

The article inspired a lot and has become the reason why the 3D Interactive courseware for cardiac anatomy: myocardial infarction is proposed and developed. Out of the five ways compiled in the article, the forth way and fifth way are selected for the development of the 3D courseware. The courseware could be a needed technological upgrade to the Malaysian medical education and healthcare and help Malaysians to live a healthier life when a platform that linking world of medicine and common people created via Interactive courseware such as the proposed 3D interactive courseware.

1.2 Problem Statement

The Awareness about coronary heart disease among Malaysian is not is at a satisfying level even it is declared as the leading killer by WHO (World Health Organization) and agreed by Ministry of health which added that in year 2009 through a statistic conducted; one in four deaths in Malaysia government hospitals was attributed to either heart attacks or strokes.

Secondly, the 3D interactive courseware could help medical or pre-medical students to access it anytime anywhere and obtain information in far more interesting way than usual. Uninteresting lecture session can be transform into an interesting period when lesson delivered in 3D interactive courseware. This could help the students to explore and experience anatomy studies in a different view and improve teaching and learning environment.

Cardiac patients and their family members often explained by the physician using models and posters to deliver patient's diagnosis report to make them understand about the organs complications.

Educational environment is already starting to associate with positive intellectual and technological outcomes for students nowadays. In accordance to that, medical courseware also needs to be changed to Interactive courseware that will support aesthetic interfaces for the users. This would be a pleasing and satisfying learning process compared to notes, books and slides. Thus, as an evolving field, graphic and multimedia could contribute significantly in illustrating the disease related organ and vessels such as artery and vein as well as the occurrences in 3D models for better understanding. User could easily understand about the risk factors and able to safe themselves from becoming the victim of this killer disease. In order to achieve the aforementioned solutions, this courseware could educate user about myocardial infarction, the root cause of the occurrence and way to prevent this disease.

1.3 Aims

i. To develop an educational courseware that will be explore by users to educate themselves about myocardial infarction which is also known as heart attack.

ii. To be one of the learning materials to teach and at the same time to create awareness amongst Malaysians regarding the importance of concerning their health issues.

iii. To help users to reconstruct their lifestyle and to prevent from becoming victim of coronary heart disease.

iv. To reduce the number of death among Malaysian who died because of coronary heart disease.

1.4 Objectives

i. To collect coronary heart disease related information and develop 3D interactive courseware which will educate users on aforementioned disease.

ii. To support green computing by reducing consumption of papers and increase efficiency in teaching and learning. This is possible when 3D interactive courseware used for lessons and creates medical awareness among people.

iii. To develop an interactive 3D courseware that provides the concepts appropriately for Malaysian on coronary heart diseases, specifically on myocardial infarction.

1.5 Scope and Limitations

i. The target users for 3D interactive courseware are medical students, lecturers, pre-medical students, nursing students, patients and adult Malaysians who are looking for a courseware to learn about coronary heart disease. The 3D models and montage with animation would help viewers to understand about myocardiac infarction. A quiz is included in this courseware to be attempted by users to evaluate their understanding on cardiac anatomy studies.

ii. This courseware is a Windows based (stand-alone) application.

The courseware is developed as a Windows based application to allow it to be used by all without any restrictions as windows have become the world's leading operating system. It is classified as a standalone application because it does not require any special software other than the operating system itself to run.

iii. This courseware will be in fully English
English language is chosen for this courseware to allow users to have accurate information about the medical terms related to myocardial infarction.

However, there are some limitations of this application which are stated as follows;

i. The application only focuses on the specific disease which is myocardial infarction. The 3D models, information and video included only focus on the educating users on heart attack instead of covering all the coronary heart diseases.

ii. The courseware users will not be notified if there is any latest version available. Since this is a stand alone courseware which never connects to internet; the users could never be informed if the content of the courseware is being updated.

1.6 Literature Review

1.6.1. Cardiovascular system – heart anatomy by J. Crimando Ph.D

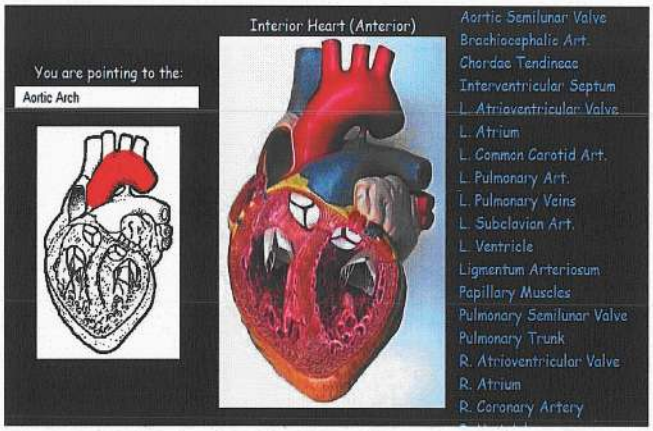


Figure 1.1: Heart Anatomy

The Heart Anatomy provided by Dr. J. Crimando is a web-based application that allows users to interact with the application to identify the parts of heart such as Artery and pulmonary trunk.

The heart structure is has been illustrated in a 2D image and line drawing image. User can move the cursor above the regions to instruct the system to display the area selected and they can click to make the region name appear inside the text box included above the picture.

a. Advantages

   i. This simple application can be a user friendly since not much instructions needed to guide the users to know how to use the system.

   ii. Contains light graphic and database that allows fast loading of the side.

iii. Test included for this anatomy application also as simple as the lesson included where the user need to click the regions in heart to identify the name of the particular area.

b. Limitations

i. No 3D model of heart included to make the application look more effective.

ii. Users cannot conduct more interactivity with the application such as rotating the model to have more detailed view of the organ.

1.6.2 Anatomy of the Heart by Google Play for Android Applications.

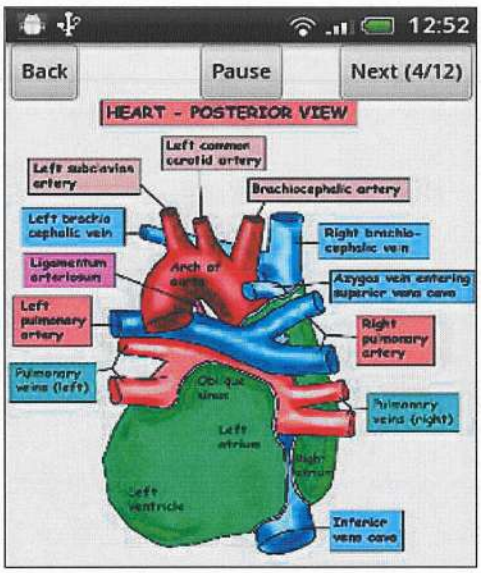


Figure 1.2: Anatomy of the Heart. Android Apps.

Anatomy of the Heart is an application provided by Google play for Android phone users. This lecture on the Heart and Pericardium application is available at www.instantanatomy.net and Android users can add it to their Google play account and download it directly to their phone. Anatomy of heart is can be play with relevant diagrams related to cardiac anatomy and provided with audios. Users can interact with the mobile application along the session by zoom in on the images with the pinch gesture as the audio plays.

This application is aimed at anyone who is studying human anatomy specifically cardiac anatomy. The application are believed to be the ideal for medical or nursing students,

biological studies students and physiotherapists or doctors looking to refresh their knowledge.

a. Advantages

   i. Based on users review, this application is provides easy to understand lecture with excellent explanations, diagrams, descriptions, clear images and audios.

   ii. It is a free application provided for android users with attractive 2D images and diagrams.

   iii. The voice guidance included along the session from the beginning until the end. It helps the user to understand more about the cardiac anatomy as attending an as actual lecture.

b. Limitations

   i. No test or quiz included on this application for the user to test their understanding on the lecture given.

   ii. Less interactivity for the users to interact with the application such as zooms in and navigates to next page.

1.6.3 Pocket Heart –The interactive human body by Apple Application store.

Figure 1.3: Pocket heart

Pocket heart is an attractive mobile application developed for iPhone and iPad that provides 3D models where users can experience the real time heartbeat and more.

According to the developer the Pocket heart application is developed based on the cooperation, they built with healthcare professionals, educators and patients to design meaningful and beautiful mobile medical education software and to become a premium medical education mobile reference tool.

a. Advantages

i. Pocket Heart application is a novel way to visualize, hear and understand how the human heart works, in 3D.

ii. There are anatomical content resides in the application, thus no need for Wi-Fi or 3G.

iii. Approximately 20,000 words of detailed learning content included in this application.

iv. Application comes with Intuitive navigation therefore the users don't have to scroll through long menus. The application also contains interactive engaging multimedia content.

v. In order to succeed the objective of this application; multiple quizzes included in enabling self-paced learning for the users.

b. Limitations

i. Expensive; even though it is a free application provided for the user, it can be utilized by people who are affordable to own iPhone or iPad.

ii. The application contains heavy graphics that requires amount of time in loading the application.

1.6.4 3D Heart Anatomy – by J.M.B. Melara for Apple.

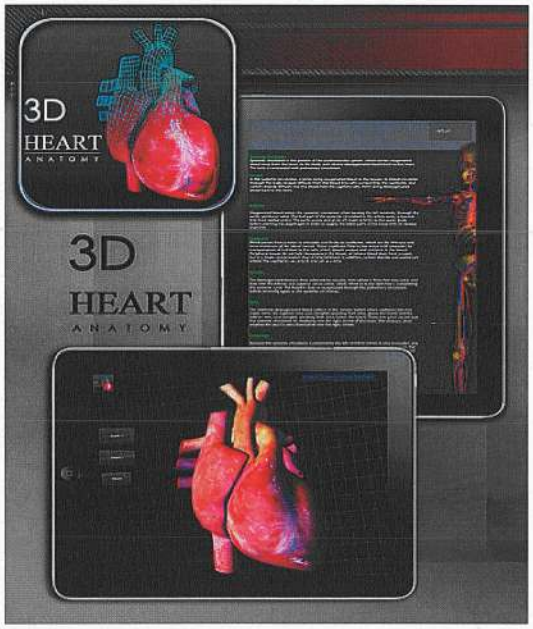


Figure 1.4: 3D Heart Anatomy

The 3D Heart Anatomy is described as a great basic Encyclopedia of the heart in 3D that allows the user to see clearly the anatomy of the heart, and basic information in colorful charts. This is a mobile application which is also can be utilized on website provided by the developer.

This application is a paid service that can be downloaded for USD.0.99 or equivalent to RM3.03. The application enable the users to interact with the application by using haptic technology and the information, pictures and information works great horizontally and vertically position.

a. Advantages

i. The 3D heart anatomy contains attractive multilayer 3D digital heart models, which can instantly grasp user's attention.

ii. Comes with both mobile and web based platforms where user can access the application from their mobile devices and computers.

iii. Good interactivity established between the user and application.

b. Limitations

i. According to the user's review, the application only shows an outer view of the heart and does not include any major cardiac veins/arteries as it supposed to be included for a better and clear understanding.

ii. The applications also does not include the ligamentum, arteriosum and the separate parts view to shows the pulmonary veins and left atrium as one part.

iii. Only allows the user to view and learn about the outer part of the heart which is can be consider not an effective or complete cardiac anatomy application.

1.6.5 iAnatomy - Cardiac Images application by Dr. Anouk Stein for iMEdical Apps.

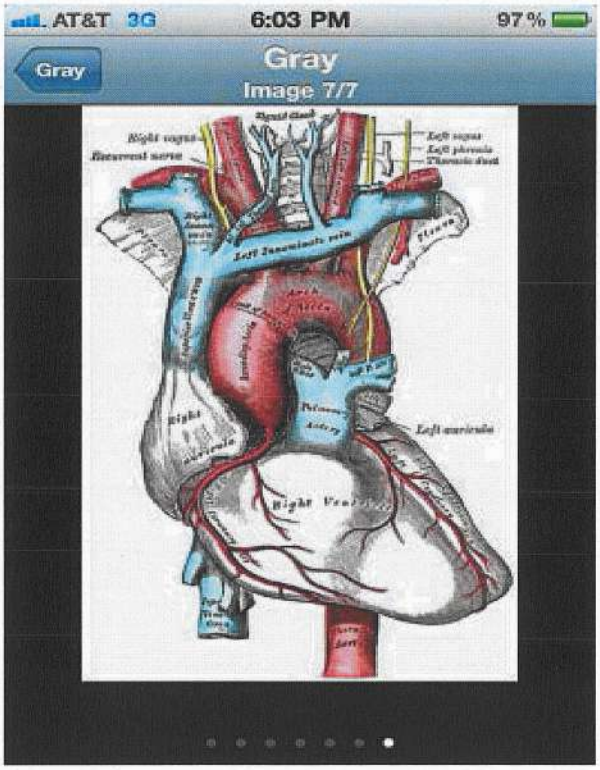


Figure 1.5 : iAnatomy - Cardiac Images application

The iAnatomy cardiac image application is developed to provide a basic understanding of cardiac anatomy to medical students or mobile users in enhancing fundamental in approaching almost any cardiopulmonary disorder, from valvular regurgitation or pulmonary hypertension to atrial arrhythmias , myocardial infarction or all heart related information.

The application contains include cardiac MRI and cardiac CT angiography, especially as applied to congenital heart disease, coronary artery disease, and hypertrophic

cardiomyopathy which are provided by radiologist to make this application more useful and effective to meet the objective.

The Cardiac Images Application is offers links to the applications material, including cine images; the dynamic films, selected illustrations from Gray's Anatomy, and sequential images. Quick tabs along the right side of the home screen can take users directly to cine images, Gray's Anatomy illustrations, or sequential images in all planes.

a. Advantages

i. Excellent, efficient user interface with no wasted buttons or clicks
ii. Well-labeled static images and dynamic films from the University of Toronto
iii. Ability to speed up or slow down cine films of the beating heart.

b. Limitations

i. This app depicts only normal cardiac anatomy, not any pathology.
ii. There is no dedicated quiz mode within the application.
iii. Inability to zoom or pan dynamic films.
iv. Limited clarity of films and images included, especially apparent upon zooming.

1.6.6 Heart Pro III app - cardiac anatomy for iPhone.

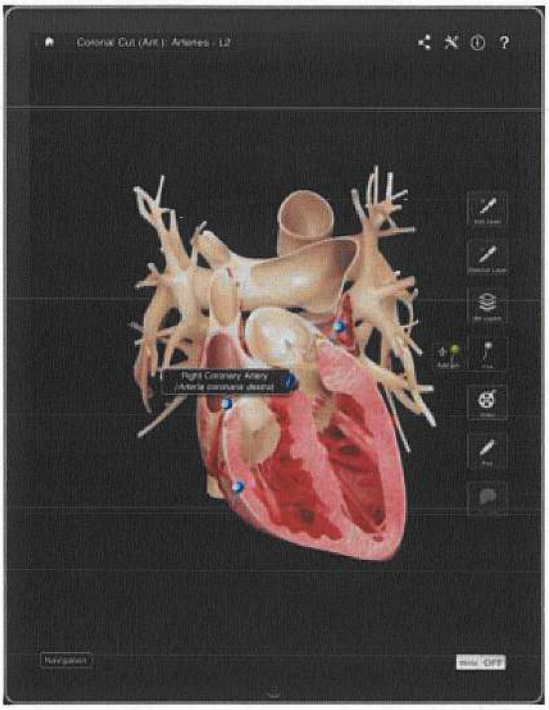


Figure 1.6: Heart Pro III app is a cardiac anatomy

The heart pro III is a cardiac anatomy for iPhone. The 3D model included in this application looks more attractive close to the actual heart. Heart Pro III allows a detailed look at the anatomy of the heart from a range of perspectives while including detailed anatomical information and a range of animations among other features. The graphics have been updated and the visual appeal of the 3D heart is impressive.

This application provides inner and outer view of the heart with accurate labels and details that allows the users to learn as much as possible knowledge regarding cardiac anatomy.

The quiz function has been updated and now includes a simpler 'drag and drop' format interactivity which is more visually appealing and effective.

a. Advantages

i. Very impressive graphics and photorealistic 3D model
ii. Animations serve to consolidate learning of how pathology affects the heart
iii. Simple user interface.

b. Limitations.

i. Expensive application, which cost around RM55.13 or equivalent to USD 17.99.
ii. Time spent loading different views.
iii. Paying for extra animations.

1.6.7 Anatronica Interactive Anatomy 3D.

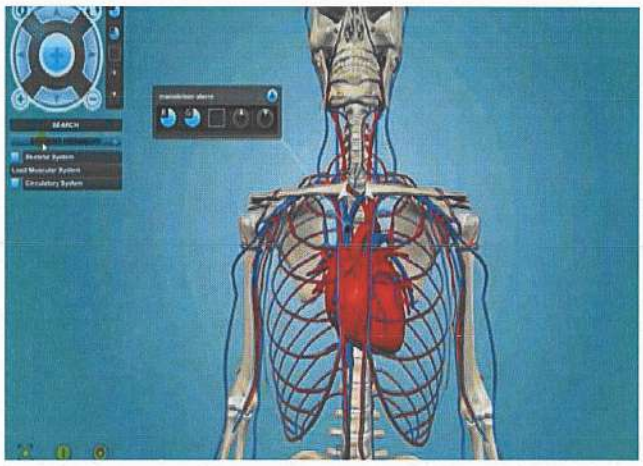


Figure 1.7: Anatronica Interactive Anatomy 3D.

Anatronica Interactive anatomy 3D is an awesome option for students who appreciate the help of 3D models when studying human anatomy anatomically accurate, high detail 3D model of human body. The application provides cardiac anatomy views with high graphical 3D images and it is an easy way of navigating and exploring human body.

The Interactive anatomy is a suitable application for students, teachers and everybody interested in human anatomy.

a. Advantages

i. The application is available for all relevant platforms, Android, iOS (iPad), Windows, MacOS and free online version.

ii. Frequent updates and additions for the cardiac anatomy lectures.

iii. Contains interactive 3D models with appropriate information on cardiac anatomy.

b. Limitations

i. In order to run online version of Anatronica Interactive 3D Anatomy Unity3D plug-in is needed.

ii. High graphic may cause the system consume more time to load.

1.6.8 HeartCam By Mechanism Digital

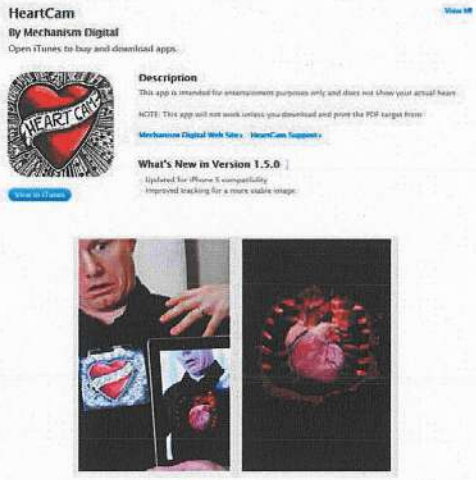


Figure 1.8 : HeartCam (Augmented Reality)

HeartCam was created for entertainment purposes where the users are allowed to use the customized marker or picture to view the heart picture on their chest. The application is provided by Mechanism Digital which was invented to be viewed in iTunes. The marker creates an illusion of the heart like it can be viewed through the chest ribs and flash.

a. Advantages

i. The Apps uses augmented reality technique to display heart model.

ii. Gives a realistic view of the heart model.

b. Limitation

i. Only available for iPhone users and available in iTune.

1.6.9 The Heart Augmented reality by Prefect Prototype

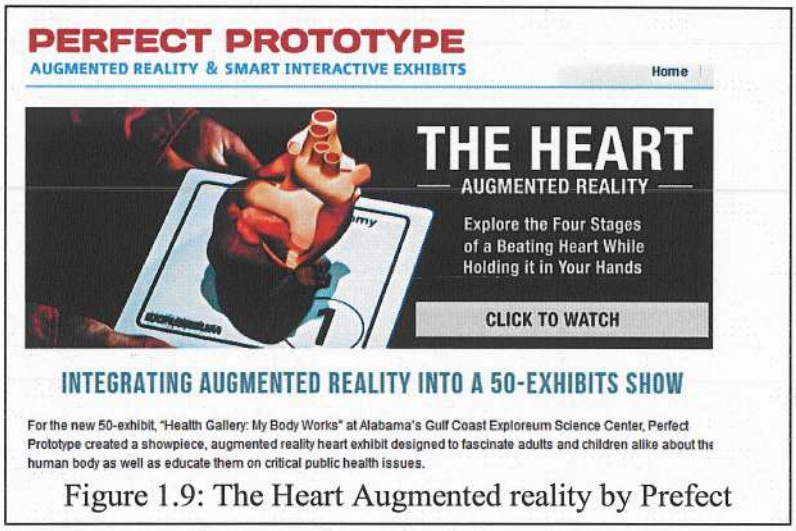


Figure 1.9: The Heart Augmented reality by Prefect

The Heart Augmented reality by Prefect Prototype was invented for the new 50-exhibit Health Gallery.The augmented reality heart that was exhibit in the exploreum was designed to educate adults and children alike about the human body and on critical public health issues. Users or exhibition visitors are encouraged to hold a simple card or marker under a high definition camera so that they could be assigned together in a virtual space and that allows them to view their beating 3D heart in their hands.

a. Advantages

   i. Provides fascinating experiences for users consist of adults and children.

b. Limitations

   i. For time being only available as the exhibitions apps, and haven't extended for online or mobile users.

1.9.10 Comparison

Application	3D Models	Interactivity
1. Heart anatomy	x	Navigate to next page
2. Anatomy of the Heart.	x	click to select., Navigate to next page
3. Pocket Heart.	√	Navigate to next page, click to select.
4. 3D Heart Anatomy	√	Navigate to next page, click to select.
5. iAnatomy	x	Navigate to next page, click to select.
6. Heart Pro III application	√	Navigate to next page, click to select.
7. Interactive Anatomy 3D.	√	Navigate to next page, click to select.
8. Heart Cam	√	Click to select.
9. The Heart Augmented reality	√	Allows user to display Augmented Reality model using marker.

Table 1.1: Literature review comparison table.

PART 2

REPORT BODY

2.1 User Requirements

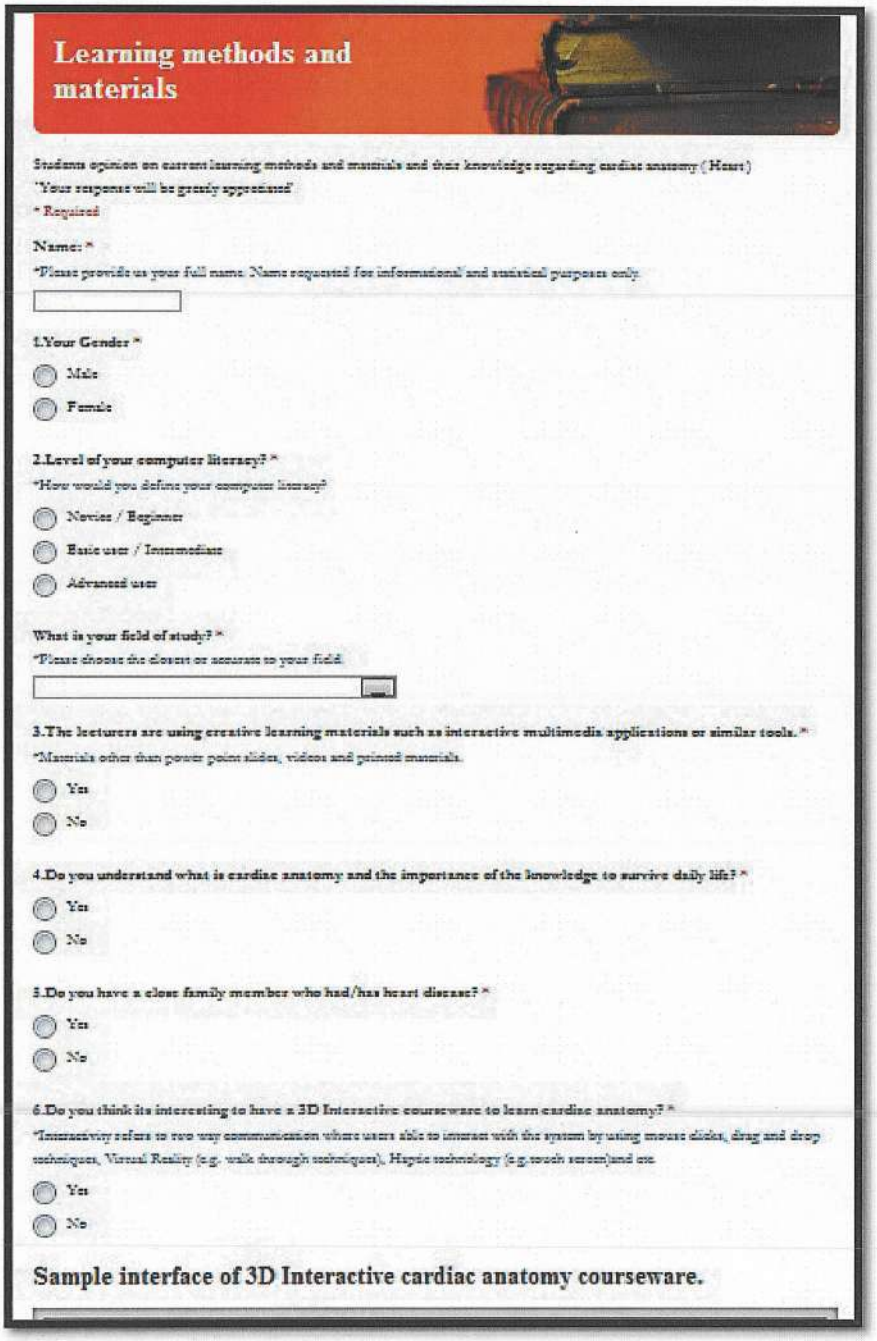
In order to define the user requirements, a questionnaire and interview had been done. Generally, all of the questions asked are focusing on the health issues related to coronary heart disease.

2.1.1 Pre-production evaluation

A set of questionnaire consists of seven close-ended questions and one open-ended question was distributed online to obtain feedback from user on the pre-production phase of the courseware development. The questionnaire focused on identifying user's computer literacy and their understanding on coronary heart disease as well as their expectation on having an interactive courseware with 3D models on myocardial infarction.

The Survey conducted was participated by users from various backgrounds and as a result it helped to information regarding interactive courseware and cardiac anatomy knowledge.

2.1.2.Questionnaire form



Learning methods and materials

Students opinion on current learning methods and materials and their knowledge regarding cardiac anatomy (Heart)
"Your response will be greatly appreciated"
* Required

Name: *
*Please provide us your full name. Name requested for informational and statistical purposes only.

1.Your Gender *
Male
Female

2.Level of your computer literacy? *
*How would you define your computer literacy?
Novice / Beginner
Basic user / Intermediate
Advanced user

What is your field of study? *
*Please choose the closest or accurate to your field.

3.The lecturers are using creative learning materials such as interactive multimedia applications or similar tools. *
*Materials other than power point slides, videos and printed materials.
Yes
No

4.Do you understand what is cardiac anatomy and the importance of the knowledge to survive daily life? *
Yes
No

5.Do you have a close family member who had/has heart disease? *
Yes
No

6.Do you think its interesting to have a 3D Interactive courseware to learn cardiac anatomy? *
*Interactivity refers to two way communication where users able to interact with the system by using mouse clicks, drag and drop techniques, Virtual Reality (e.g. walk through techniques), Haptic technology (e.g.touch screen)and etc.
Yes
No

Sample interface of 3D Interactive cardiac anatomy courseware.

Figure 2.1: Questionnaire

2.1.3 Questionnaire results.

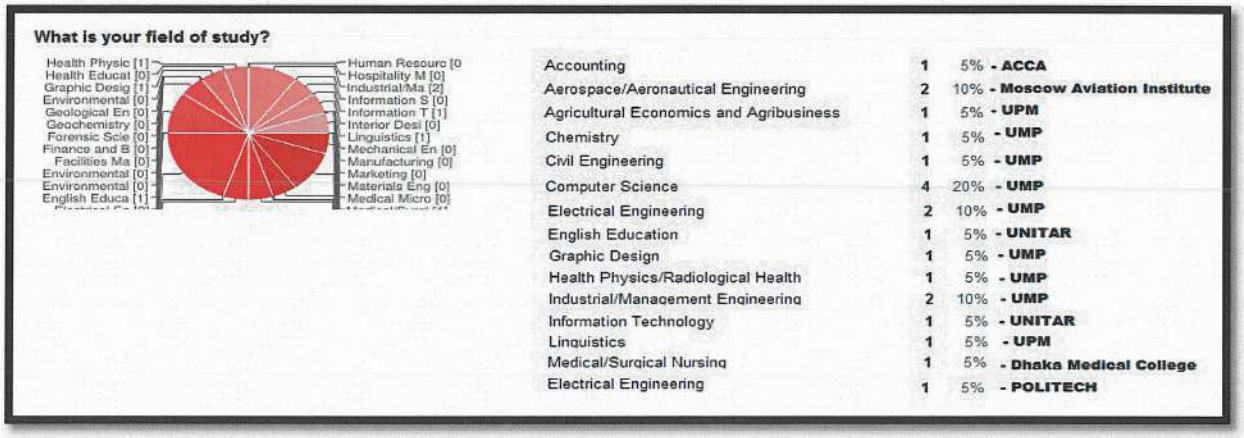


Figure **2.2.1**: Field of study

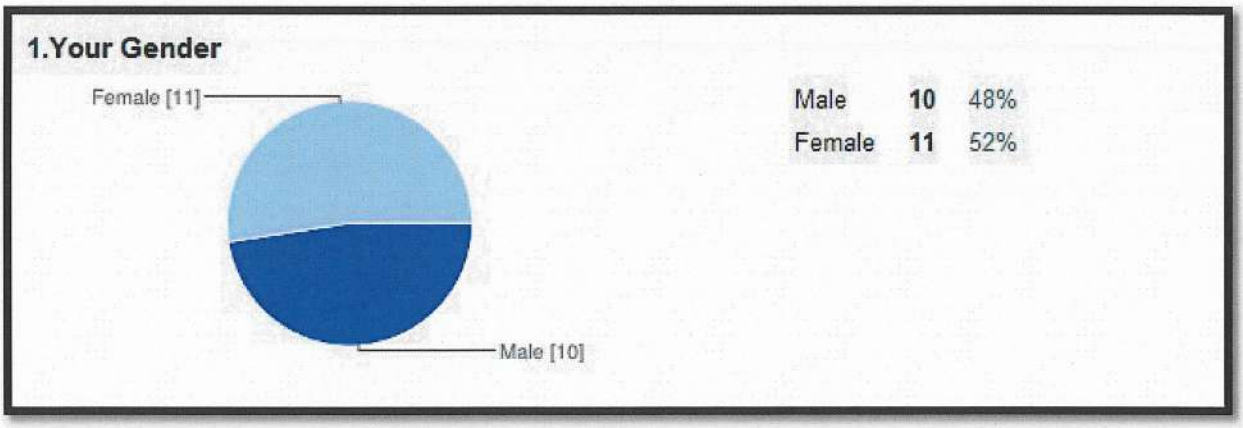


Figure **2.2.2**: Gender

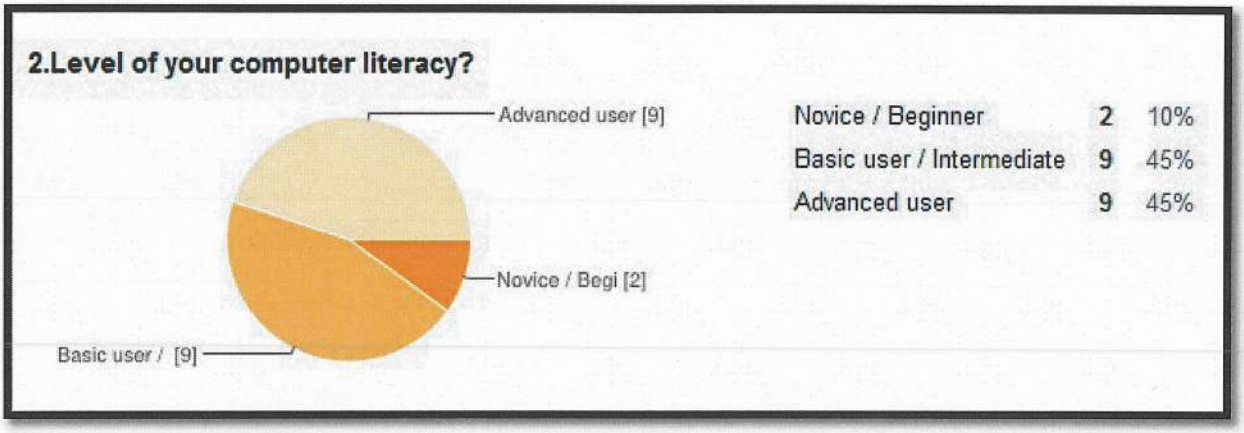


Figure **2.2.3**: Computer literacy

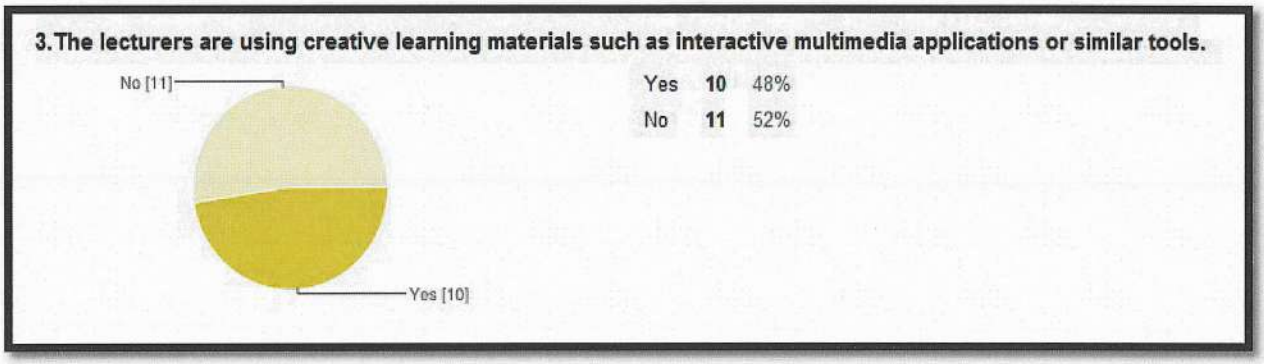


Figure **2.2.4**: Learning methods and materials.

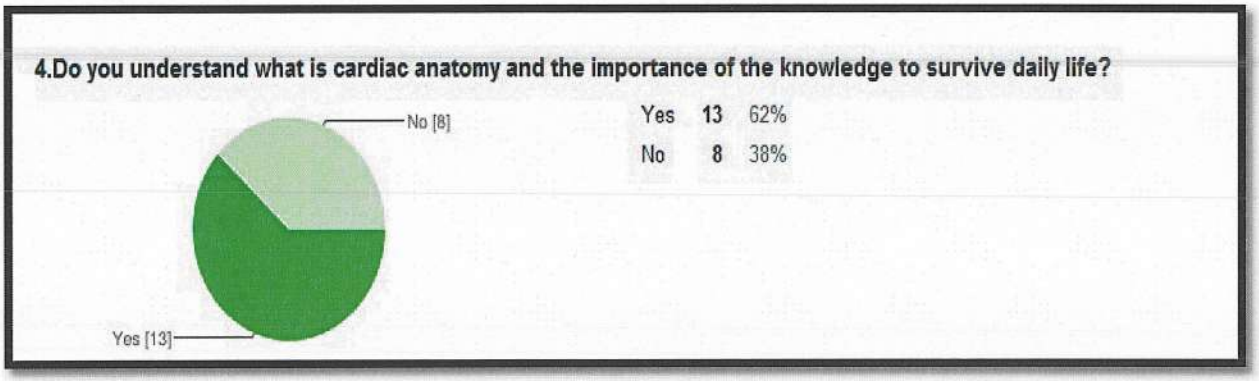


Figure **2.2.5**: Cardiac Anatomy

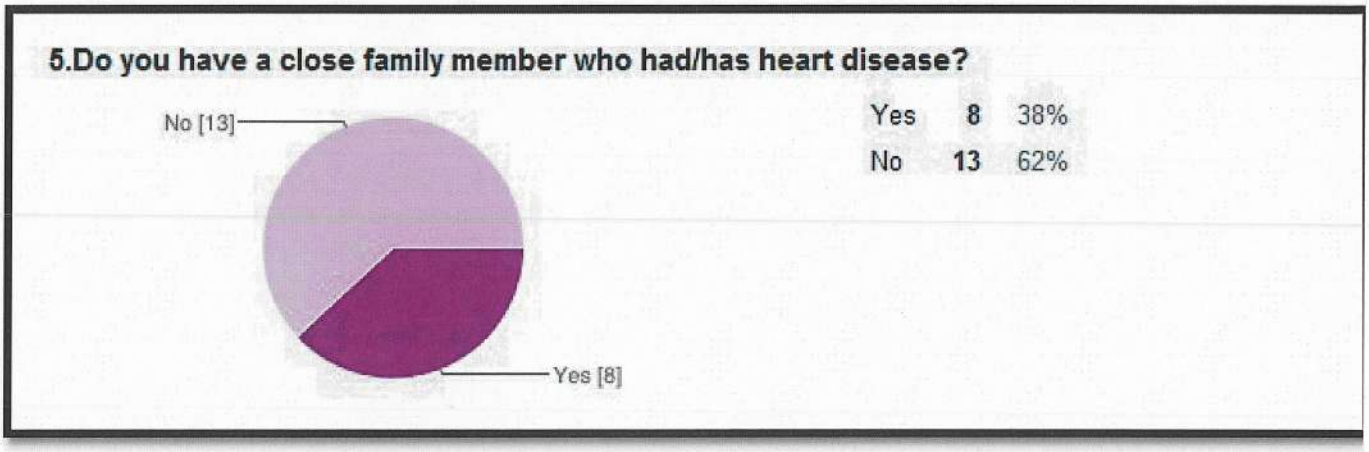


Figure **2.2.6**: Heart diseases.

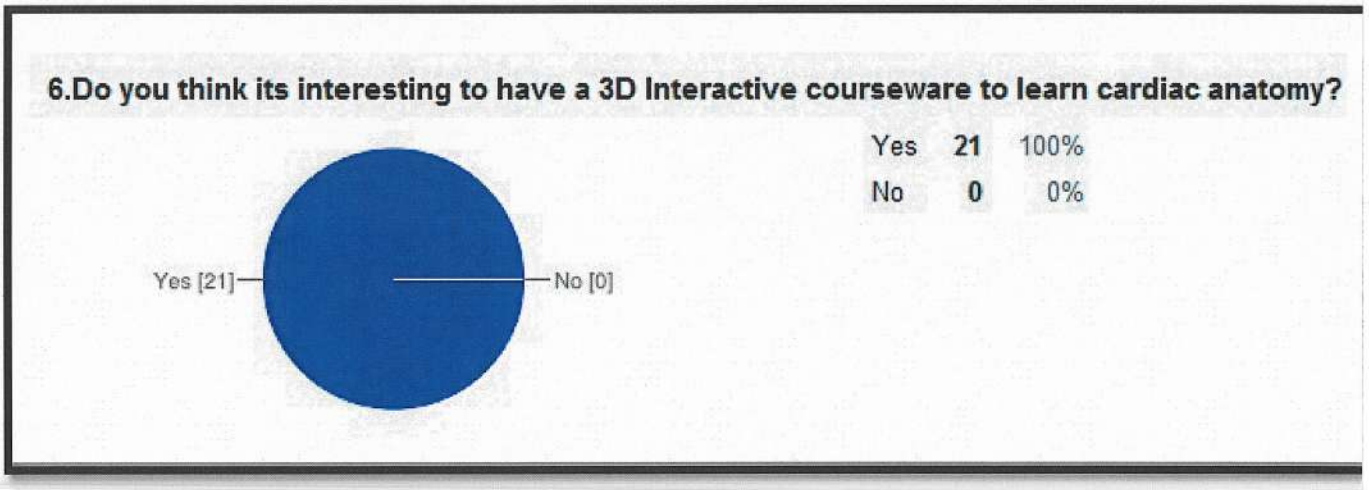


Figure **2.2.7**: User feedback to have interactive courseware

2.2 Post production evaluation:

Evaluation in the post production phase focused on obtaining user feedback and opinion on the courseware upon the completion on the project. The beta version of the courseware was given to them to be evaluated by them before they complete the feedback form.

2.2.1 Feedback form.

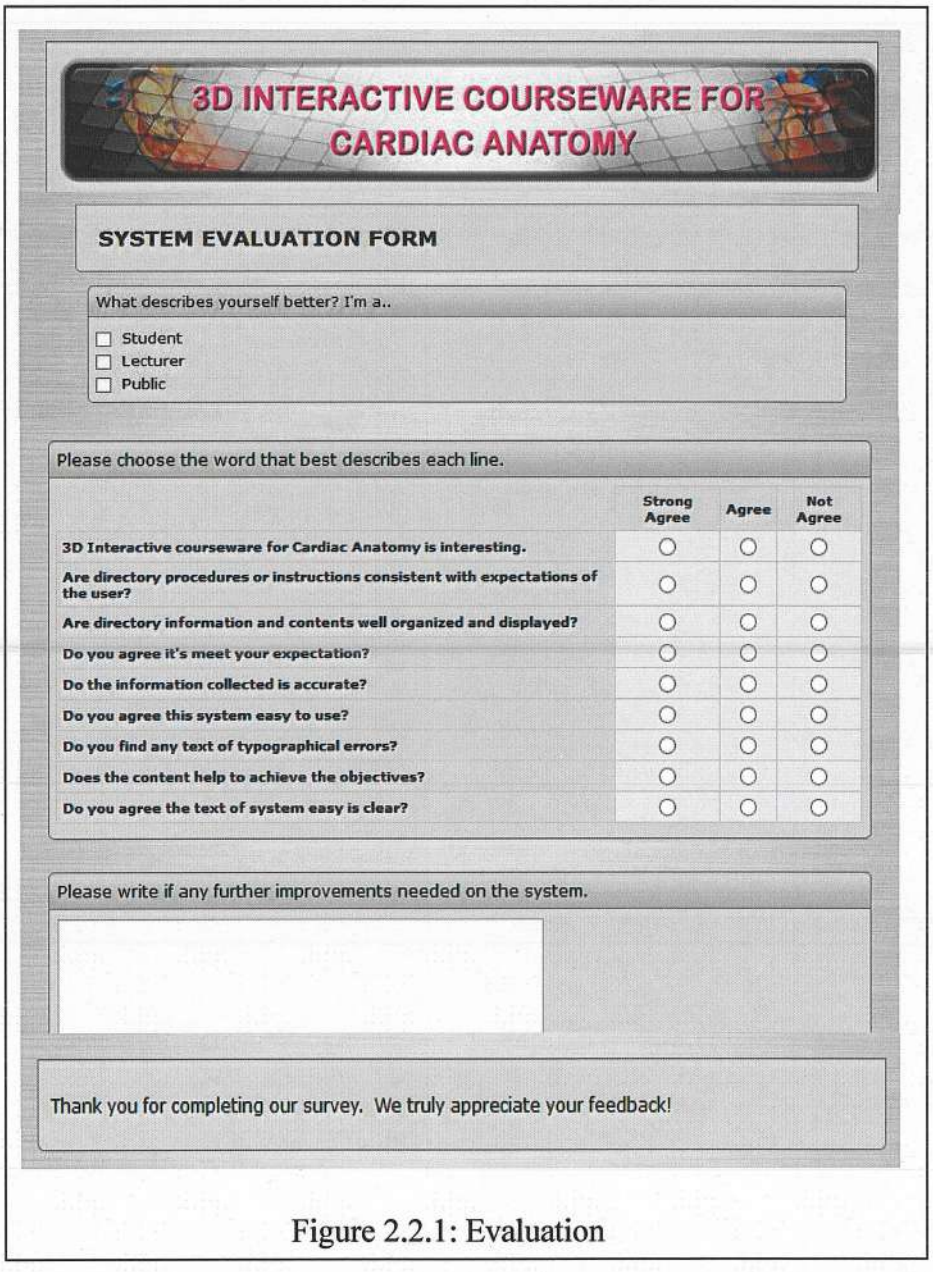
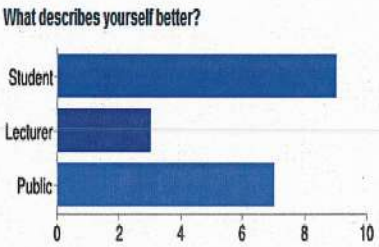


Figure 2.2.1: Evaluation

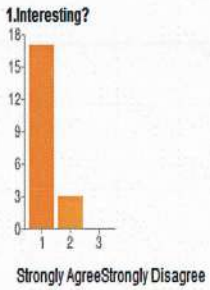
2.2.2. Evaluations results:



Student	9	47%
Lecturer	3	16%
Public	7	37%

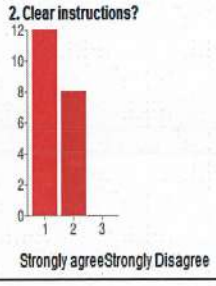
People may select more than one checkbox, so percentages may add up to more than 100%.

Figure 2.2.2. :Users



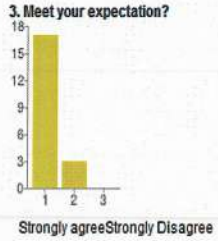
1- Strongly Agree	17	85%
2	3	15%
3- Strongly Disagree	0	0%

Figure 2.2.3: The courseware is interactive or not



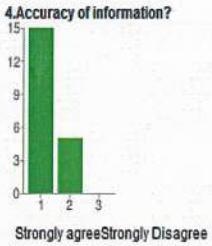
1- Strongly agree	12	60%
2	8	40%
3- Strongly Disagree	0	0%

Figure 2.2.4: User interactions are clear or not?



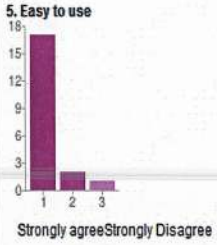
1 -	Strongly agree	17	85%
2		3	15%
3 -	Strongly Disagree	0	0%

Figure 2.2.5: Met expectation?



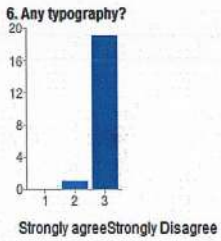
1 -	Strongly agree	15	75%
2		5	25%
3 -	Strongly Disagree	0	0%

Figure 2.2.6: Ease of use?



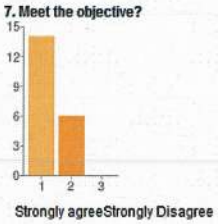
1 -	Strongly agree	17	85%
2		2	10%
3 -	Strongly Disagree	1	5%

Figure 2.2.7: Accuracy of information?



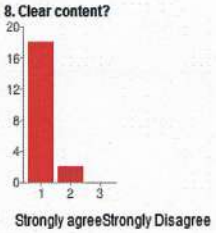
1 -	Strongly agree	0	0%
2		1	5%
3 -	Strongly Disagree	19	95%

Figure 2.2.8: Any typography found?



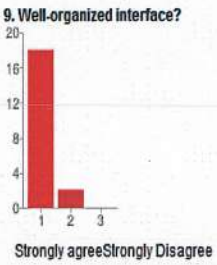
1 -	Strongly agree	14	70%
2		6	30%
3 -	Strongly Disagree	0	0%

Figure 2.2.9: Met the objective?



1 -	Strongly agree	18	90%
2		2	10%
3 -	Strongly Disagree	0	0%

Figure 2.2.10: The contents are clear?



1 -	Strongly agree	18	90%
2		2	10%
3 -	Strongly Disagree	0	0%

Figure 2.2.11: Well-organized interface?

2.2.3 User Responses

There are two techniques in the evaluation phase, namely summative evaluation and formative evaluation.

The formative evaluation conducted to identify the effectiveness and efficiency of the 3D Interactive courseware for Medical education (Cardiac Anatomy). Based on the constructive response or feedback provided by the users, appropriate adjustments will be applied for the courseware.

The summative evaluation will be conducted to identify the overall 3D Interactive courseware for Medical education (Myocardial infarction)'s effectiveness measured upon the courseware completion. The user feedbacks via survey and questionnaire collected and the contain accuracy, methods and effectiveness of the courseware will be validated.

There 20 participants responded for both evaluation processes and the responses were collected and recorded in charts.

2.3. Methodology

2.3.1. Introduction

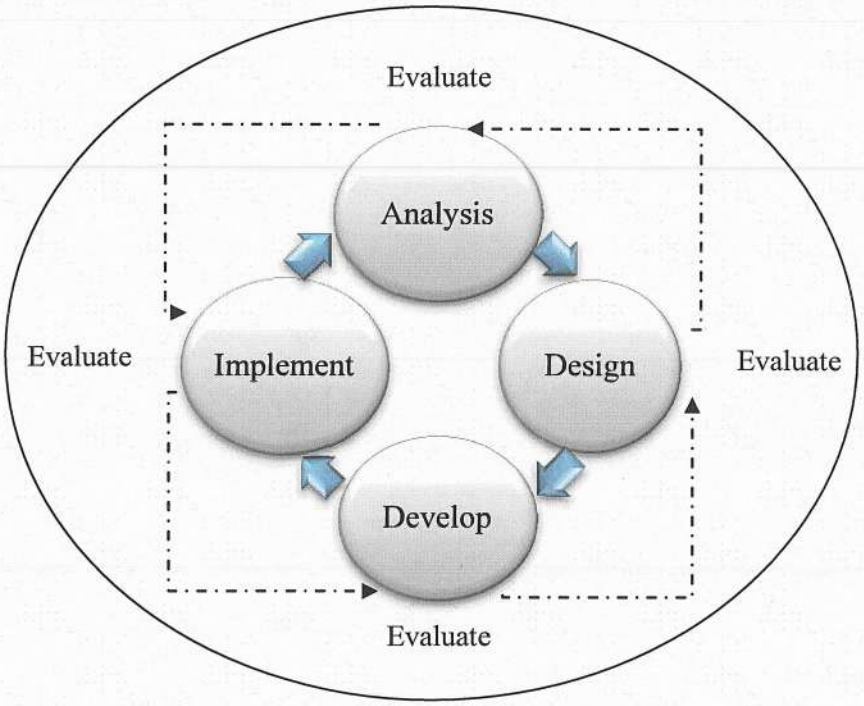


Figure 2.3.1: ADDIE Model – Instructional Design

The abbreviation for ADDIE model is Analysis, Design, Develop, Implement and Evaluation. This model is an instructional design model to develop multimedia courseware and projects in the most effective and efficient way.

The analysis phase is a well-organized exploration of the way of defining things that need to done in a correct way. Related issues will be thoroughly analyzed before begin the design phase. Upon the completion of analysis phase, the designing phase will play its part based on the analyses conducted. Designing phase is all about preparing outlines of the performance objectives.

When the project moves to the development phase it will be developed by utilizing the information gathered during analysis and design phases. The solution for the performance

will be created in this phase. Eventually in the implementation phase the solution will be delivered properly.

Evaluation phase in this model measures how well the performances solution achieved the objective by evaluating each phase in the model. It is interconnected to all other four phases.

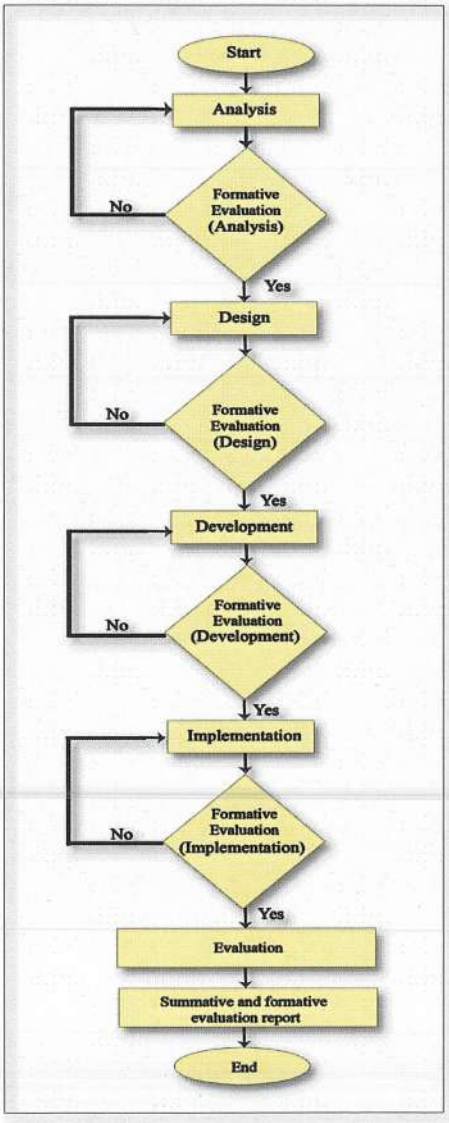


Figure 2.3.2: Flow chart based on ADDIE Model.

2.3 Phases in ADDIE model and description for 3D interactive courseware for medical education on cardiac anatomy: myocardial infaction

2.4.1 Analysis phase.

As per aforementioned, in the analysis phase the instructional problems that can be found in the project will be clarified earlier and the instructional goals and objectives will be established to be a guidance in designing phase. The learning environment for the courseware will be developed and the medical students or other user's existing knowledge and skills are will be identified and interpreted clearly.

2.4.2 The users and their characteristics.

The target users for the 3D interactive medical courseware are medical students, lecturers, pre-medical students, nursing students, patients or anyone who is seeking for basic cardiac anatomy information and all the related issues to improvise their knowledge and skills. Thus, the learning behavior of above listed users and the existing knowledge regarding 3D interactive technology is the most important criteria in analyzing the characteristics.

2.4.3 Learning method of participants in medical lectures.

a. List of existing learning methods and sources.

- Medical and health related book or printed materials.
- PowerPoint slides.
- Educational audio or videos.
- Internet resources.
- Mobile applications.

- Educational software.
- Multimedia courseware.

Participant Name (medical Students)		Name of the institute.	Learning methods and materials.
1.	Vimala A/P Kupan	Dhaka Medical College, Bangladesh.	• Book and printed notes. • Presentation using OHP projector. • Anatomy sections with actually models.
2.	Sshulakshana A/P Manikam	Sriwijaya University, Palembang Indonesia.	• Power point slides. • Notes in CDs. • Books. • Videos.

Table 2.1: Source of information

2.4.4. Contain of the 3D interactive courseware

The contain of the course ware must be a one stop source of retrieving information about cardiac anatomy where the users can refer to it anytime to clarify any doubts that may arise on issues related to Heart.

a. List of contains.

- 3D model of human heart with labels.
- Detailed view of the heart structures.
- Information on Cardiac related disease.
- Information on blood circulation.
- Blood cells.
- Quiz related to cardiac anatomy.

Based on the analysis and literature review there are no 3D cardiac anatomy courseware available which supports technology. Therefore a 3D interactive courseware using would be a revolutionary technology in educating medical students and other on cardiac anatomy related knowledge.

2.3.1 Flowchart

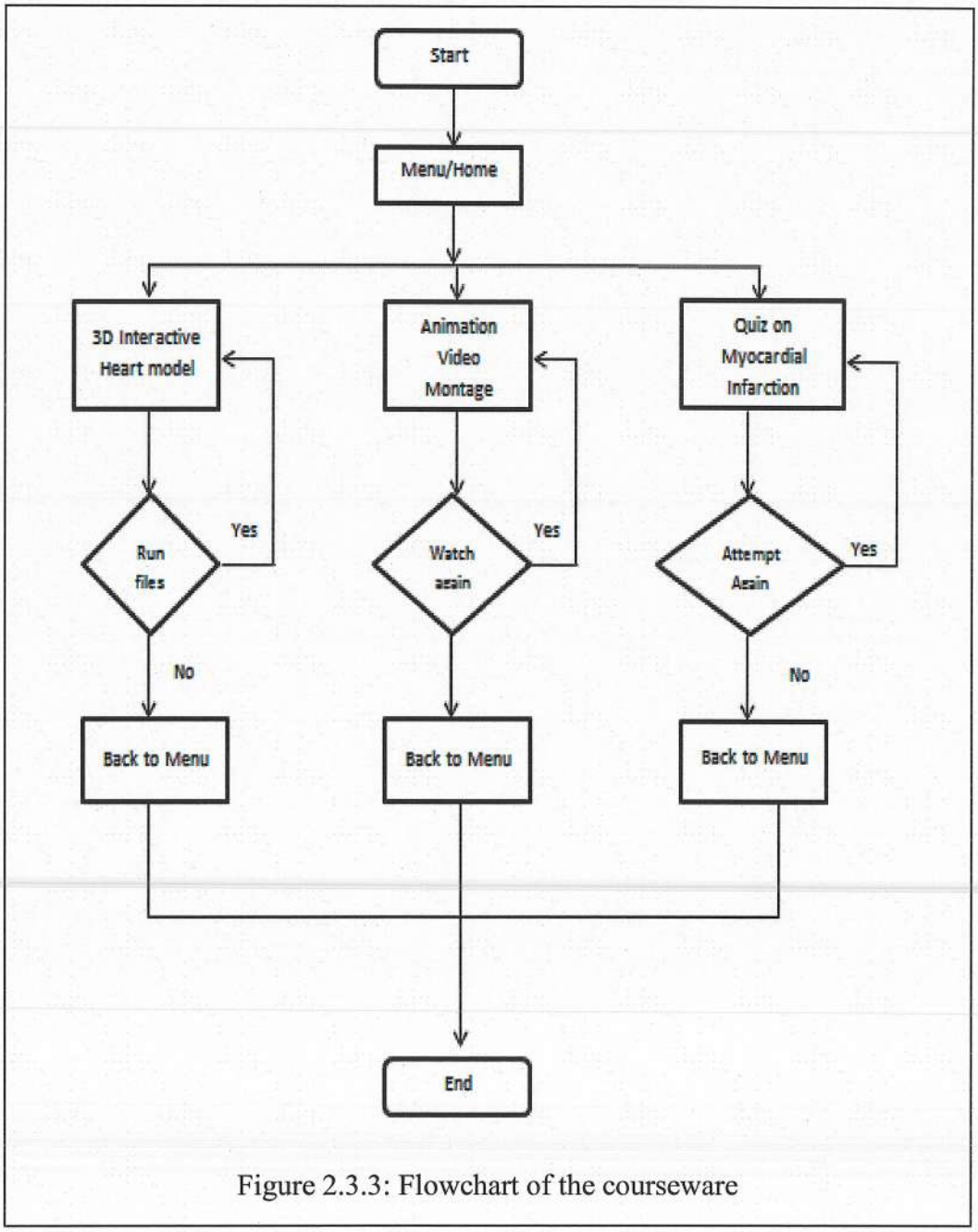


Figure 2.3.3: Flowchart of the courseware

2.4.5 Design phase

The third phase in the model is design phase which is deals with learning objectives of the courseware, assessment evaluation for quiz included, contents based on cardiac anatomy and related topics. Designers are able to organize the system in a very systematic way such as identifying the methods sequentially, developing the instructional model and evaluating the design to meet the project objectives.

The design of the interface is essential to deliver an effective system or courseware for the view of the user. Thus, the 3D interactive courseware which will be developed using Eon Reality has an attractive interface design with high quality 3D models and construction of navigational interfaces to courseware.

The multimedia navigation menu is the most appropriate navigation menu identified for a learning environment such as interactive courseware. A Multimedia menu is consist of a home button, back and next buttons, setting button where user can customize the courseware according to their preferences and other related buttons which are not only look attractive but familiar among electronic device users.

Figure 2.3.4: multimedia navigation menu icons.

2.4.Storyboard

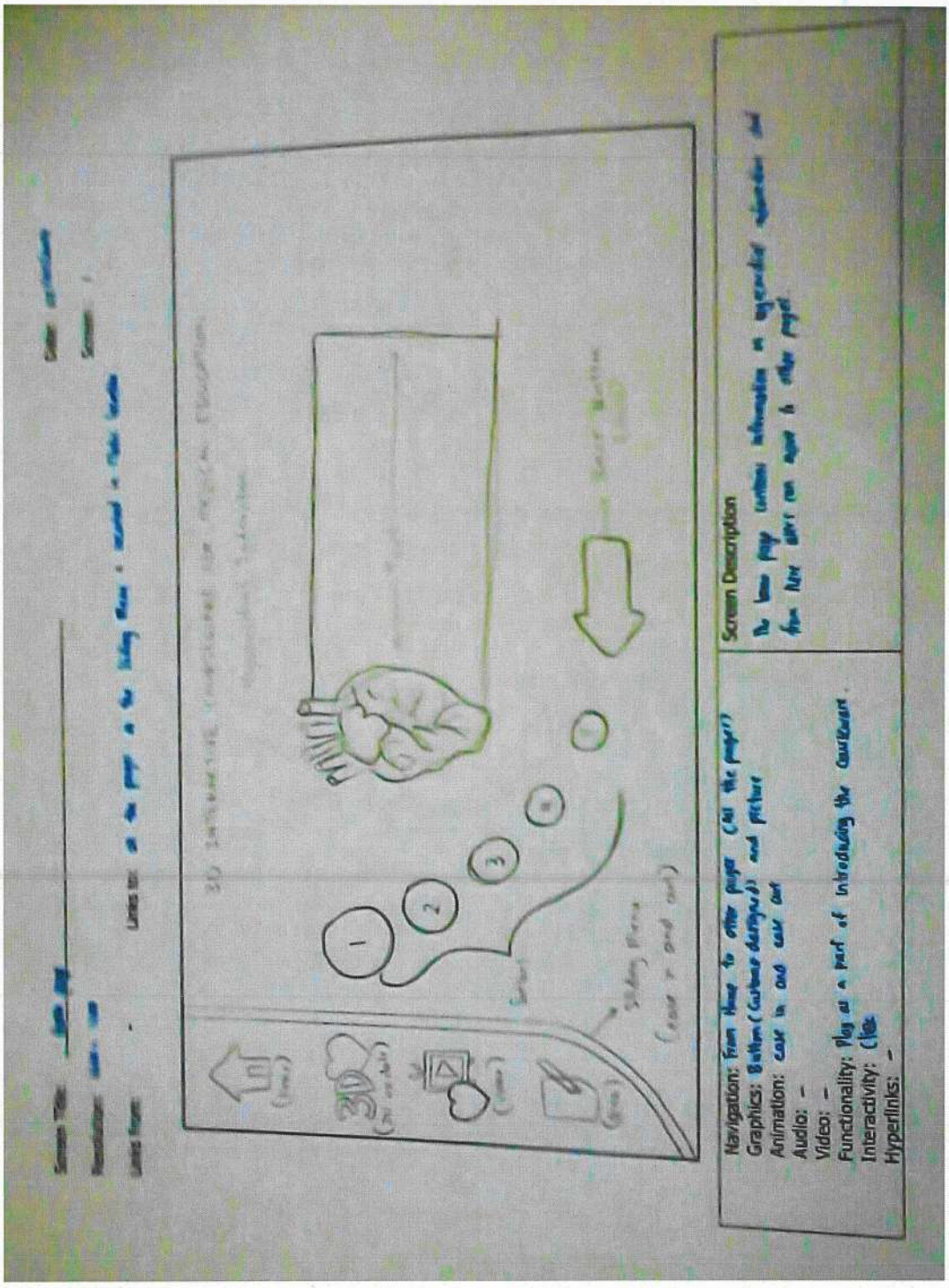


Figure 2.4.1 Storyboard 1 (Home page)

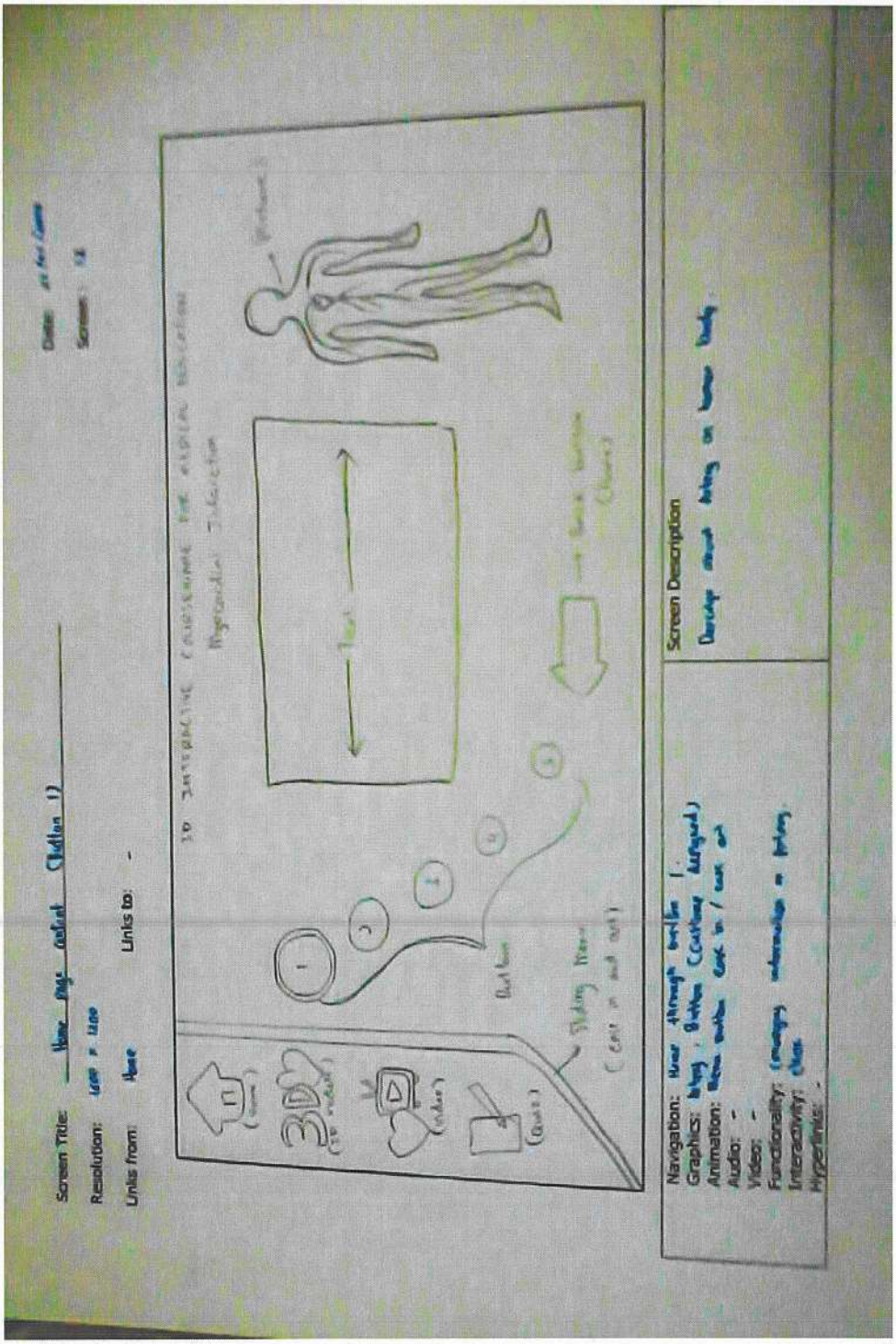


Figure 2.4.2 Storyboard 2 (Home page content 1)

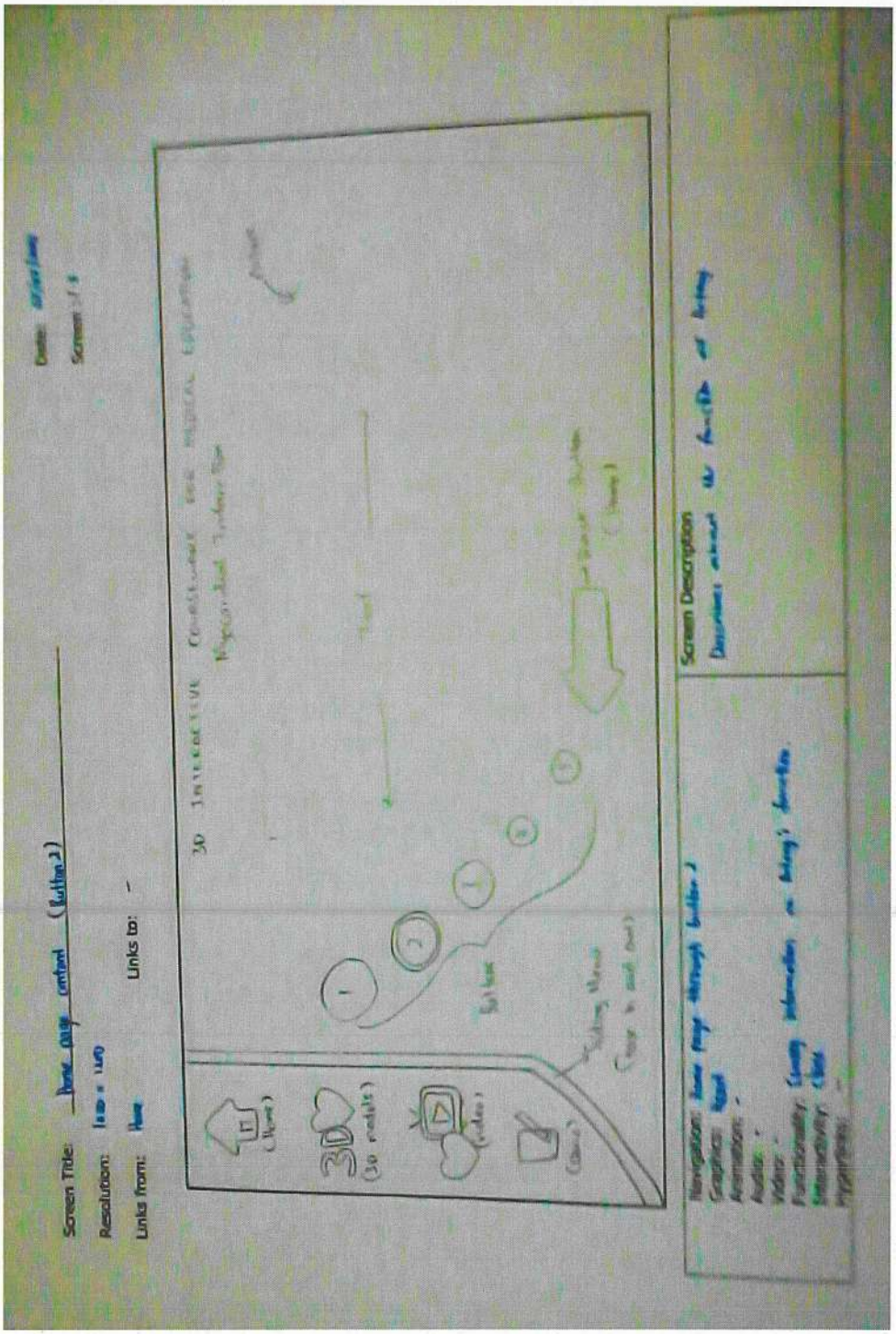


Figure 2.4.3 Storyboard 3 (Home page content 2)

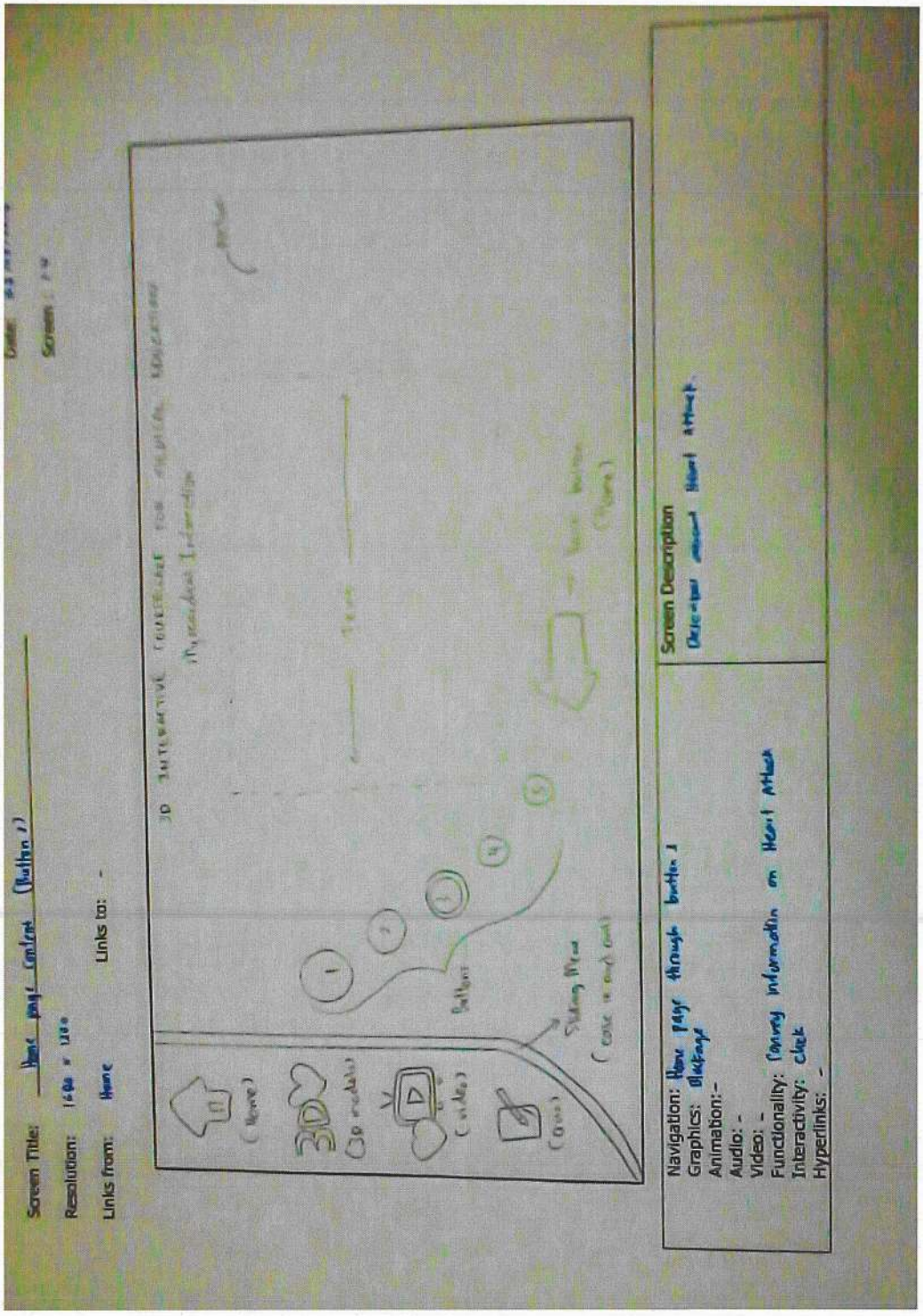


Figure 2.4.4 Storyboard 4 (Home page content 3)

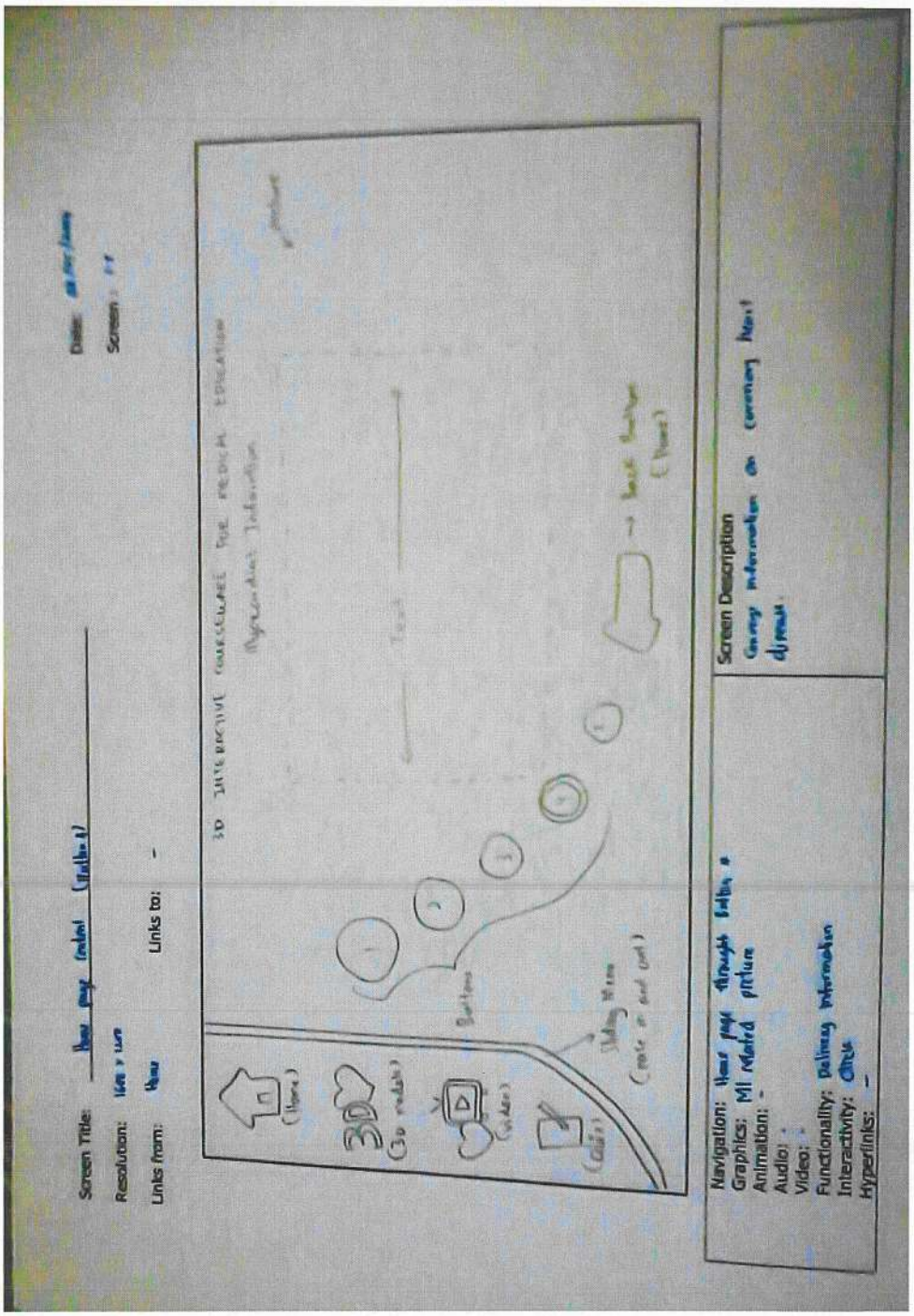


Figure 2.4.5 Storyboard 5 (Home page content 4)

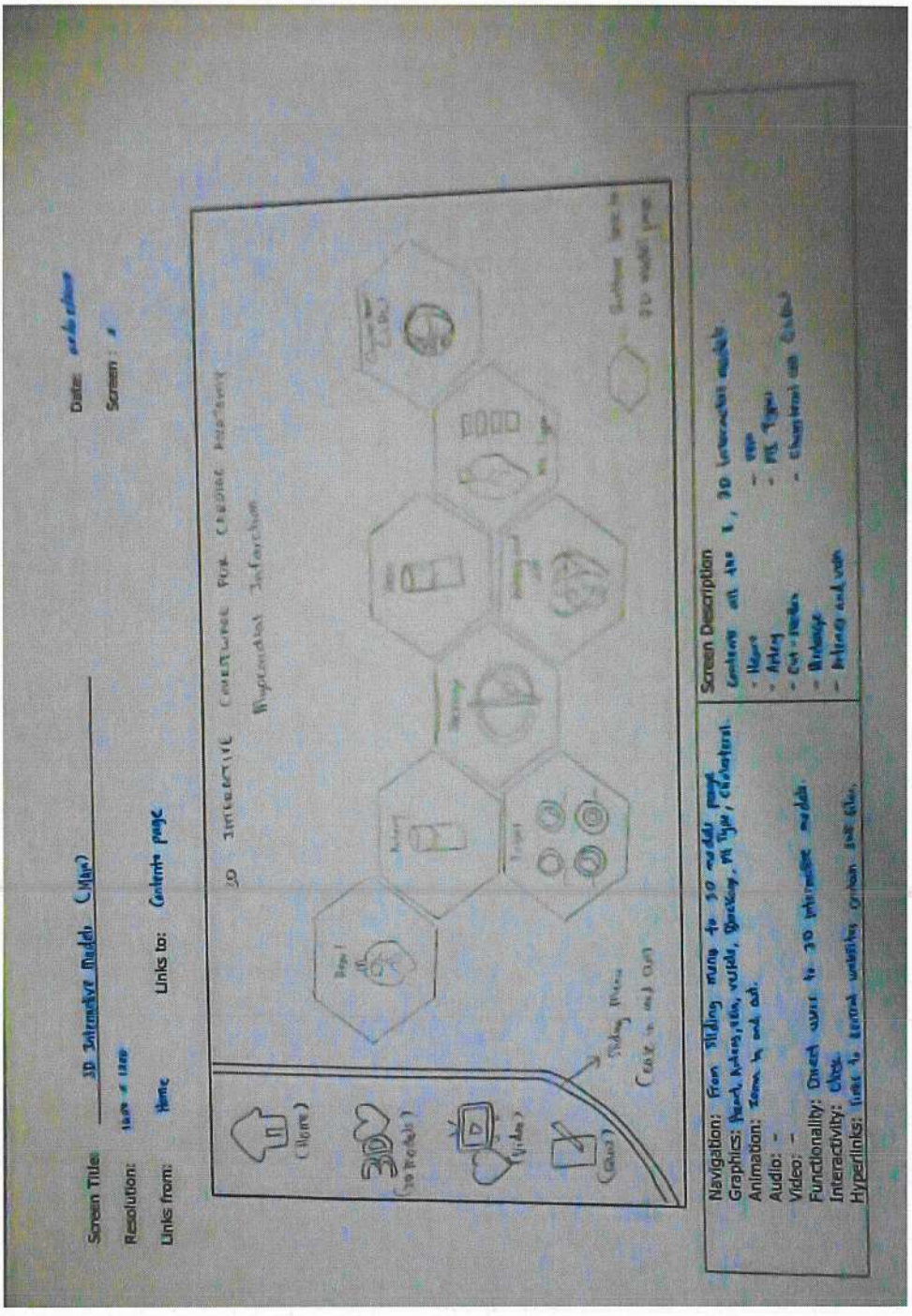


Figure 2.4.6 Storyboard 6 (3D Interactive Models)

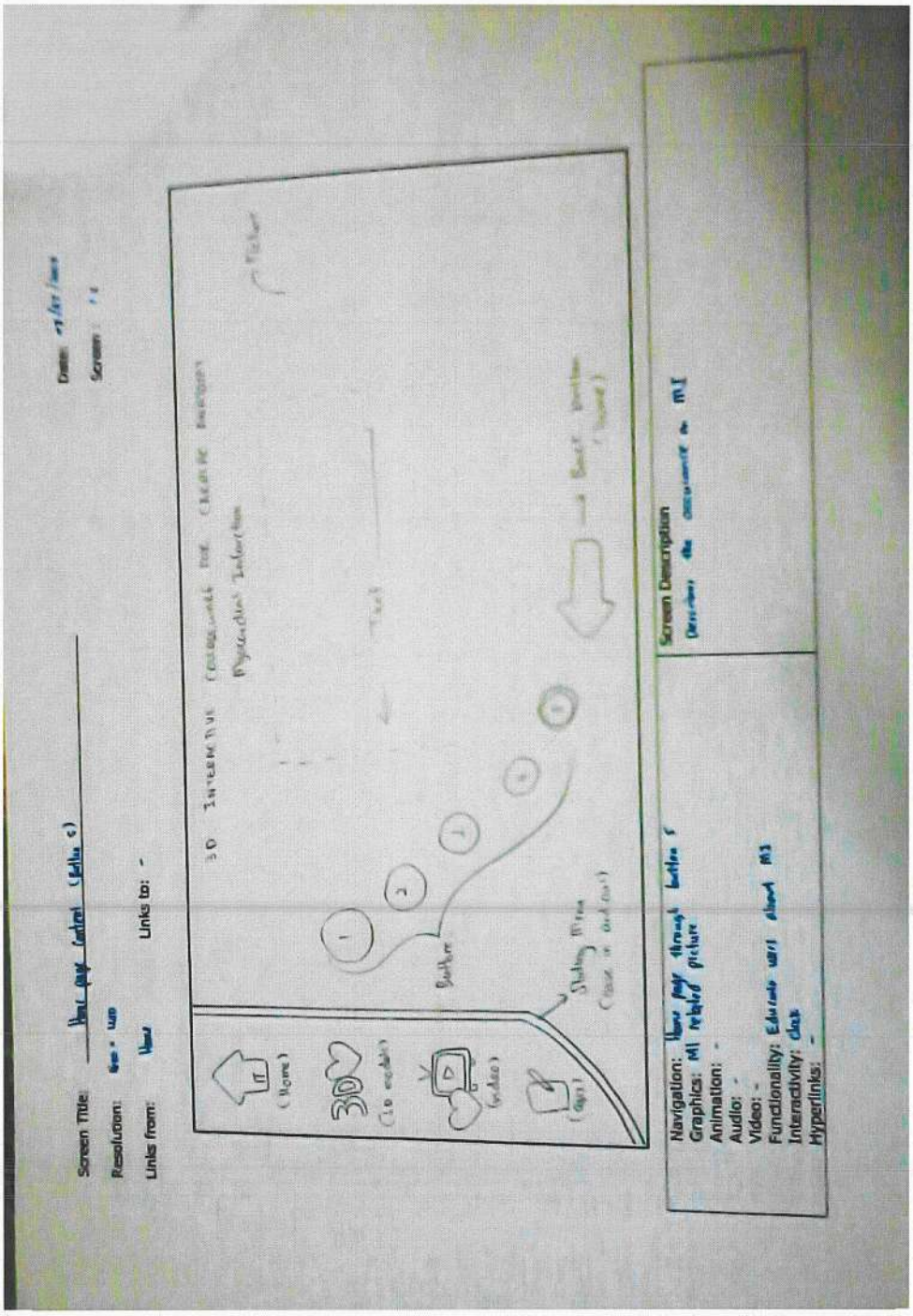


Figure 2.4.7 Storyboard 7 (Home page content 5)

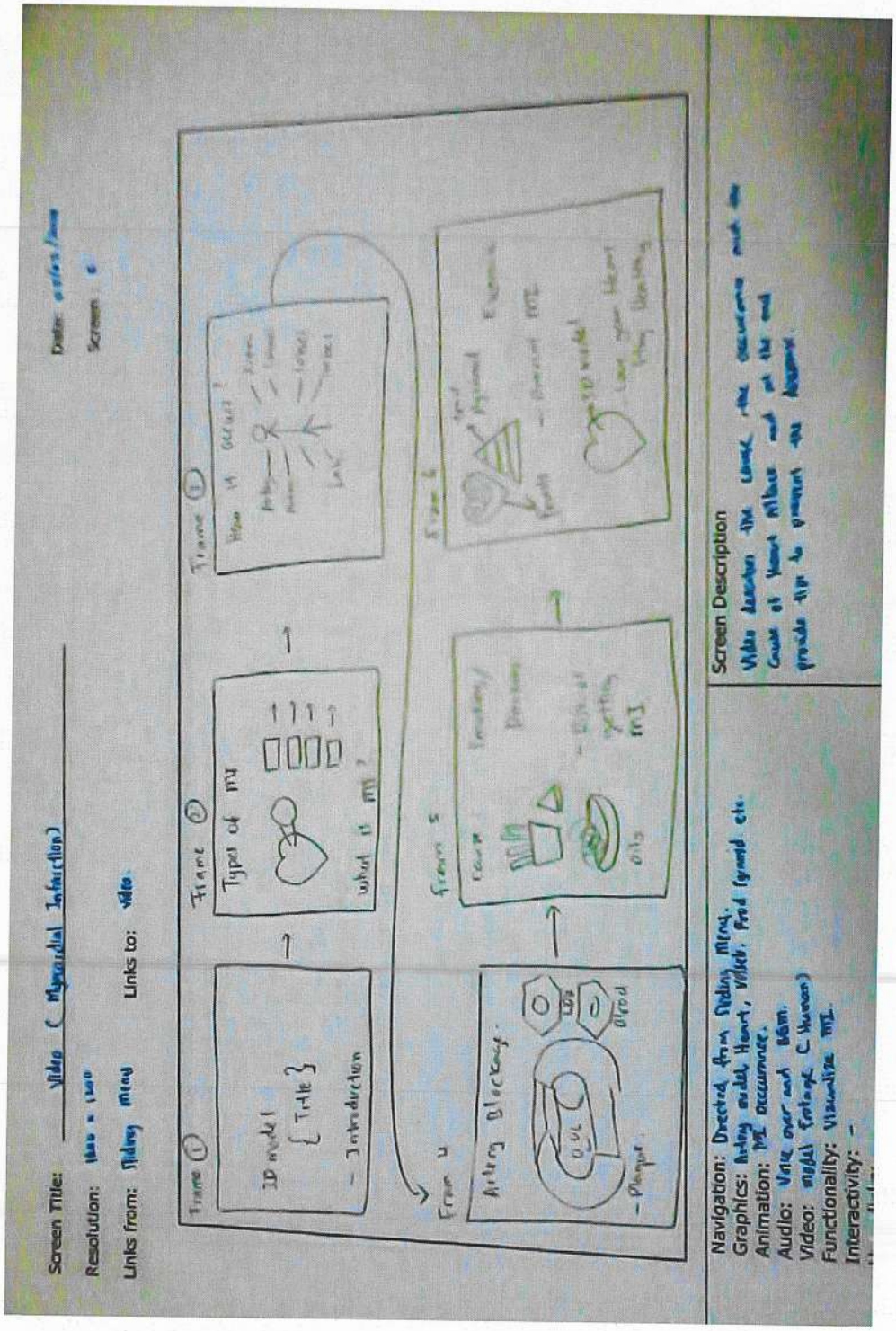


Figure 2.4.8 Storyboard 8 (Video)

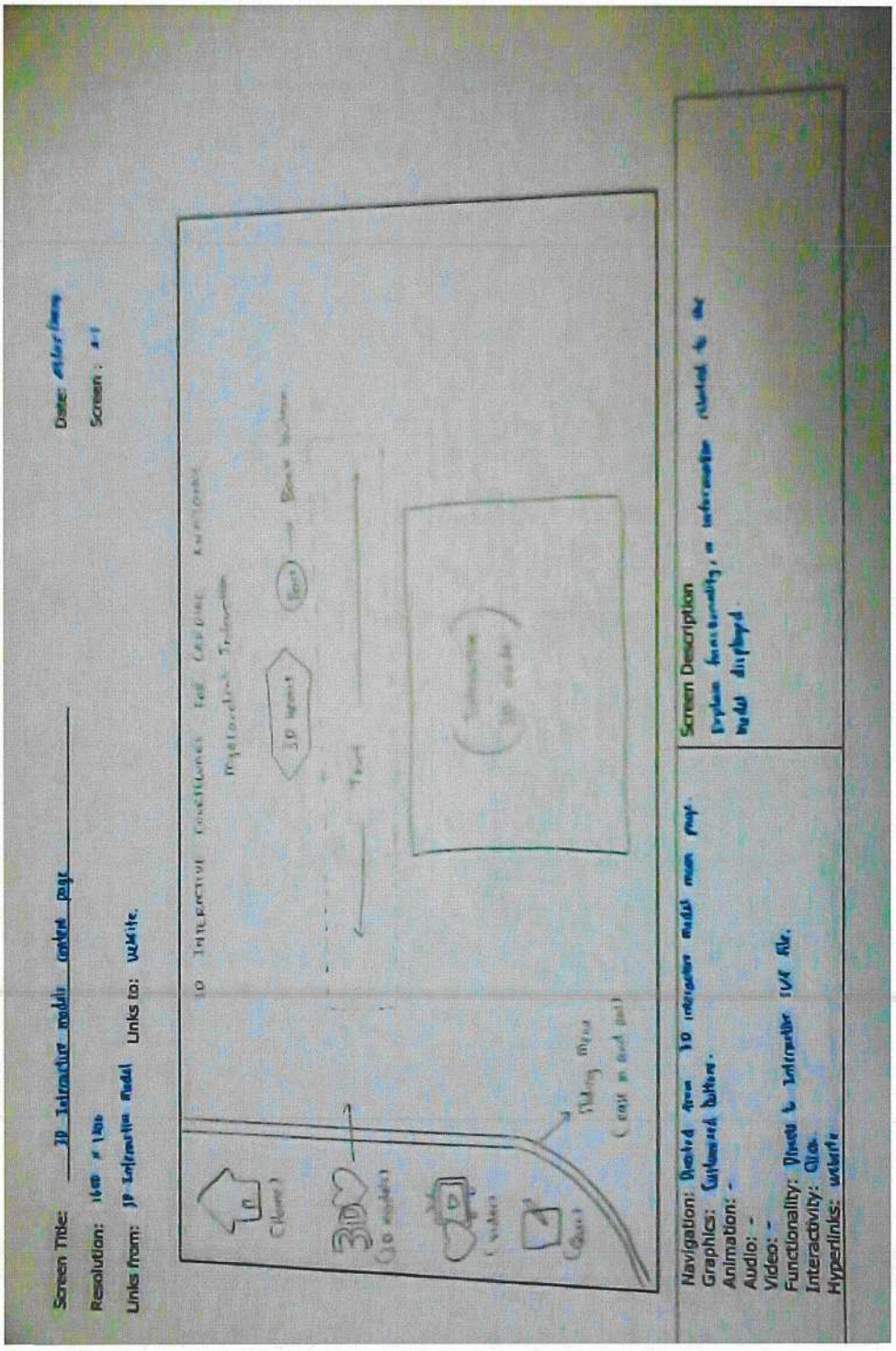


Figure 2.4.9 Storyboard 9 (3D model content page)

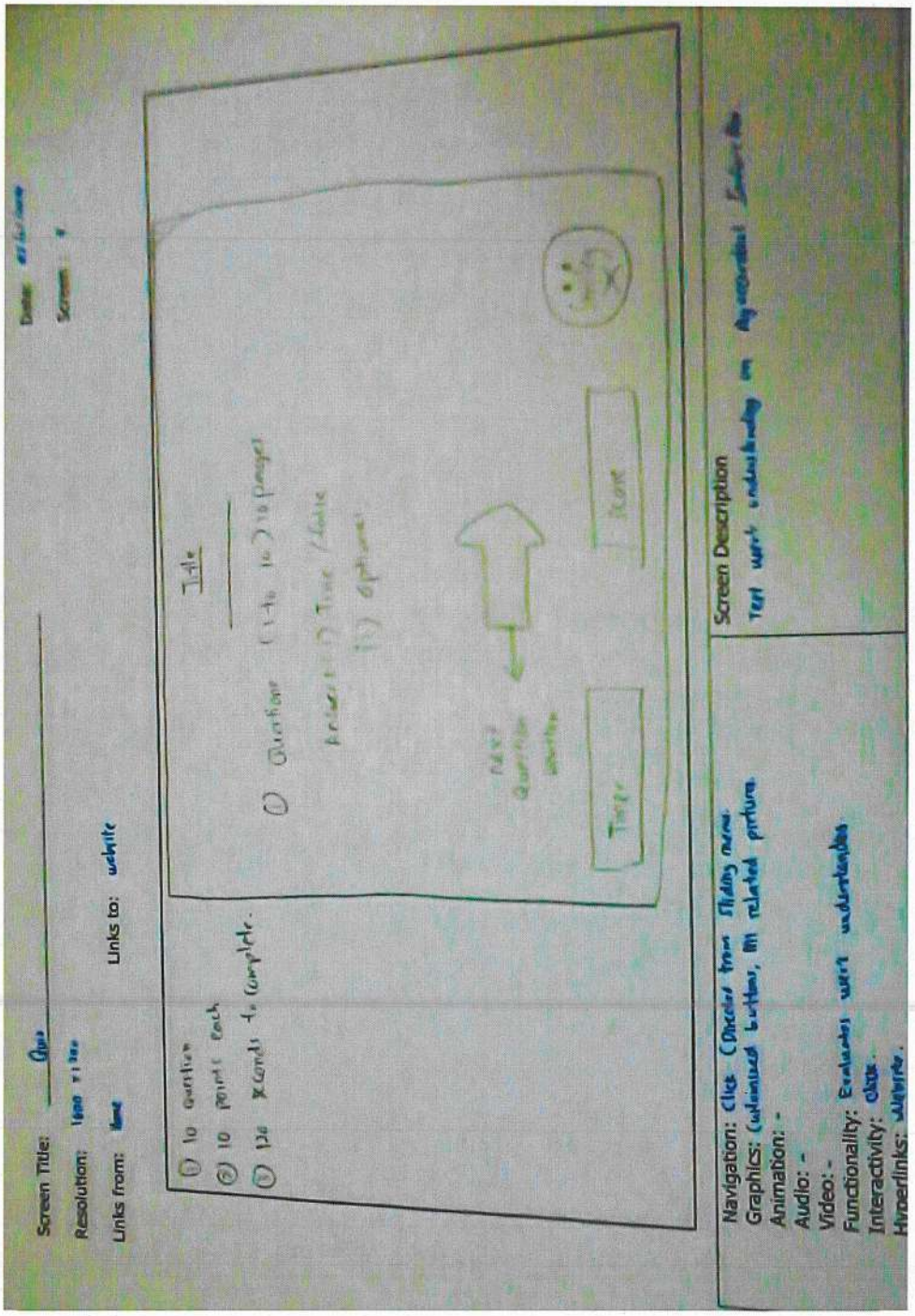


Figure 2.4.10 Storyboard 10 (Quiz)

2.5 Development phase

The following phase next to design phase is the development phase where the developers able to create and assemble the content that were identified in analysis phase and created in the design phase.

Developers or programmers work to develop the 3D interactive courseware with the accurate information about cardiac anatomy. As the final part in the development phase the testers will also perform debugging procedures to identify errors or weakness that can be found in the courseware. Eventually, the 3D interactive courseware will be reviewed; revised and all possible correction will be done according to any feedback given during development phase level evaluation conducted.

Adobe Flash and Autodesk Maya are the software that will be utilized for the development of this courseware.

2.4.7 Implementation phase

The fourth phase in the model is Implementation phase where during this phase, a procedure user guidance or user manual will be delivered for training the students, lecturers, medical practitioners, patient or any user who would show their interest in learning cardiac anatomy and related issues.

Upon the completion of the implementation phase developer or designer required to prepare and deliver courseware with proper documentation and other materials needed to run the system or courseware. For example 3d courseware developed using Adobe Flash and Autodesk Maya

2.5.5 Evaluation

There are two techniques in the evaluation phase, namely summative evaluation and formative evaluation.

The formative evaluation needed to monitor the effectiveness and efficiency of the 3D interactive cardiac anatomy courseware. Based on the constructive response or feedback provided by the users, appropriate adjustments will be applied for the courseware.

The summative evaluation will be conducted to identify the overall 3D interactive courseware's effectiveness will be measured upon the courseware completion. The user feedbacks via survey and questionnaire will be collected and the contain accuracy, methods and effectiveness of the courseware will be validated.

PART 3

CONCLUSION

3.1 Adobe Flash CS6 Professional

This application is implemented using Adobe Flash CS6 Professional which allows the development of any stand-alone application for both windows OS and Mac. This tools is used to develop the application and it come out with a vary package depending on what is going to be developed. Basically, in order to develop a project, Adobe Flash must use its own programming language which is known as ActionScript (AS) and ActionScript 2.0 (AS2) is used for the development of this courseware. The reason AS 2 is used for this project is to develop the courseware with simple yet effective way of creating a courseware.

3.2 Autodesk Maya

Autodesk Maya 2013 is used to develop the 3d models included in this courseware. The models were animated to rotate 360 degree and rendered into 24 frames of sequence of picture.

3.3 Adobe Photoshop

Photoshop is used to design the interfaces for the courseware. The textures for 3D models are also designed in Photoshop. For this courseware Photoshop version CS6 was utilized.

3.4 Adobe After Effect

After effect is another software in the adobe group which is used in this project to create video mantage that visualize the myocardial infraction using 3D models.

3.5 Object2VR

Object2VR used to create the interactive 3d models using sequence of picture consist of 24 frames

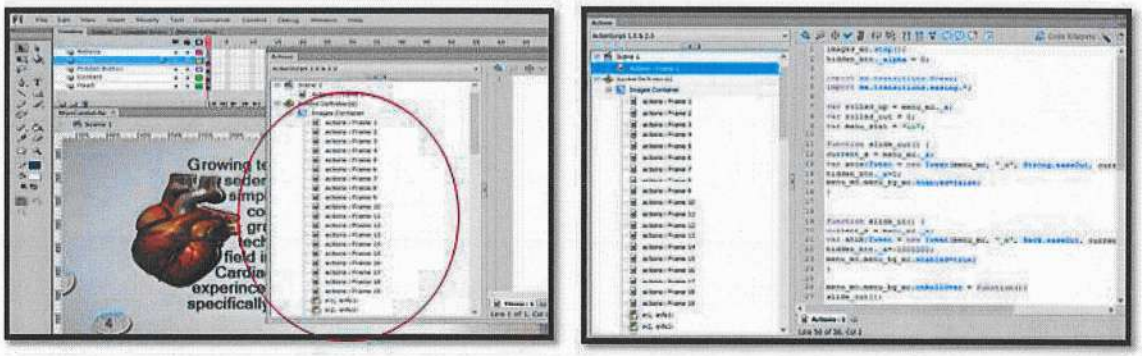


Figure 3.1: Code Snippets Panel and Actionscript 2.0

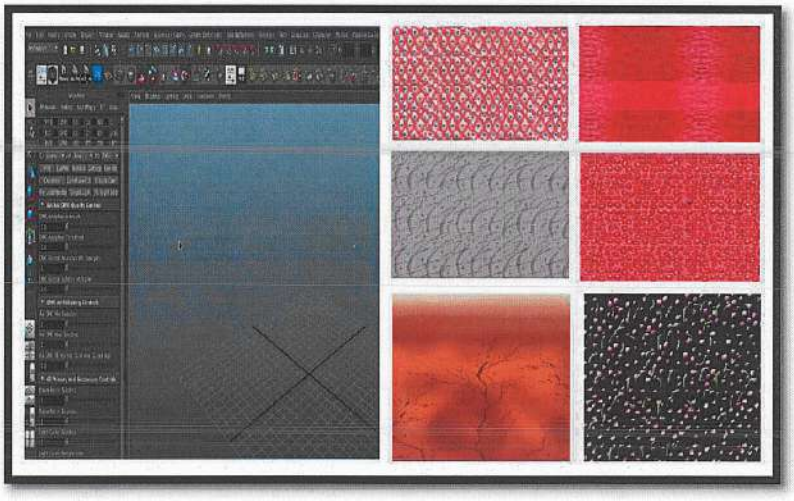


Figure 3.2: Figure 3.2: Autodesk Maya and textures used in this courseware

3.3 Results

As planned, this project should come out with the final results that relate back to Part I and II within this report. Thus, the final results for this project are supposed to be an educational courseware for medical education specifically for myocardial infarction. The interfaces of this courseware are shown as follow:

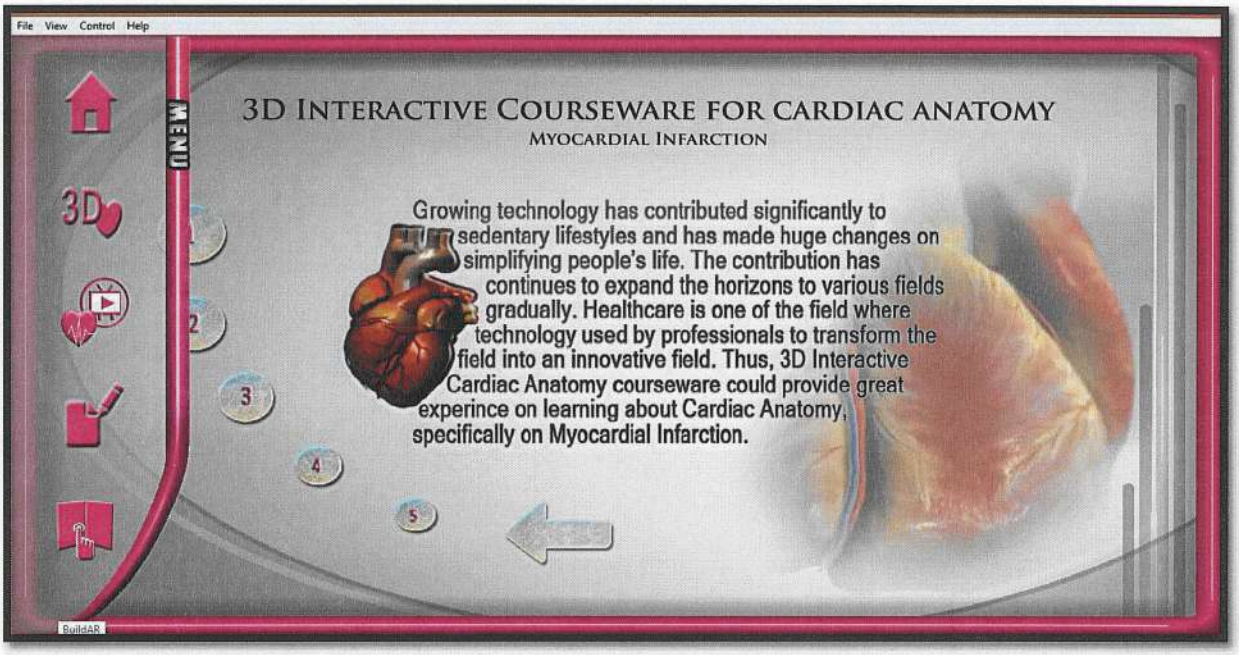


Figure 3.3: Home page

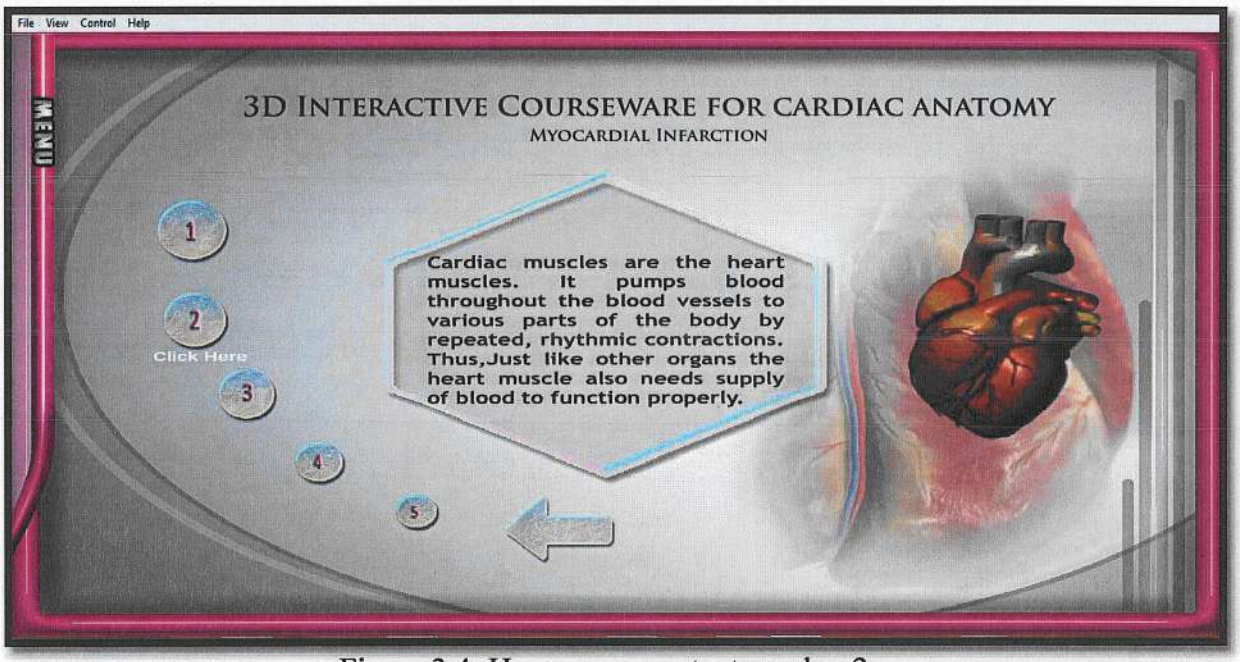


Figure 3.4: Home page content number 2

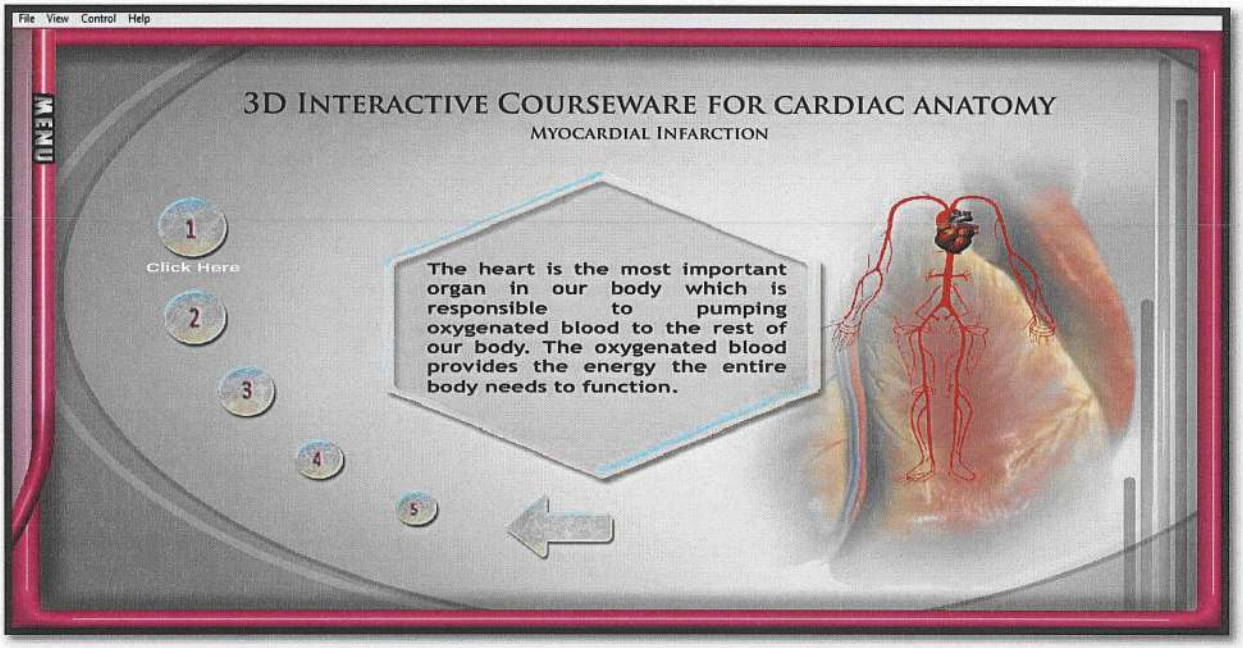


Figure 3.5: Home page content number 1

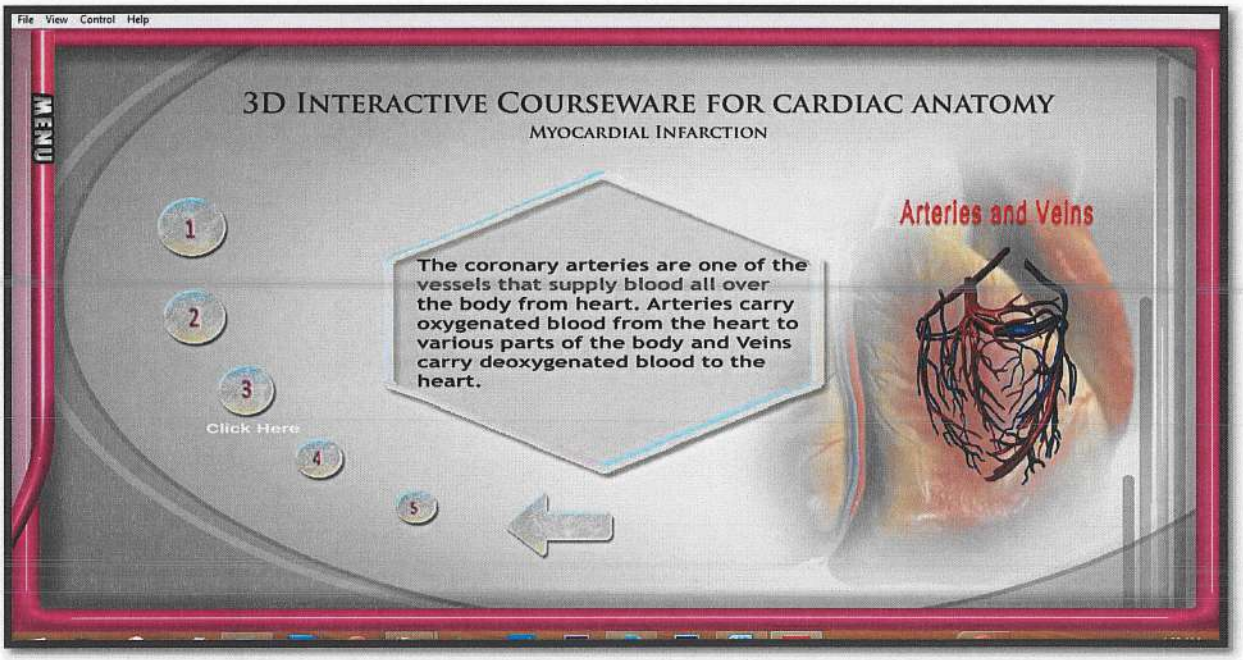


Figure 3.6: Home page content number 3

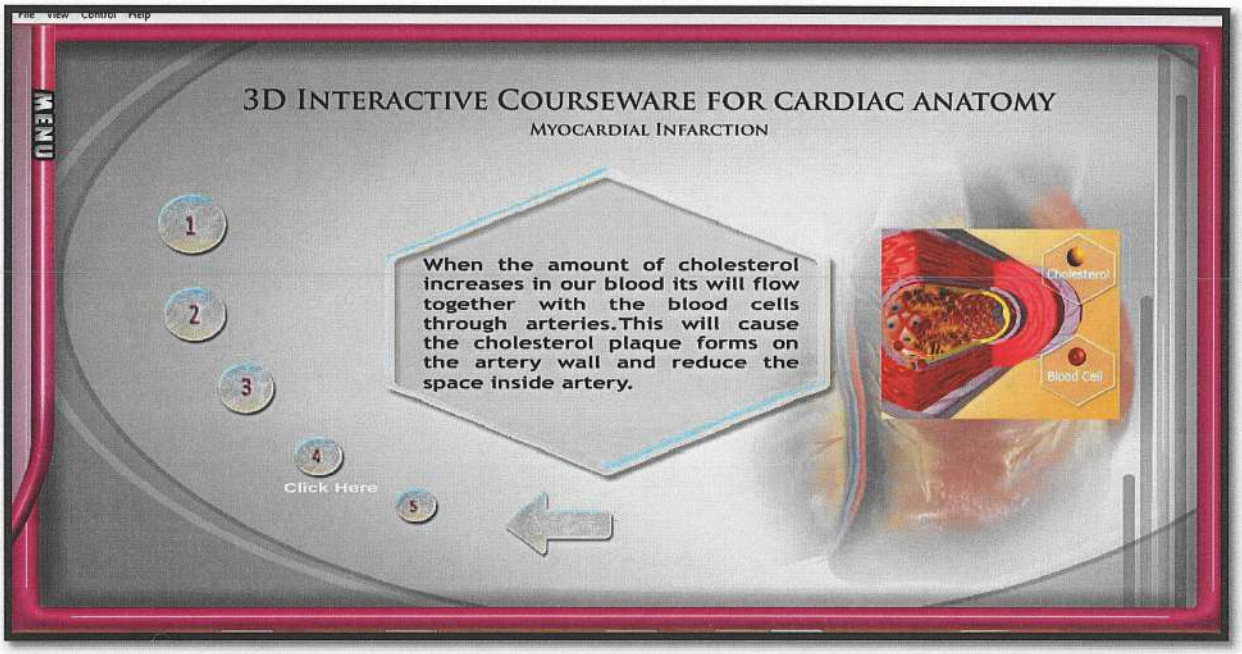


Figure 3.7: Home page content number 4

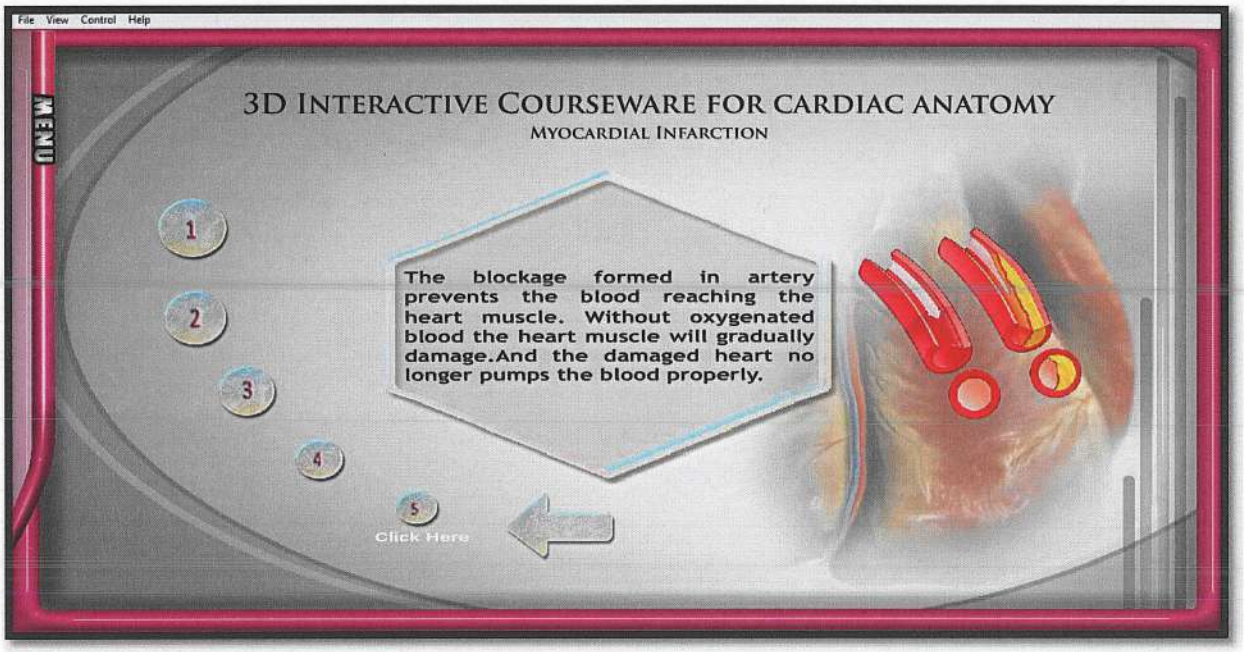


Figure 3.8: Home page content number 5

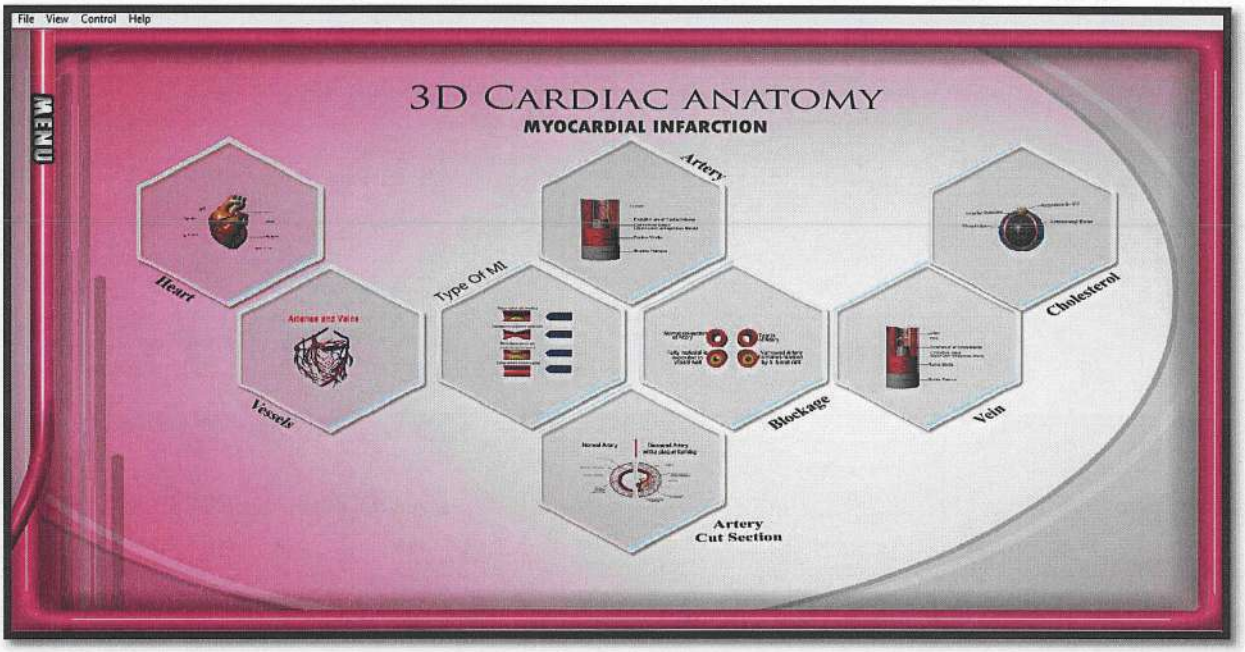


Figure 3.9: Home page content number 1

Description for the buttons on figure 3.7:

1. The heart
2. The arteries around the heart wall.
3. The Myocardial infarction types.
4. The Artery
5. The blockage on artery
6. The cut section of artery
7. The vein
8. The cholesterol (LDL)

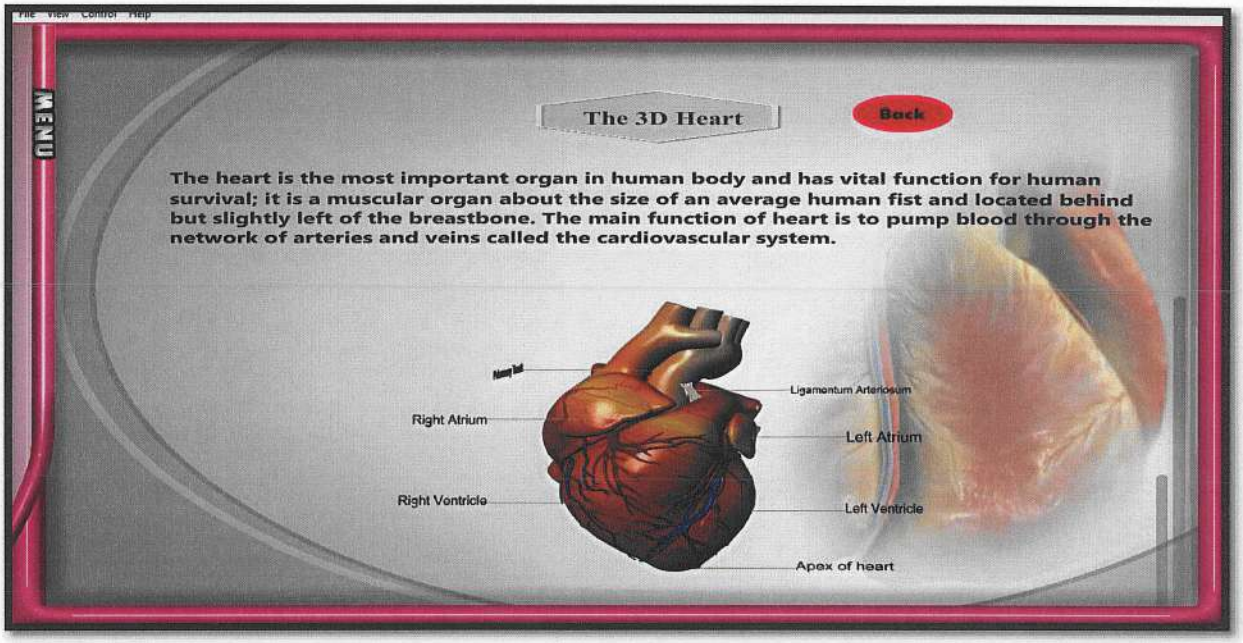


Figure 3.10: content on button 1

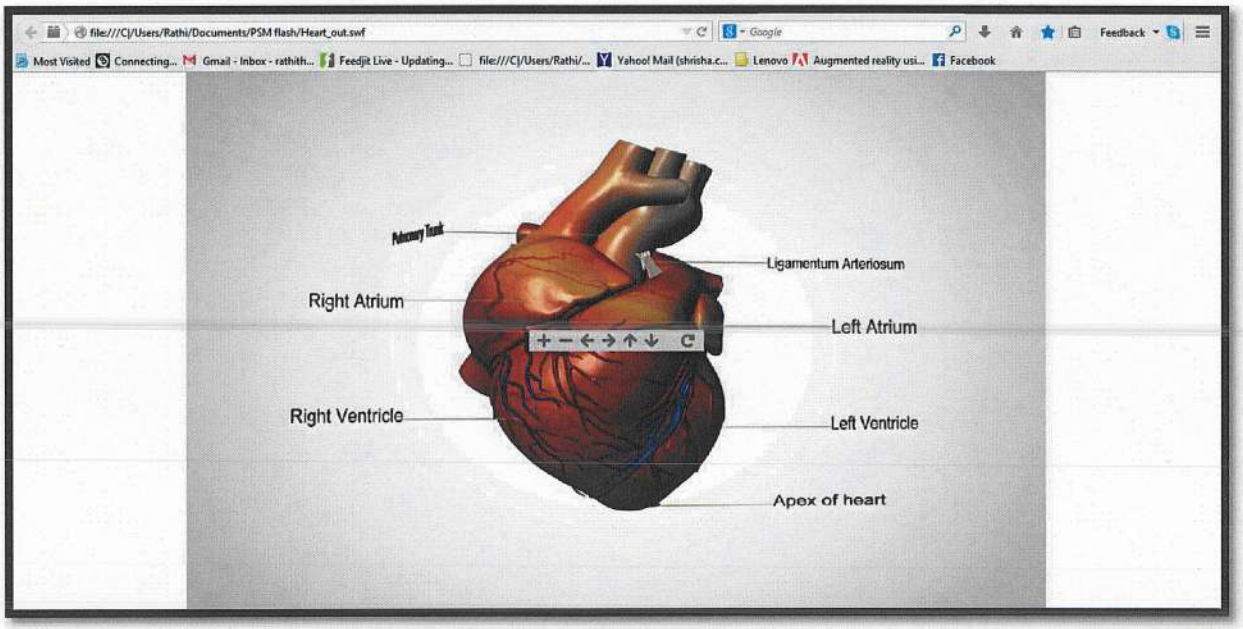


Figure 3.11: 3d models of heart

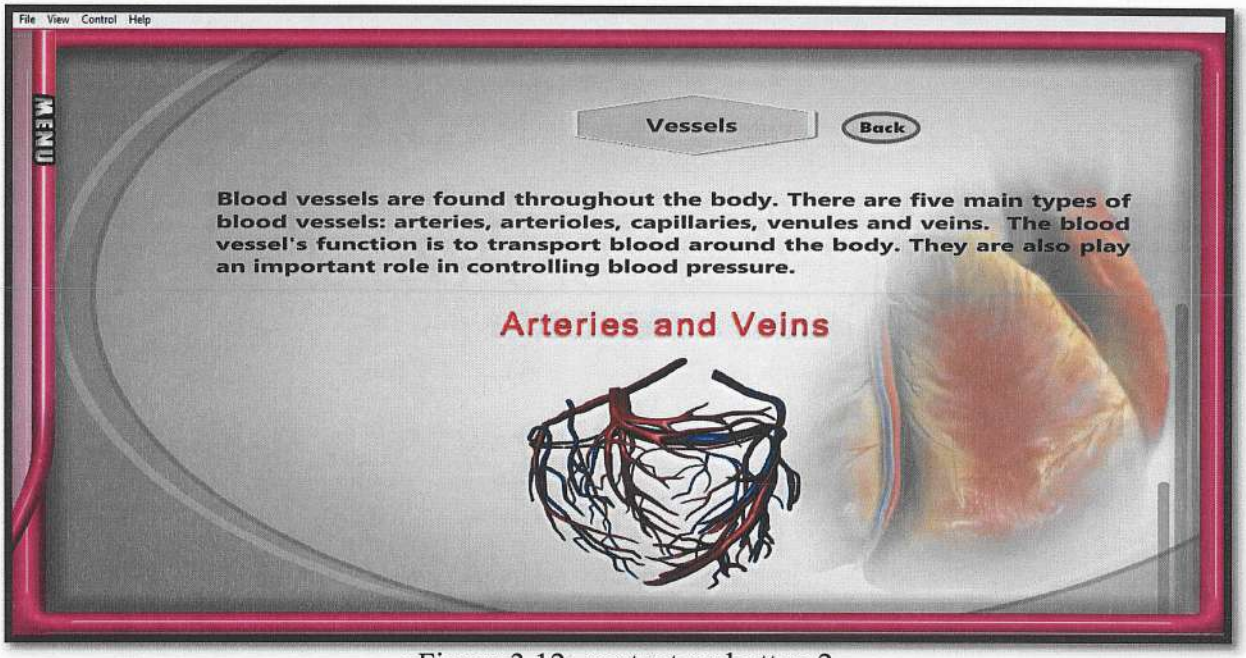


Figure 3.12: content on button 2

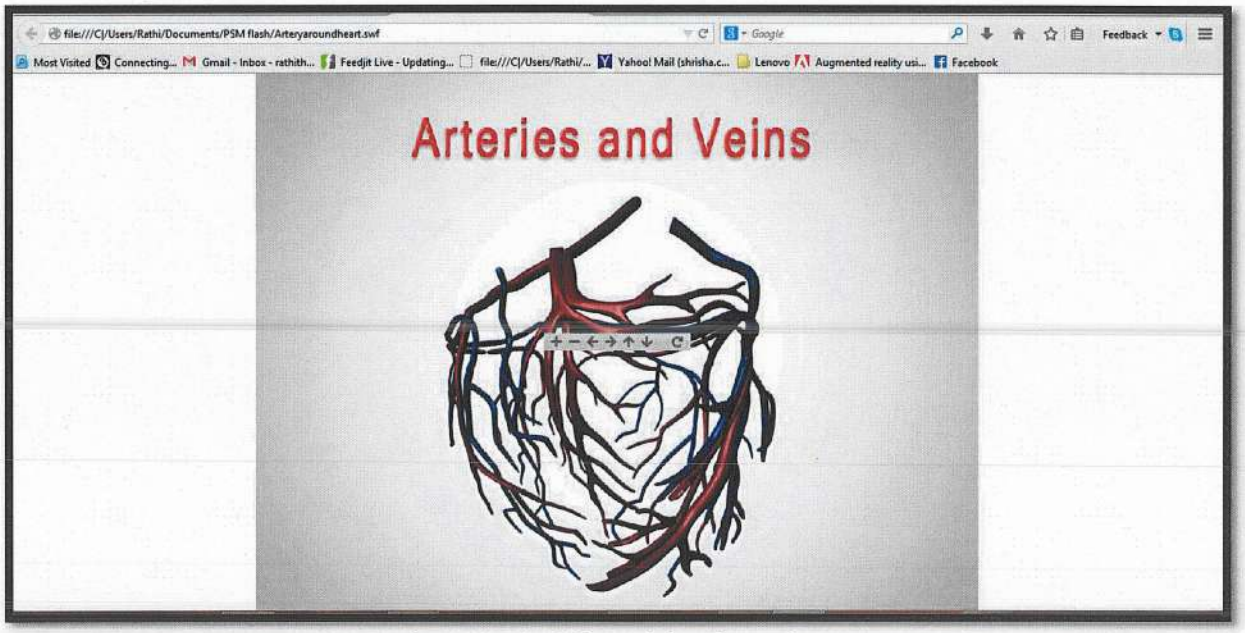


Figure 3.13: 3d models of arteries

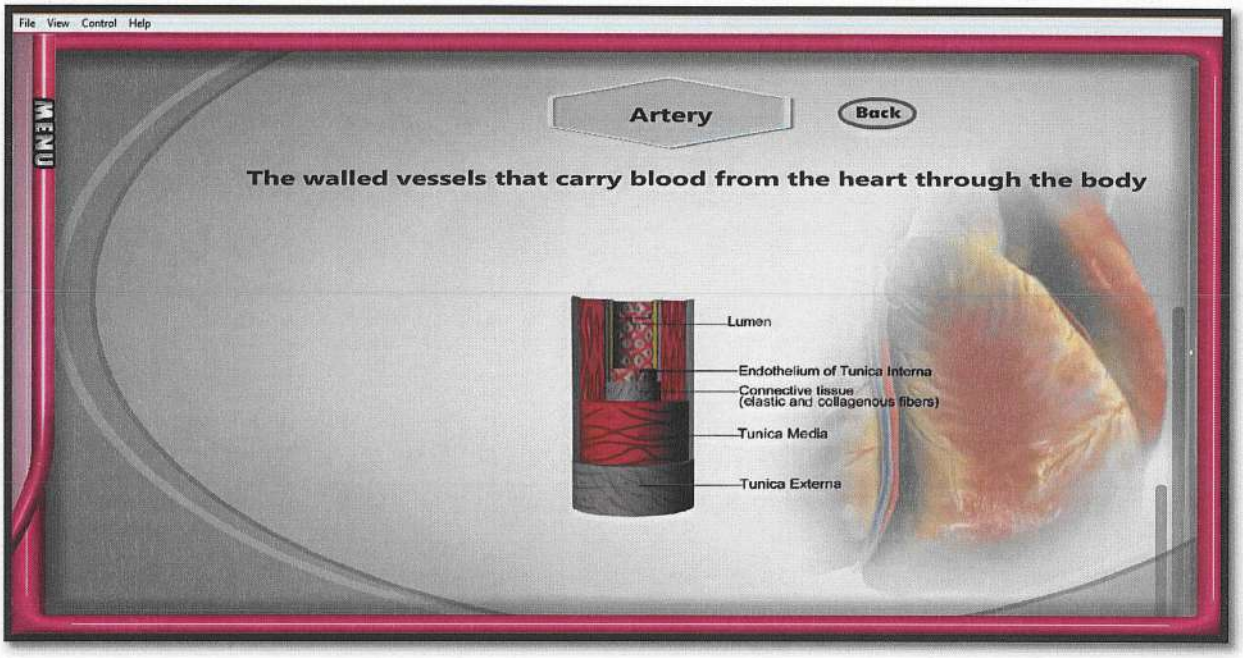


Figure 3.14: content on button 3

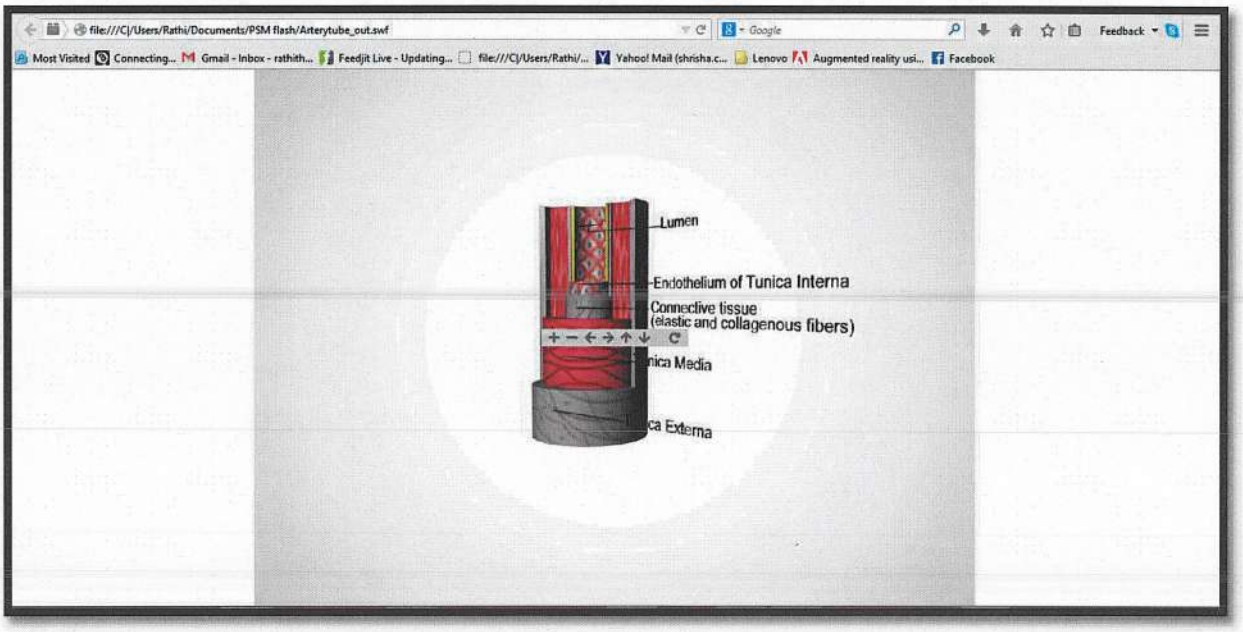


Figure 3.15: 3d models of Artery

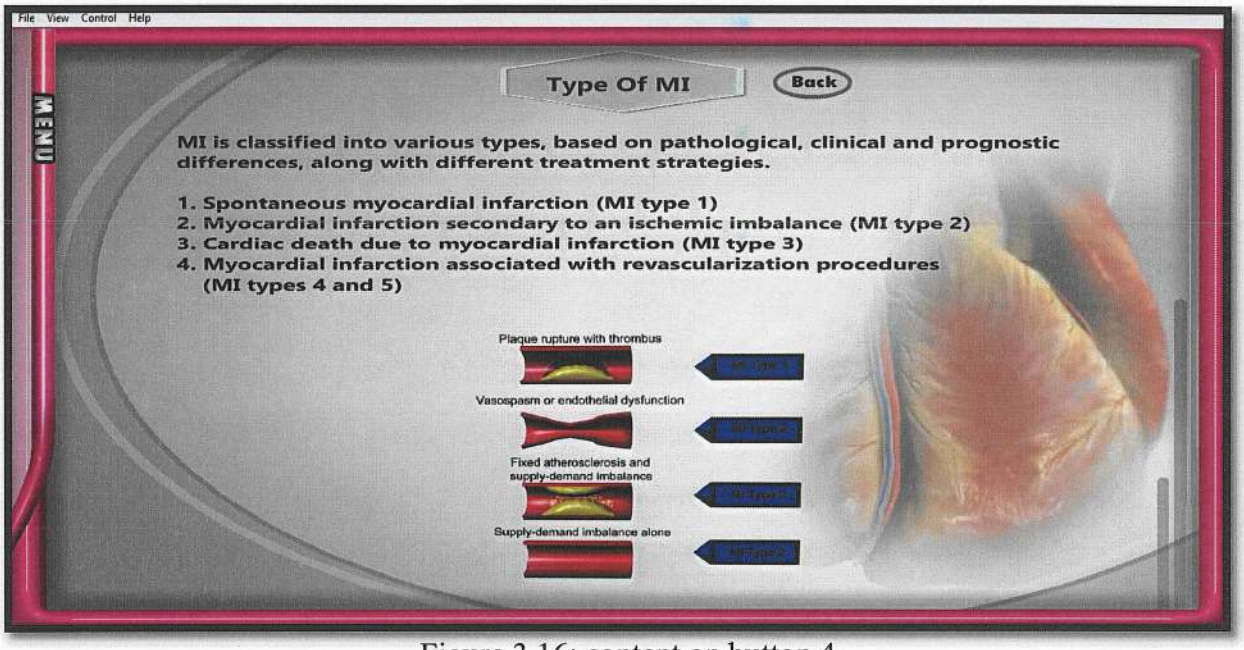


Figure 3.16: content on button 4

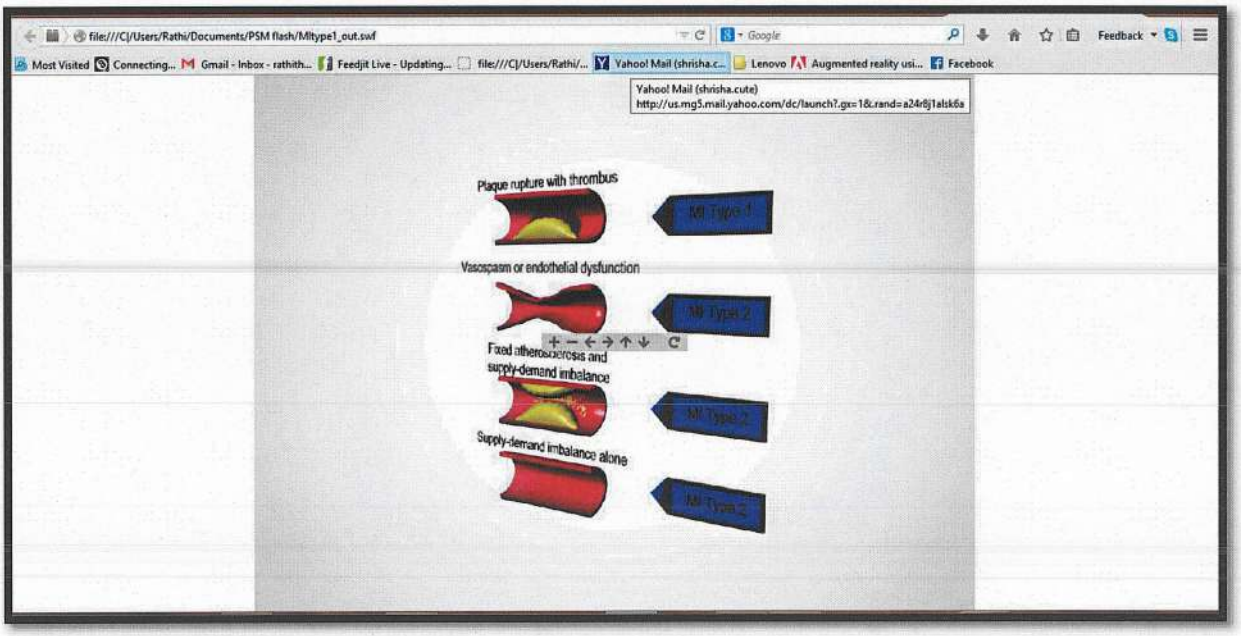


Figure 3.17: 3d model of MI types

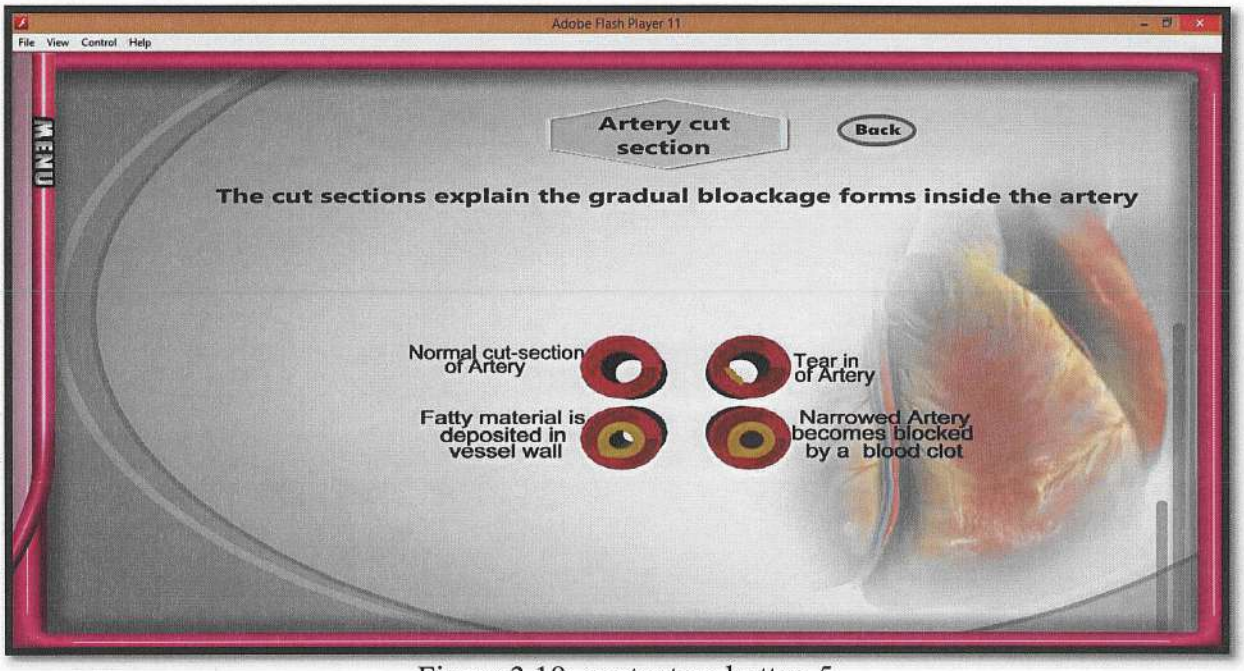


Figure 3.18: content on button 5

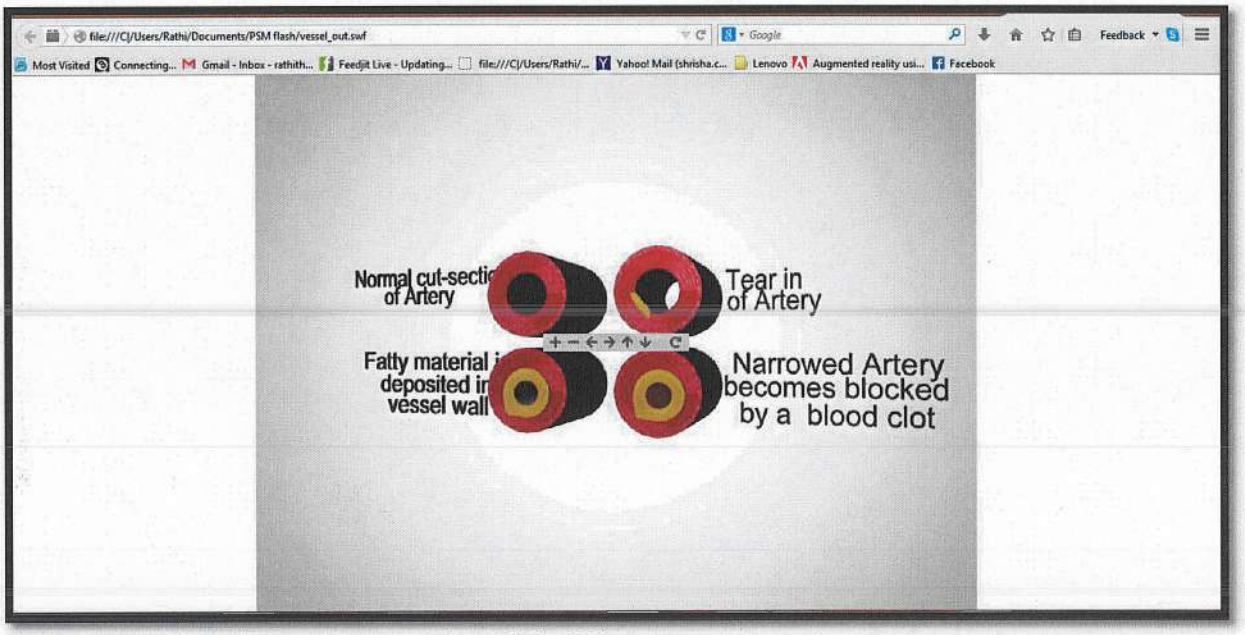


Figure 3.19: 3d model of the artery cut section

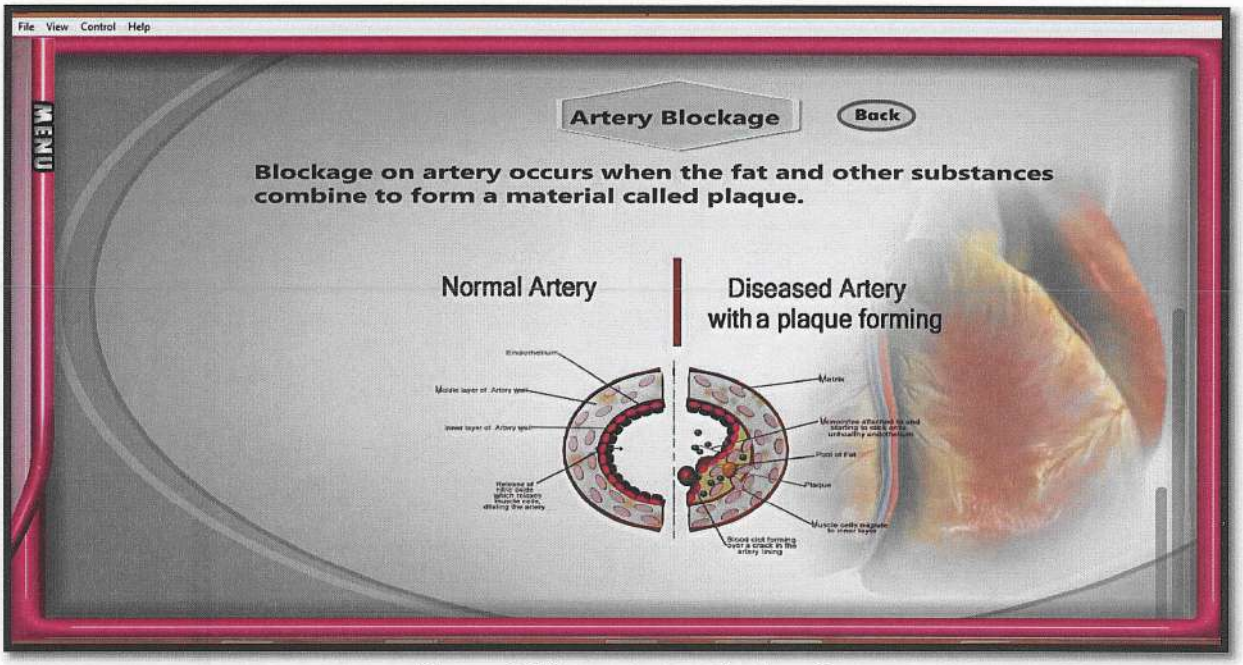


Figure 3.20: content on button 6

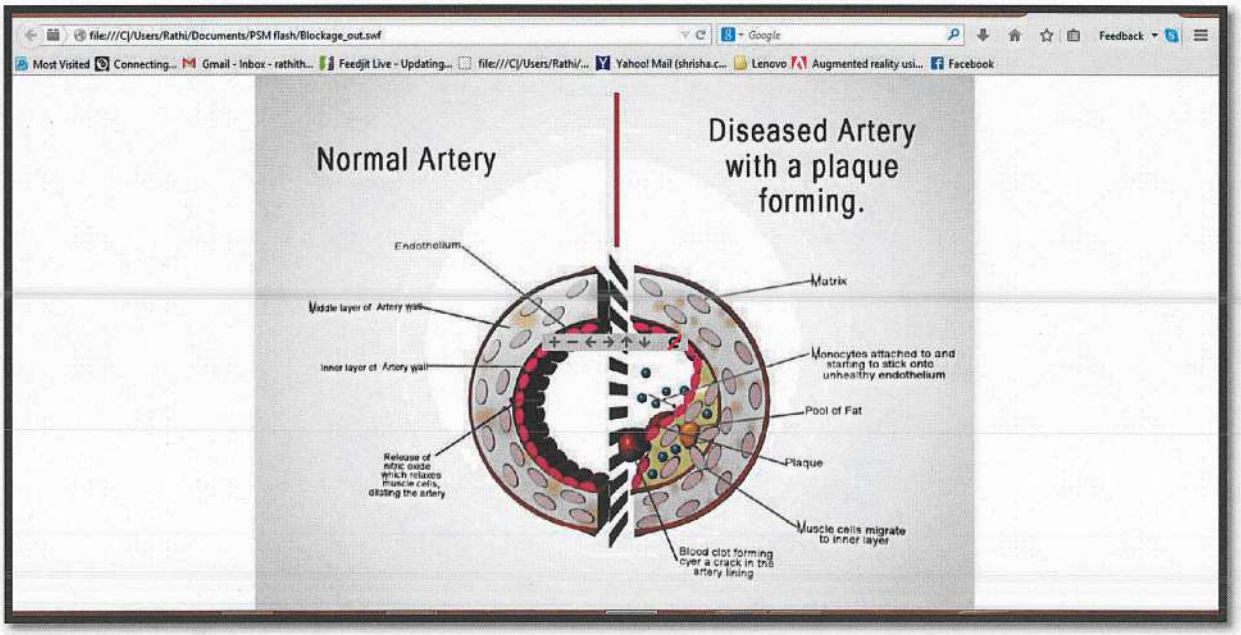


Figure 3.21: 3d model of the normal and blocked artery

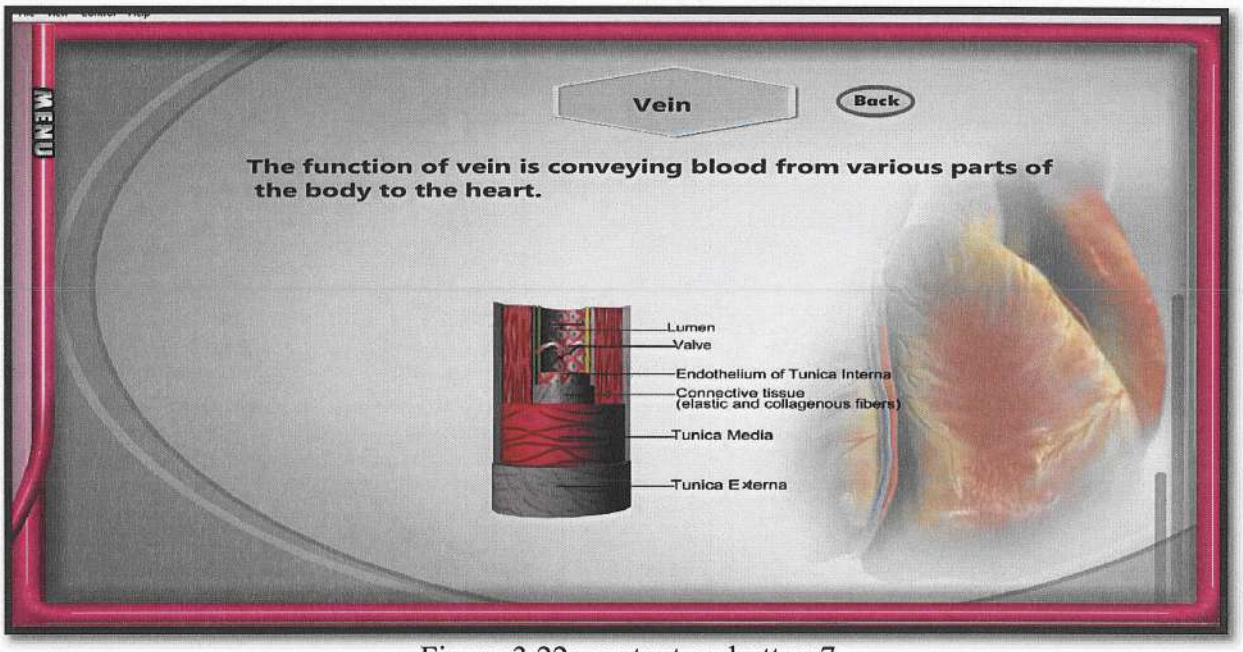


Figure 3.22: content on button 7

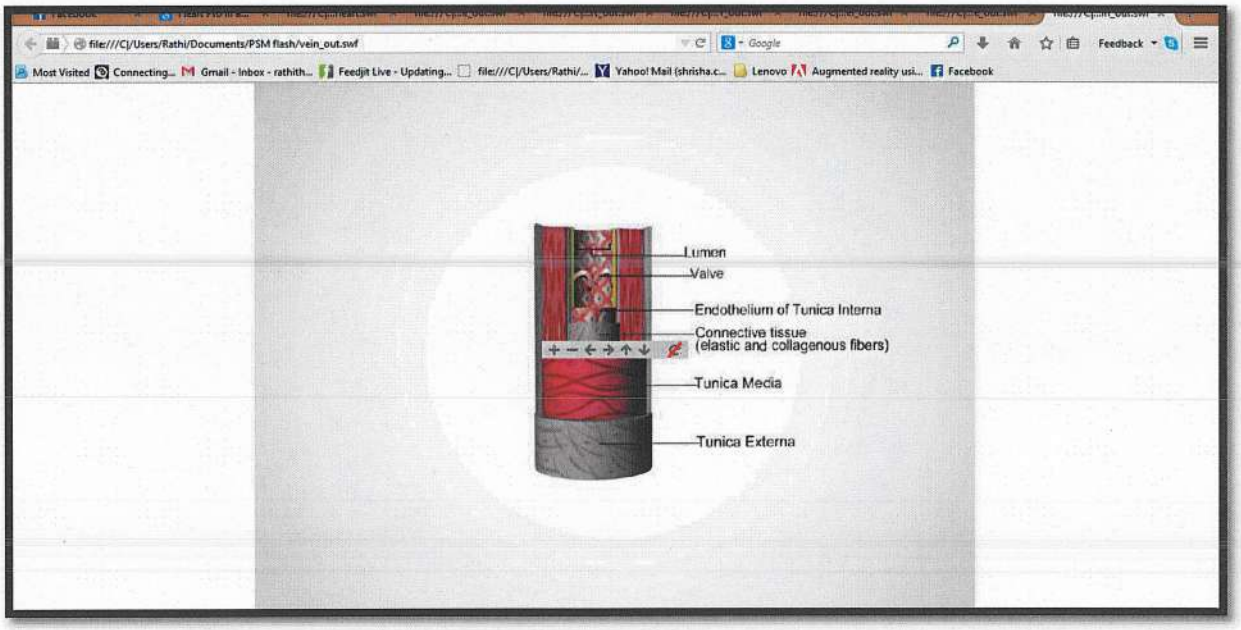


Figure 3.23: 3d model of the artery

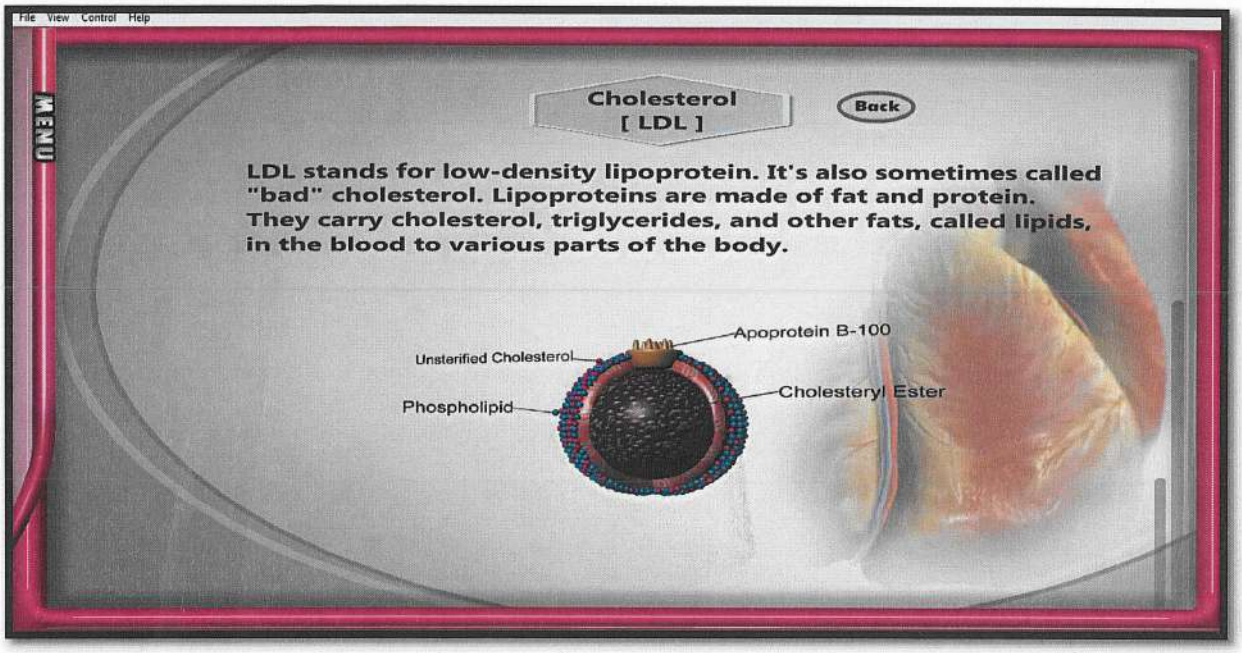


Figure 3.24: content on button 8

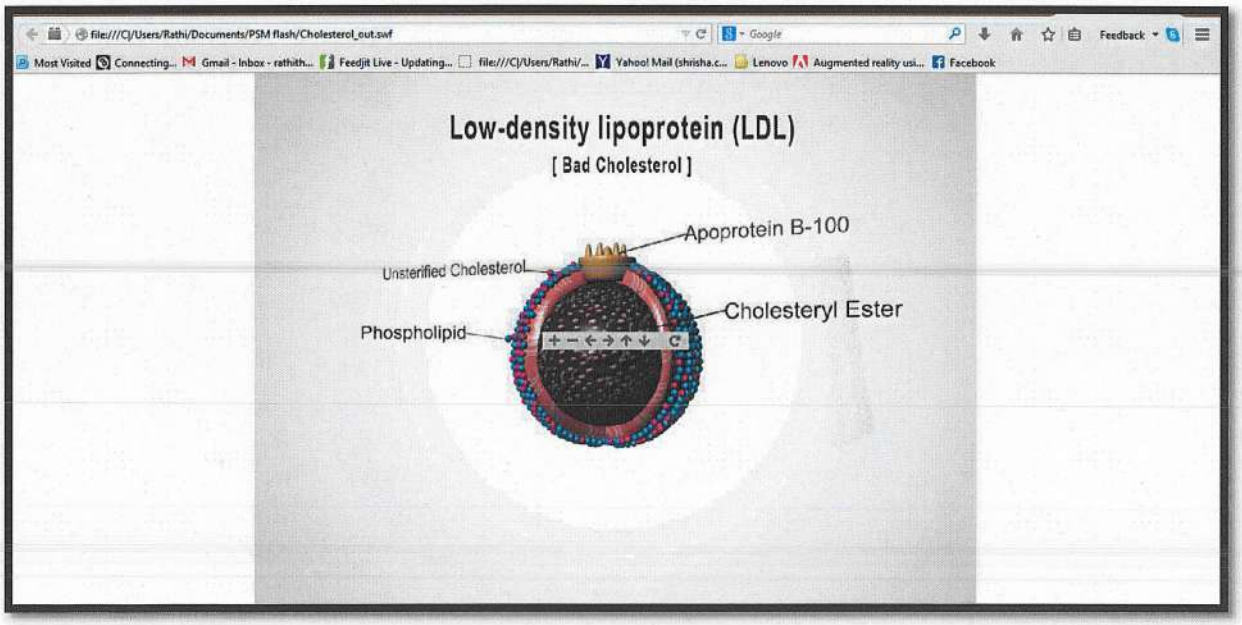


Figure 3.25: 3d model of the cholesterol cell

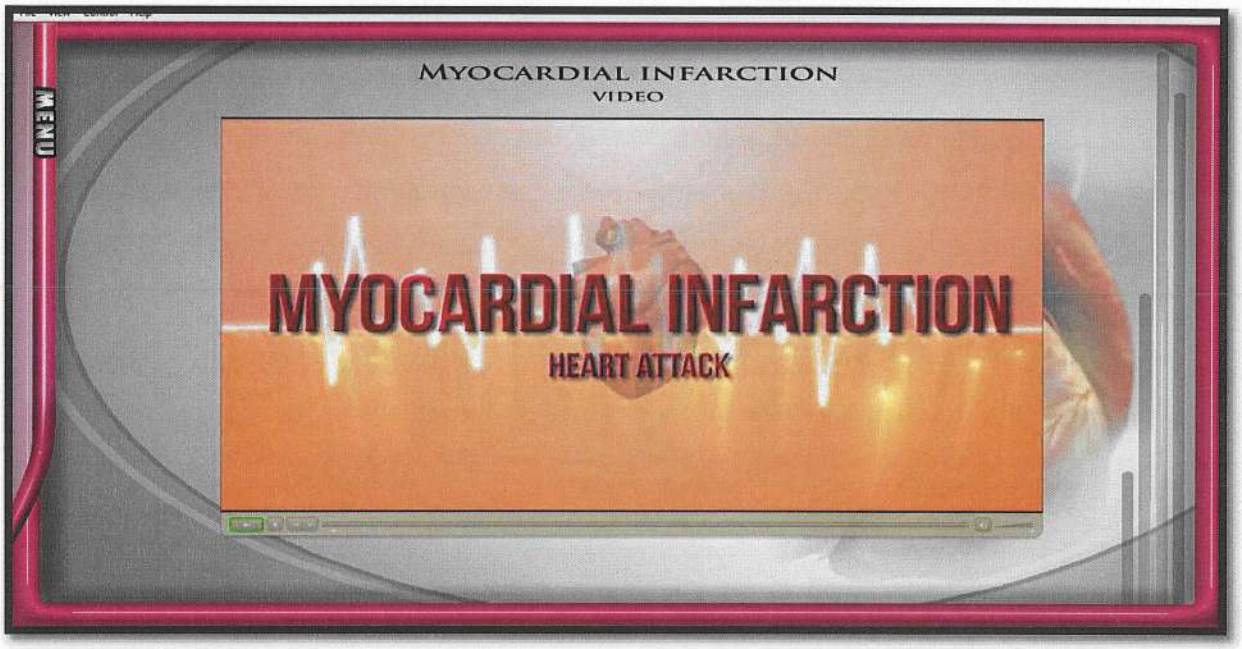


Figure 3.26: content video page

Figure 3.27: Quiz page

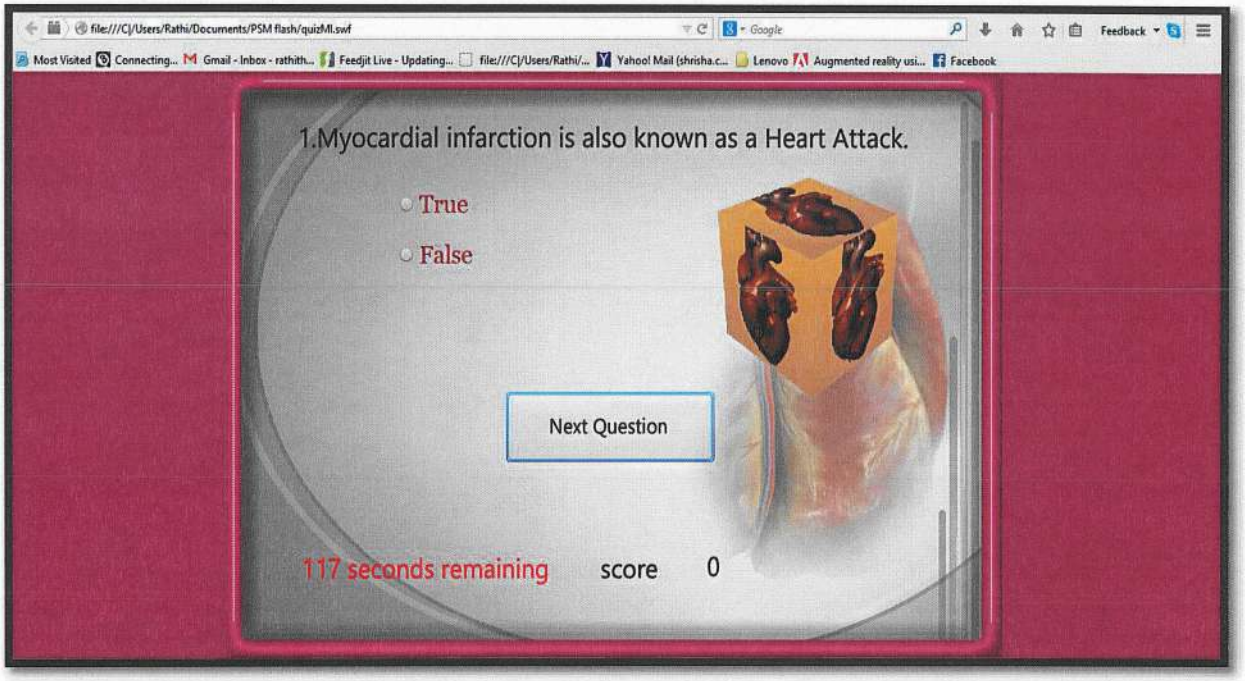


Figure 3.28: Quiz question page

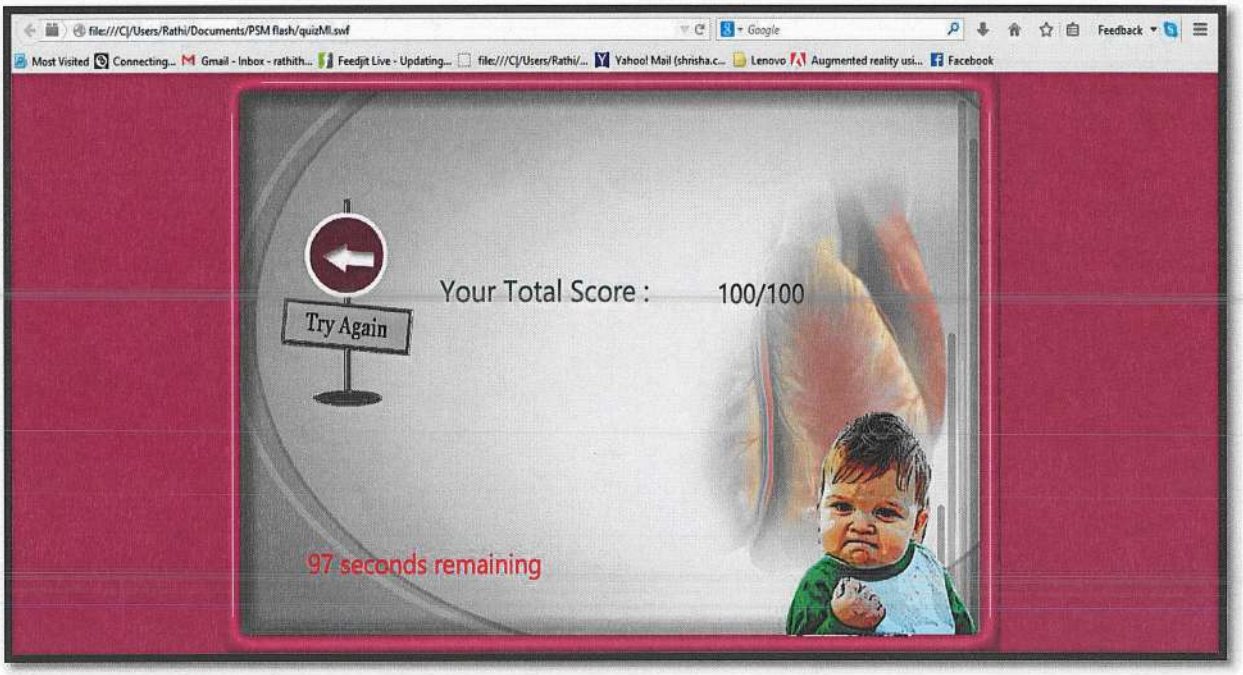


Figure 3.29: The score page

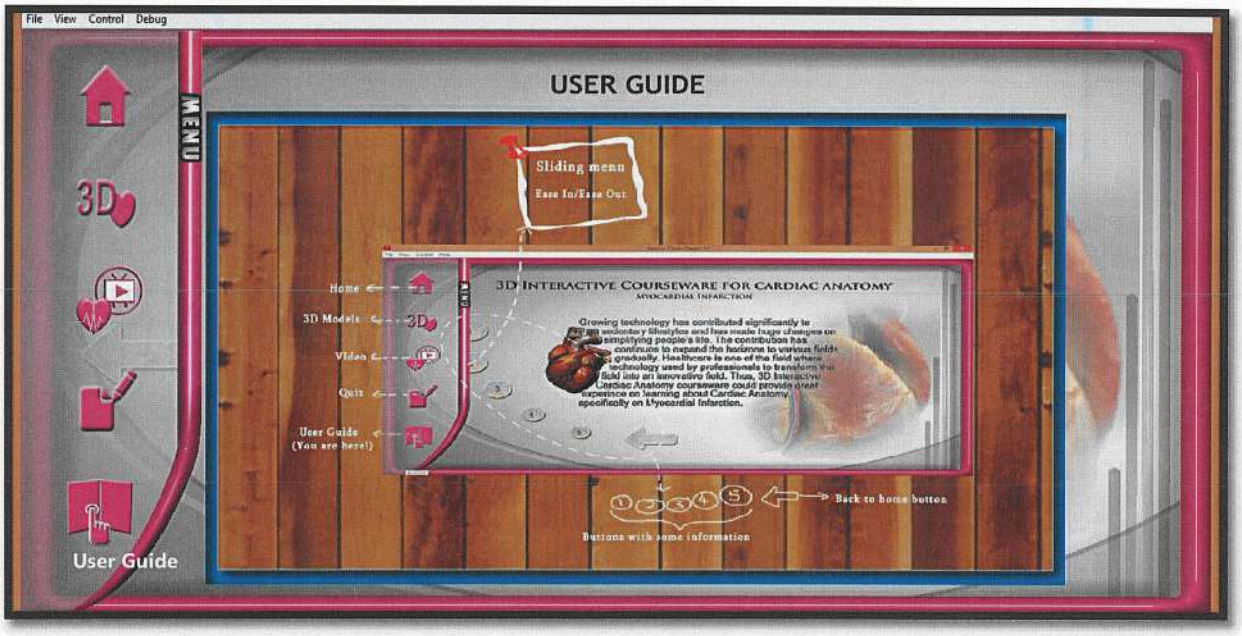


Figure 3.30: User guide 1

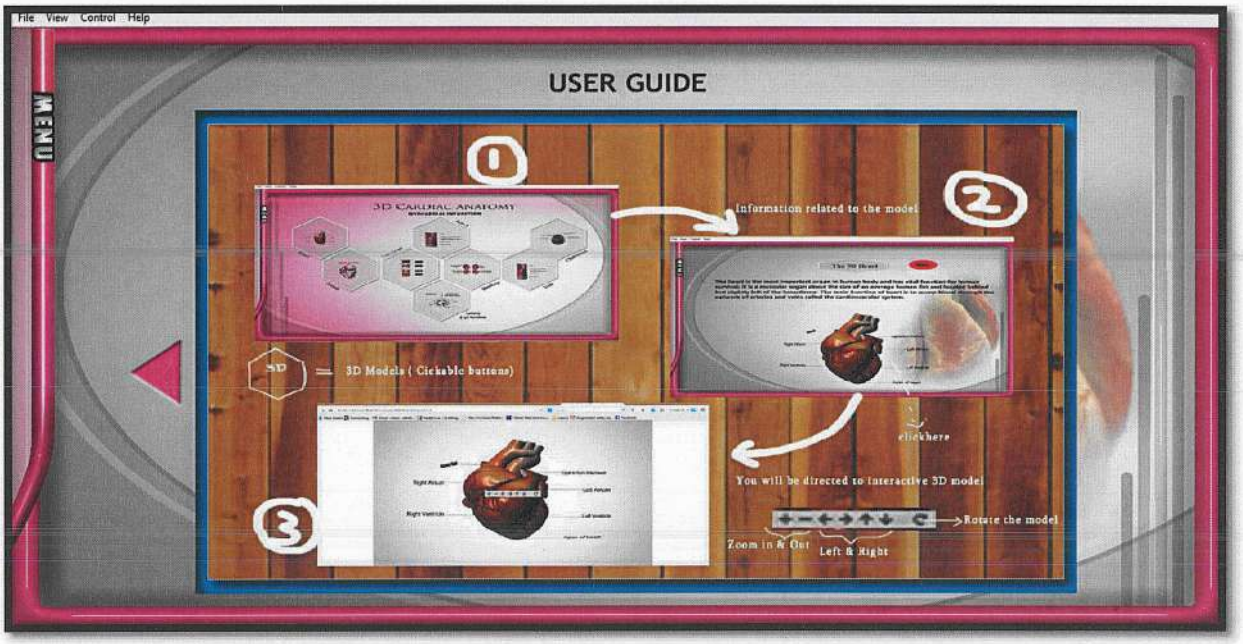


Figure 3.31: User guide 2

3.5 User Guide

The user guide is included within the courseware in order to instruct the users how to use and obtain information from this courseware.

3.6 Testing and Evaluation

As parts of the completing phase of the development of this project, there should be a testing and evaluation session where this testing had been conducted randomly to the end users. This session is done in order to get the feedback from the users about how the courseware works and does it fulfill the main objectives of this project.

Hence, the testing and evaluation session has been conducted and the responses were recorded for future improvement or enhancements.

3.7 Conclusion

As a conclusion, 3D Interactive courseware for medical education for cardiac anatomy on myocardial infarction has been successfully developed using Adobe Flash CS6 Professional as the development tools for this project. This application has fulfilled the user requirements and the objectives that have been decided at the early stage of this project. In the other hand, the aim is to educate and give exposure to Malaysians on the importance of their health, specifically on coronary heart diseases.

However, this courseware still have some weakness and limitations that should be improved and upgrade in the future. As a result, it is a hope that this courseware would help to improve the exposure of health care issues to Malaysian and reduce the number of death that cause by coronary heart disease in Malaysia.

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    b. Kamen1, D. Mereles2,H. Steen2, B. Meder2, H. Katus2, D. Comaniciu1Siemens Corporation, Corporate Research and Technology, Image Analytics and Informatics, Princeton, NJ, USA, University Hospital Heidelberg, Department of Internal Medicine III, Cardiology, Angiology and Pneumology, Heidelberg, Germany

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APPENDIX A

GANTT CHART

1.6 Gantt Chart

Gantt Chart Using ADDIE model																													
Activity Description	**TIMELINE (WEEK)**																												
A. ANALYSIS PHASE	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
I. Identify the instructional goal of the courseware.	x																											
		x																										
II. Conduct instructional analysis and identify tools, techniques and software.			x																									
				x																								
III. Learner analysis - Identify the target users.					x																							
IV. Identify the learning objectives of the project.						x																						
							x																					
								x																				

B.DESIGN PHASE																													
I. Design assessment for the courseware.									x																				
II. Choose the course format.										x																			
III. Develop storyboard based on analysis.											x																		
IV. Create the instructional strategies.												x																	
													x																
C.DEVELOPMENT PHASE														x															
I. Create (sample) prototype of the interactive courseware.															x														
II. Collect the courseware material consists of cardiac anatomy syllabuses.																x													

III.	Develop the 3D courseware based on syllabus.																x													
D. IMPLEMENTATION PHASE																		x												
I.	Prepare training materials and train the users.																		x											
II.	Arrange the learning space with proper tools and knowledge based on anatomy.																			X	x									
III.	Test the functionally of the interactive courseware.																					x	x							
IV.	Identify the appropriate prerequisites for the cardiac anatomy and																								x	x	x			

	implement accordingly on the courseware.																													
E.EVALUATION PHASE																														
I.	Formative evaluation - Evaluate the phase using questionnaire to ensure the accuracy of the information collected.																											x	x	
II.	Summative evaluation. - Evaluate entire project or courseware to determine the success of the objectives identified.																													x

The flowchart:

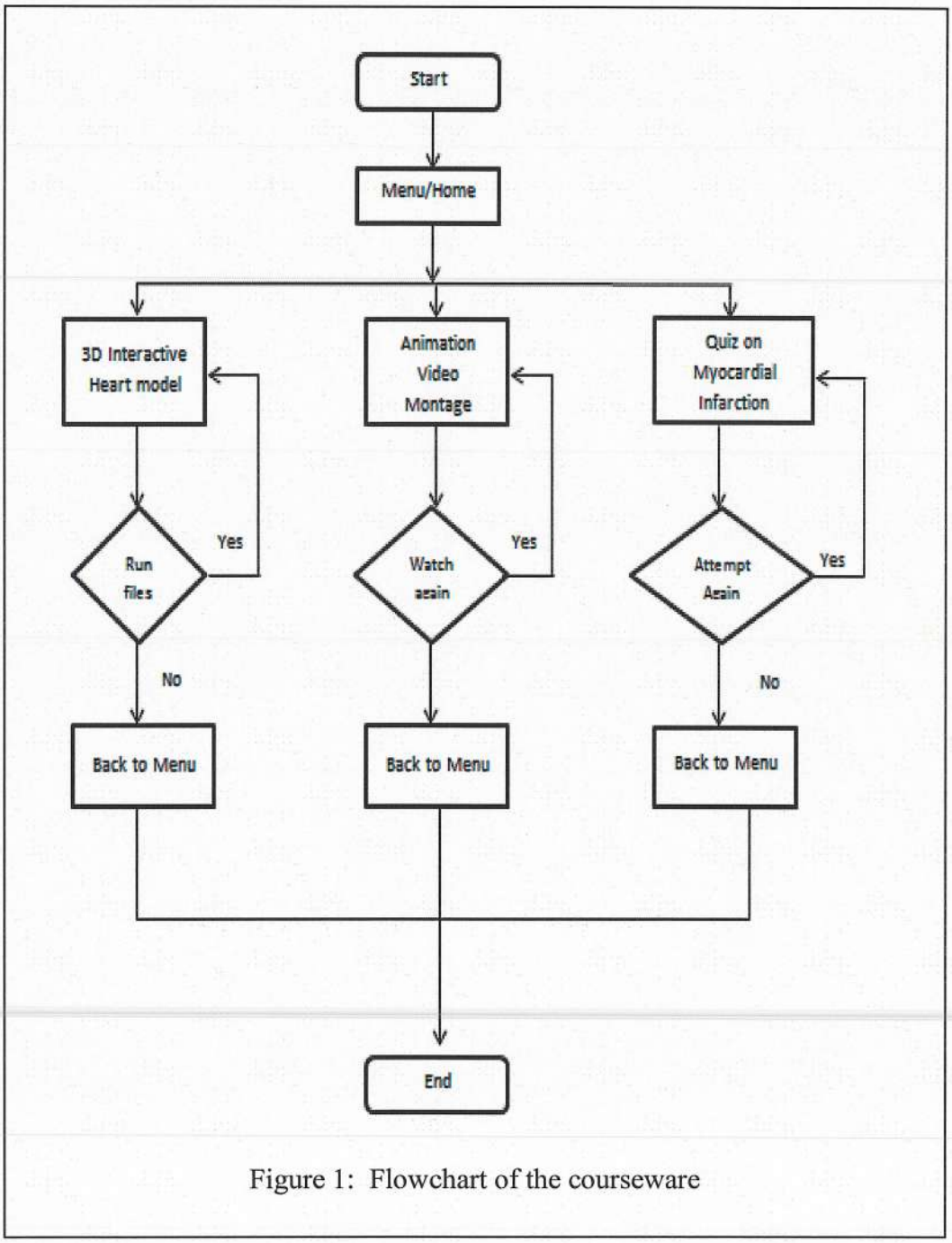

Figure 1: Flowchart of the courseware