

Virtual Reality Mobile Application for First-Aid training

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Declaration

I declare that this written document represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Approval

The B.Des Design Project - 2 titled “Virtual Reality Mobile Application for First-Aid Training” by Thadhagath MP, Roll Number 16U130028 is approved, in partial fulfillment of the Bachelor in Design Degree at the IDC School of Design, Indian Institute of Technology Bombay.

Project Guide

Chairperson

External Examiner

Internal Examiner

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Abstract

The shift in education system towards a more holistic development of human being is driven by technological and cultural advancement of the society. Empathy and caring for a fellow human being is being adapted is given more value than ever. Helping another being who is in an emergency situation can be a double sword if the person trying to help is not educated previously on how to handle the situation. This project aims at creating awareness and to educate simple and basic First-Aid knowledge to anyone who is interested in learning.

1.0 Introduction

Technology in the medical field has saved countless lives and is continuously improving the quality of life. Digital medical records, greater patient care, easy workflow, cost efficient health systems and equipment are just a few major contributions to name[1]. The advancement of technology helps patients to get better health and the medical staff to provide better care in a much more efficient way. But it is also a notable point that with the present technology available, a common man can now access most of the documented medical knowledge online. This is a major revolution in the medical field which still has not reached its peak. India has failed to provide its citizens the minimum doctor:patient ratio of 1:1000 made by 'High Level Expert Group (HLEG) for Universal Health Coverage' constituted by the Planning Commission[2]. Technology has the potential to play a huge role in reducing this gap with its thoughtful designs to give the medical care sector a huge boost.

Within the medical sector, India falls behind very badly in the paramedics and disaster management. With no centralised Emergency Medical Service (EMS) which provides guidelines for training and operation of EMS, people are unaware about what to do in case of an emergency[3]. Private ambulance services exist with extremely wide variability in their dispatch and transport capabilities according to the location of emergency. Since the EMS has a long way to go before establishing a solid system to attend every emergency situation in the country, an alternative can be to educate the maximum of our general public and spread awareness about paramedics and First-Aid. So this project will be focusing on reaching out to the general public to give a basic idea of how to react in an emergency situation.

VR is not ready for mass consumption in India due to its expensive equipment. The Head Mounted Display (HMD) gear is still an inaccessible medium to a common man. But Industrial Development of VR and AR in the past decade has brought down hardware and software costs to a small fraction of its price before[4]. So it is safe to assume that in the coming few years the hardware and software for VR will come down to an affordable price, just like the revolution of affordable smartphones. Contributing more softwares and applications to this medium will help in boosting publicity and reach of VR. This project can also be seen as a contribution to a larger movement of making VR an affordable technology.

My primary aim here is to spread awareness and educate the general public. With the rise of internet usage and smartphones getting cheaper, the reach of the internet is still expanding in India. The popularity of

using different mobile applications has also increased with the introduction of cheaper data plans. So using mobile applications to share knowledge is an efficient way to access a larger population. There are 1000s of mobile applications being produced daily, and around 1,00,000 educational apps existing on Google and Apple stores[5]. Hence including an attractive, suitable and novel feature in the application is necessary to help the audience grow interest in using an application for learning First-Aid.

2.0 Motivation and Goal

2.1 Motivation

This project is my graduation project and I wanted to explore the Virtual Reality (VR) medium. I have always been curious about this technology which gives a very immersive experience for the user, nevertheless, I wasn't able to do a project until my final year. Hence I chose to work in this medium to learn more about this technology and to learn how this technology can be applied to a product that can have good social cause.

2.2 Goal

I chose to work on a topic that is really important yet not seen as relevant. Paramedics and First-Aid is something we all have seen in a small section in our school textbooks. It is a simple and incredibly powerful life-saving set of skills and

knowledge that most normal people can learn with very less effort. Yet its importance is always undermined and seen as not worth taking a few minutes of our time to learn to save a life. So my goal is to use an emerging technology to spread awareness about First-Aid and help people to have an interactive learning on how to react in an emergency situation and assist First-Aid.

3.0 Primary Research

To learn more about the basics of First-Aid and know more about how training for First-Aid is conducted, I did a field visit to Indian Red Cross Society(IRCS) Maharashtra State branch in Fort, Mumbai. A meeting was set up with Mr. Vikas Kurne, senior Lecturer in First-Aid. He introduced me to various services and activities IRCS undertake with the help of their volunteers. Then he gave me detailed explanations of the process of becoming a volunteer. According to him, **more than belated expert care, a quick & simple basic First-Aid can save lives in critical conditions.** So rather than focusing on training a few experts, it is more effective if every human being knew what to do in an emergency scene. He explained to me about how he conducts his classes, the methods he uses for teaching his students. He does practical tests after theory class for his trainee volunteers, in which they are taken to remote areas and act out a mock emergency scene and ask each trainee, one at a time, to find any suitable tools in their immediate surroundings to attend the victim. This

role-play method is used to evaluate the spontaneity and presence of mind in the trainees. But this has its own limitations as mostly **all the students just copy what their classmates do.** He also mentioned how it is difficult to portray the sense of emergency in the scene in these roleplays.

Using rubber dummy is a method they use to demonstrate how to attend to wounds. The problem with this method is that **not all students get to use the one-time-use tools** like bandages and cotton to do hands-on learning. Even if the bandages were supplied, they cannot be used again since the activity involves tying it together and cutting off the extra parts. This will lead to a waste of a lot of resources, so this method is not recommended. Another issue is that the **rubber dummy isn't responsive like the humans**, the scene they train in and the scene in which they will use these training is completely different from each other. The major difference being the panic attacks and shock the victim or victims will show in response to the situation.

4.0 Objective and Scope

4.1 Objective

From the primary research interview with Mr. Vikas Kurne, a lot of educational limitations of the current method was identified. This project is aiming to overcome the following inabilities of current class-lectures and role plays :

- More engaging learning experience
- Create an emergency environment for every student to try which would not be possible in real world
- Stop the wastage of one-time use medical equipments like bandages and gauzes
- Push the student to think for solutions and not passively repeat what their friend did
- Balance learning and fun in an intuitive and safe environment
- Contextualised to a beginners
- Accessible to everyone and not limited to First-Aid Volunteer trainees

4.2 Scope

The scope of the project was defined keeping in mind the objective and goal.

- Identifying domains where VR technology can intervene in First-Aid training
- Ideating possible solutions
- Creating a prototype
- Identifying scope for future work

5.0 Secondary Research

The secondary research was conducted to gain wider knowledge about all the topics related to the topic. This gave an overview of the direction and extended possibilities of how the project can progress.

5.1 Virtual Reality for Education

With the advancement in technology, the education system has tried to incorporate video based learning to its syllabus. Even though it's not widespread like the traditional lecture based classes, video based learning has shown higher student engagement and keeping the attention span longer for the students. Now, educators face major challenges as a result of the shift from the Information Age to the Experience Age[6]. A common problem with the traditional lecture based teaching is its disengagement of students which leads to unfavourable behavior which hinders the success of the student[7]. The 21st century learners are finding the

traditional classroom learning as passive and lacking important skills such as empathy, systems thinking, creativity and abstract thinking[8].

Compared to educational videos, Virtual Reality is a medium which is capable of providing more immersion to engage the students in a more interactive environment and hence helping them to visualize and experience 3D space. This can help for a better learning experience for learning something that develops the empathy and abstract thinking capabilities.

5.2 VR Learning Strategies

There are different strategies of using VR by instructional designers. Three commonly used strategies are Conceptual Orienteering, Critical Incident and Orientational Application[9]. With further research and reading on these, I identified that Orientational Application is the most suitable strategy. This strategy is based on applying physical world rules to objects in the virtual world. For this Oculus Quest is the most suitable device to learn. But since Oculus Quest is inaccessible to the majority of students and learners, I will shift my device platform to an android smartphone. This aligns more with our goal of reaching out to a bigger population.

For developing a learning strategy for an android device, I will inculcate the Critical Incident strategy. This strategy gives the advantage of immersing learners into dangerous scenarios without actually being in danger. Being in a real dangerous scenario affects the emotional as well as the cognitive ability of the student. But in a virtual environment, they can relax and not worry about the consequences. This can help them to focus more on the learning domain.[9]

5.3 First Aid

First aid is the first assistance or treatment given to a casualty or a sick person for any injury or sudden illness before the arrival of an ambulance, the arrival of a qualified paramedical or medical person or before arriving at a facility that can provide professional medical care. To study more about the procedure, I examined the First-Aid Manual developed by IRCS with help of St John's Ambulance Services and field tested by Belgian Red Cross Flanders. The manual gives a very detailed step by step procedures of each type of injuries that can happen to a human being.

From the manual I tried to gather insights about the basic procedures for an ideal response to any emergency situation.

The following is the simple things to keep in mind when you are in an emergency situation:

- First-Aid = Timely Intervention
- Response time and quick decision making
- First-Aid box may not be available in most situations so finding alternatives in crucial
- Presence of mind

5.4 Focused study of one type of casualty

To further scope down the project, I am focusing on teaching the user one type of casualty. The most common casualties are burns, cut wounds and bone fractures. Further examination showed that most people panic in situations involve cut wounds and bleeding. This motivated me to choose this particular type.

Inside cut wounds section of the First-Aid Manual, a variety of subsection were documented

- Incisions
- Abrasions
- Lacerations
- Puncture wounds
- Amputations

These wounds can get complicated if an embedded object is stuck inside the wound. According to Mr. Kurne, in order to save the casualty, the first step that any ignorant man will do is remove the object making more damage to the tissues and thereby increasing the danger. This is a valuable lesson worth sharing as a pilot version of the project.

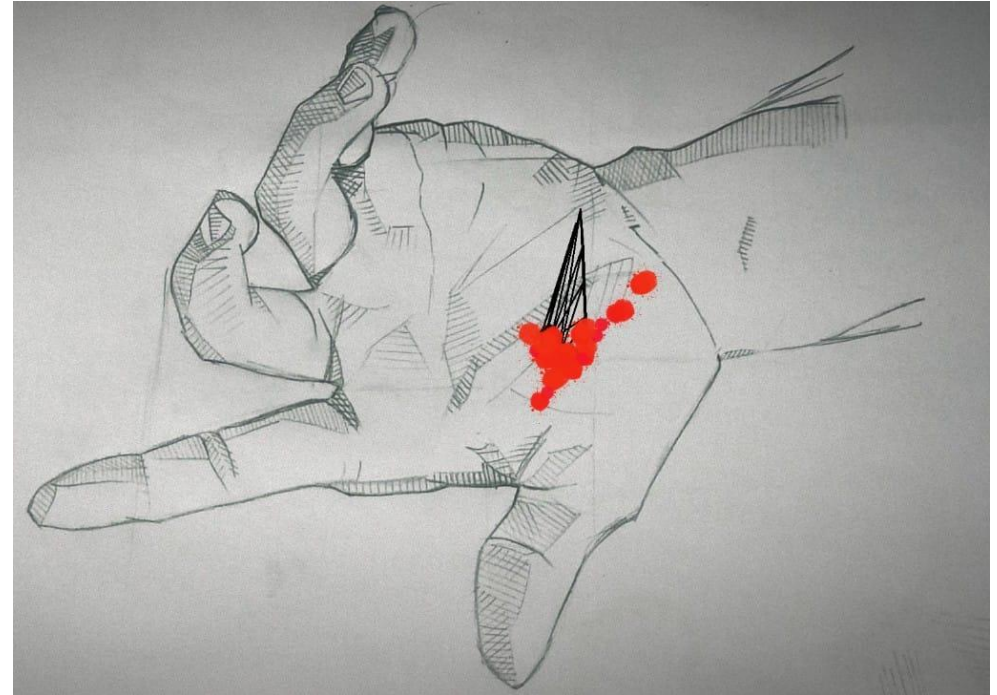


Fig 5.4 : Embedded glass piece in an open wound

5.5 Existing Solution

- *St Johns Victoria SJx*

Launched to the public on 21 May 2019, SJx uses Virtual Reality technology to deliver a high quality first aid training experience in a reduced amount of time. By placing the student in the middle of a realistic first aid scenario, they will be better able to recall their skills and act fast compared to traditional lecture based learning. The drawback of this solution is zero interaction. The student is given a 360° view of a qualified trainer assisting First-Aid to a casualty. With limited interaction, the full potential of Virtual Reality is not used.



Fig 5.5 : VR used to demonstrate First-Aid by St Johns Victoria

6.0 Choosing the device

VR can be run on various platforms. I tried exploring the possibilities of devices available in IDC.



VR	Oculus Quest	Oculus Rift	HTC Vive	Google Cardboard / Other smartphone HMDs	Google Daydream
Platform	Oculus Mobile	Oculus PC	PC based operations	Android,	Android
Resolution	1440x1600	1080x1200	1080x1200	Depends on mobile device	Depends on mobile device
Field of view	100°	94°	110°	90°	100°
Price (2019)	₹79,999	Discontinued	₹89,990	₹1,890	Discontinued
Popularity (Units shipped by 2019)	180,000	-	1.3 million	15 million	-
Other features	6DoF dual controllers Tracked by HMD, Hand Tracking	6DoF dual controllers	6DoF dual controllers	3DoF, Affordable	3DoF, controller

Fig 6.1 : VR devices comparison[10]

7.0 Design Brief

From the primary and secondary research, the First-Aid training app should be developed keeping in mind the following key features:

- Easily accessible
The most widely used device for VR is android devices which can be set into any HMD with easy installation procedures.
- A simple app architecture which should be easy for beginners
- Intuitive UI for android users to navigate easily
- The “coolness” of VR should not interfere the learning aspect
- Focus on learning one type of casualty i.e. embedded object in a wound

Final Design Brief :

To design a VR android mobile application for anyone interested in learning the basics of First-Aid by providing them a tutorial and a testing session for attending a casualty with embedded object inside the wound.

8.0 Concept Generation

Concept 1 : Floating First-Aid Kit

This concept helps the user to learn about assisting first aid by first giving them a demo of the procedures involved in first aid and then choosing the suitable objects from a large number of objects in the first aid box which will float around the user in the 3D space. The learning part will be to see the demo 360° video of how an open wound with embedded object should be treated.

In the Test Session, the user is asked to choose the objects suitable for this particular wound and select all the needed objects using a reticle gaze pointer. This will help the user to recollect the procedures involved in assisting First-Aid and selecting the objects from a moving box will create a fun element for the learning.

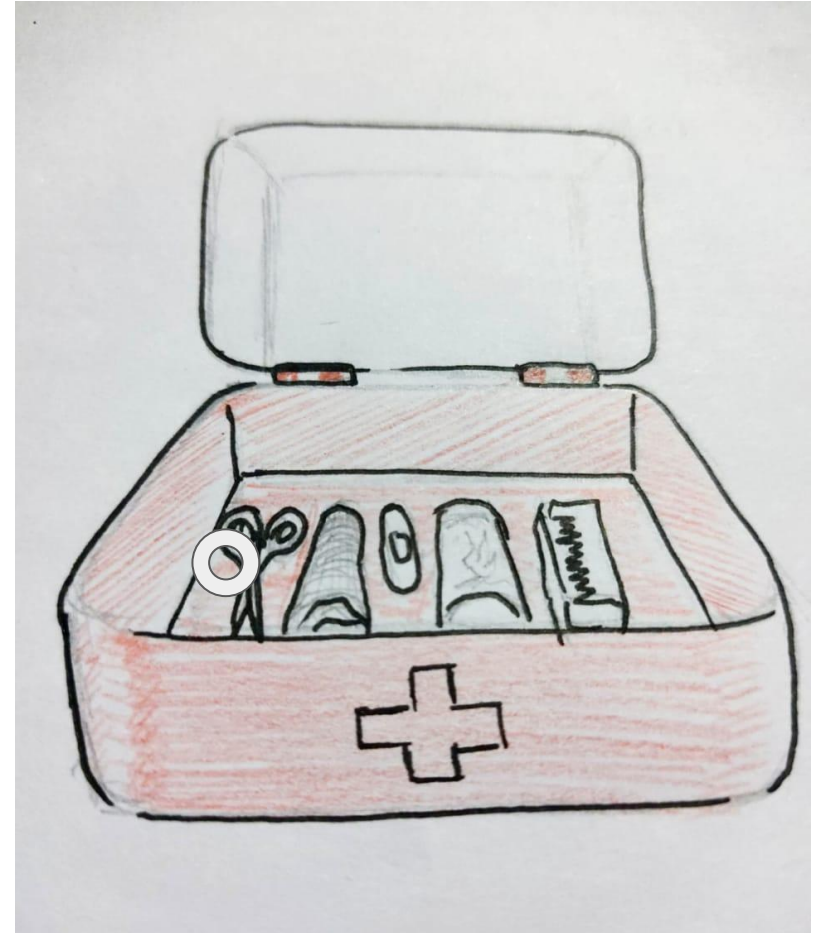


Fig 8.1 : Concept 1, The floating First-Aid kit

Concept 2

The idea here is to walk around the mannequin body and identify the wounded area and choosing the suitable object on the table to assist First-Aid to the mannequin. This mannequin, unlike the rubber dummies is interactive and gives visual and vocal cues to the progress made.

The interactions will be done using reticle gaze pointers.

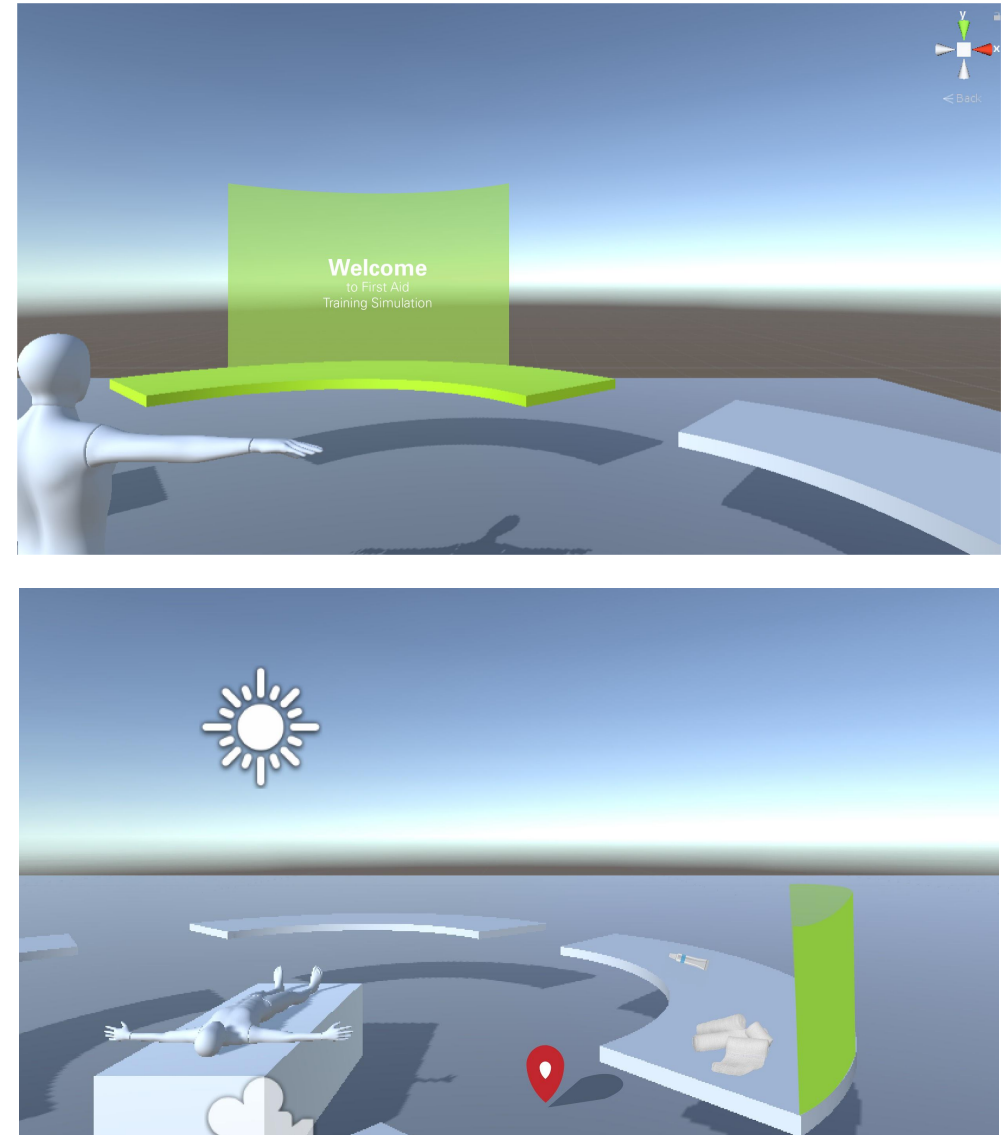


Fig 8.2 : Concept 2, Mannequin First-Aid

9.2 Content Development

The main objective of this application is to get to know important basics of First-Aid. So I have chosen a very common type of casualty, a cut wound, with added complexity of an object stuck in the wound.

The theory part of the app's learning domain consist of basics of First-Aid and the process of attending an embedded object wound. So I revised the content from the Official IRCS First-Aid Manual to a short and easy to explain and understand.

The Basics of First-Aid :

1. Make the area safe
2. Evaluate the injured person's condition
3. Seek help
4. Give first aid

Encouraging users to help the casualty

The fear of getting into the trouble of going through long procedures at hospitals discourages the bystanders from helping the casualty. It is important to assure the users that they will not be in trouble for helping in saving a life.

Emergency Helpline Numbers

The users are required to dial the correct number for calling the ambulance service in the Test session. To help them to recollect this, a slide for Helpline Numbers is given during introduction.

Process of attending to an embedded object wound :

1. Identifying the wound and assessing its criticality
2. Limiting the movement of the wounded region unless required
3. Placing two gauzes around the embedded object (if not available, use other alternatives like clean rolled cloth piece)
4. Tying the gauzes to the body with a bandage cloth to support the gauze and to suppress further bleeding. Remember not to disturb the embedded object

10.0 Design

The development of this app is primarily done in Unity and due to the current global pandemic situation, my resources have been limited and hence affected the development.

To explain the concept further, I have used Blender 2.8 to create a video prototype with all the visuals, UI/UX and animations.

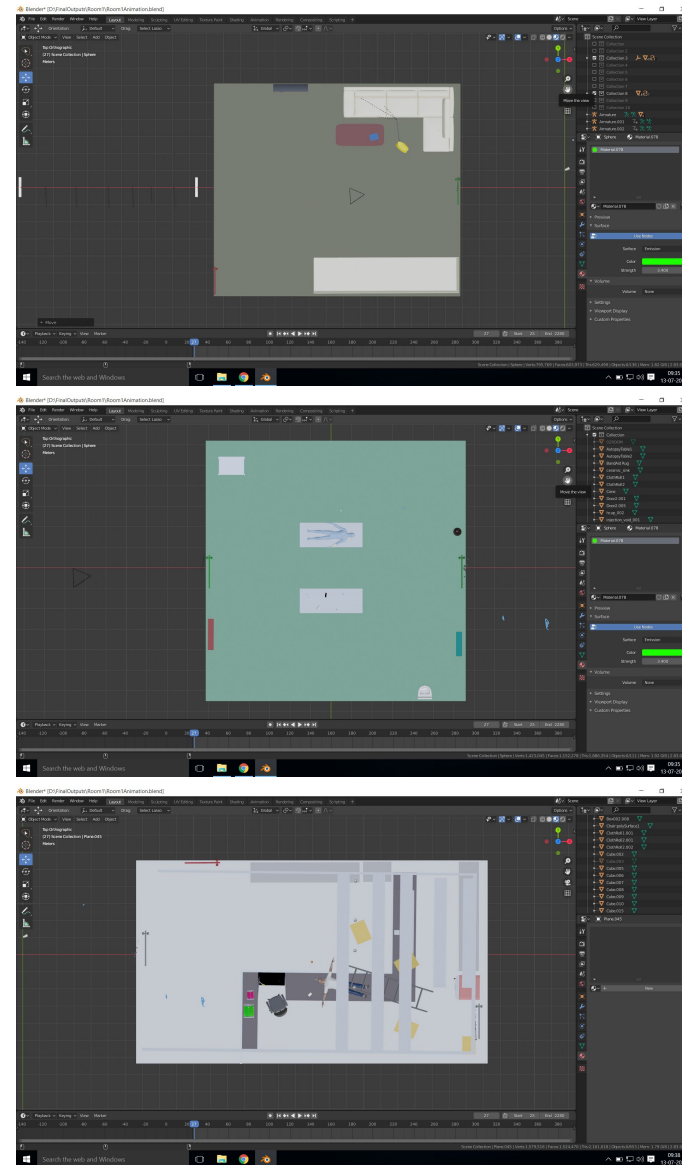


Fig 10 : Blender Screenshots of rooms from Top View

10.1 Field of View

The Field of View of a VR device is the range of what a user can see at a given time. These measurements have been considered while positioning the objects and UI so that everything is visible for user at a comfortable angle.

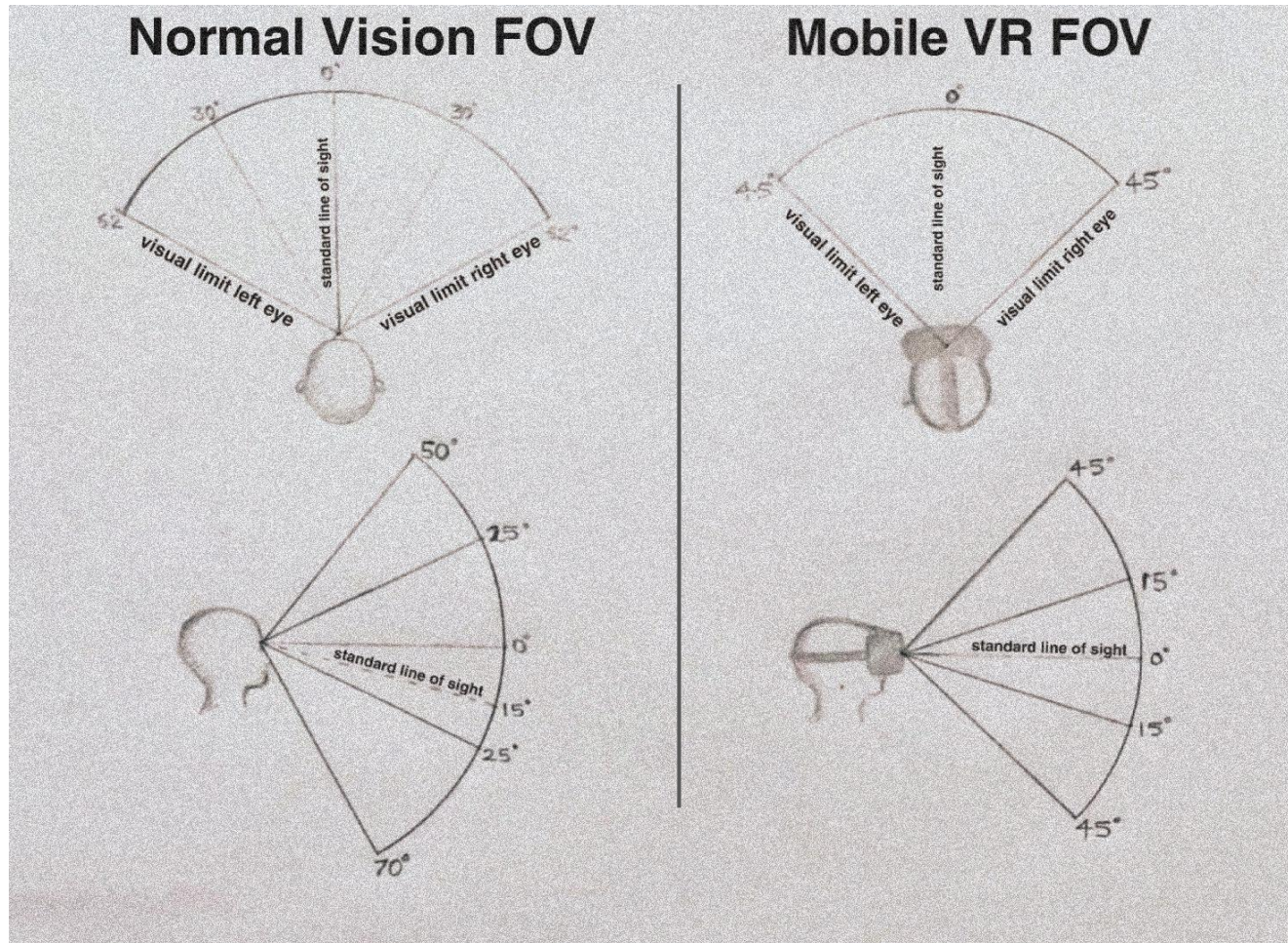


Fig 10.1 : Comparison of FOV [11][12]

10.2 Design of Room 1

Room 1 : Onboarding & Introduction

This room can be considered as Home room, the equivalent of a Home Page in a website. This is where the user begins with his onboarding by doing a simple activity of moving a pillow and then going through the basics of First-Aid and then choosing the category and type of wound and its tutorial they want to attend in the next room.



Fig 10.2.a : Room 1 Perspective View

Room 1 : Colour Scheme and Lighting

The room's colours are kept warm and bright with interactable objects in contrasting & highly saturated colours. The warm yellowish walls and sofa set is to provide a welcoming feel to new users.

The room is well lit with 12 square lights of 30W power and the middle row with 100W.



Fig 10.2.b : Room 1 Rendered Images

10.3 Design of Room 2

Room 2 : Tutorial

The user undergoes a virtual interactive tutorial here by assisting First-Aid to a mannequin with an embedded object wound. The user has to identify the area of injury, and then give First-Aid step-by-step as prompted by the texts on the screens. The screens will give all the information on how to progress through the tutorial.

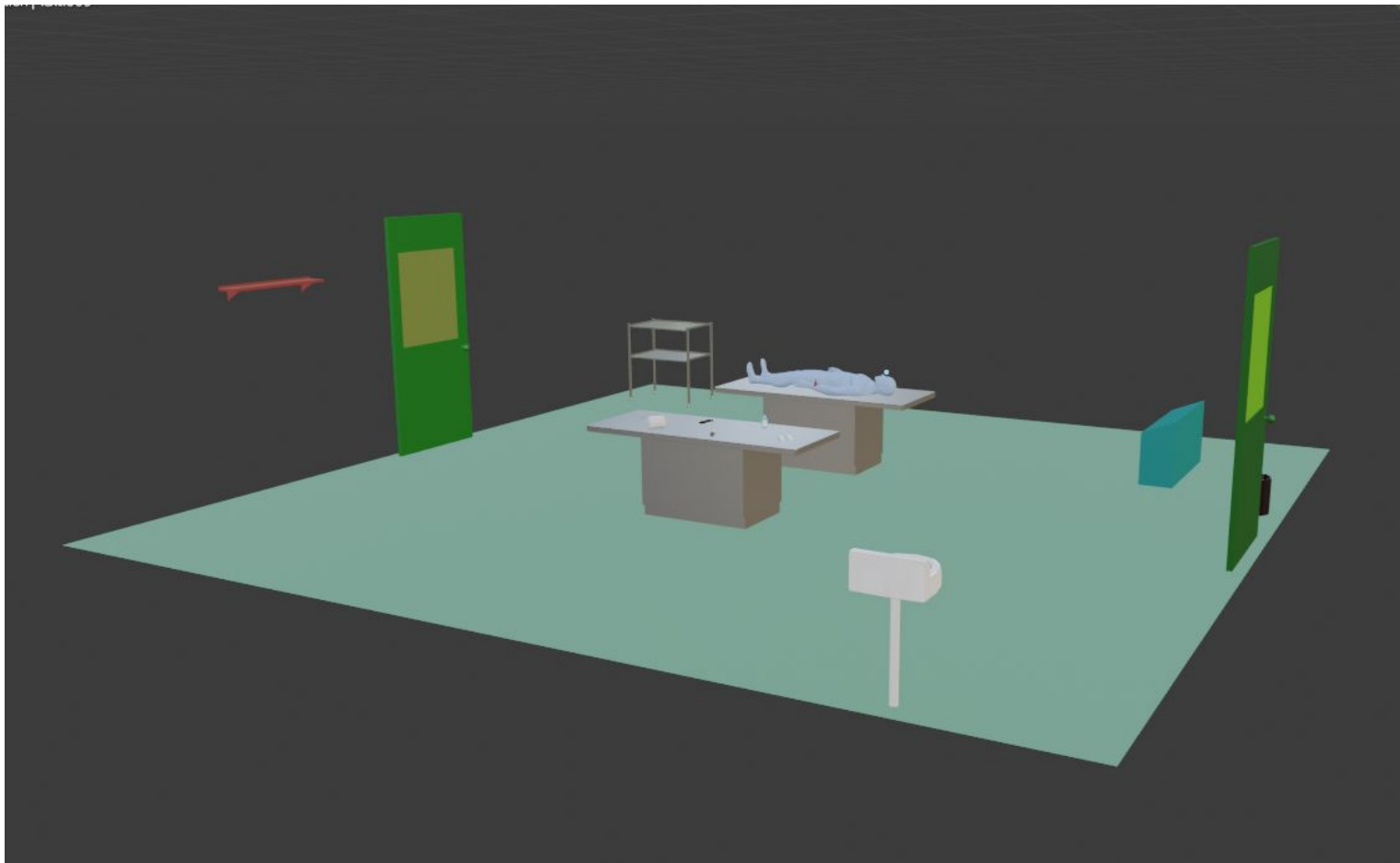


Fig 10.3.a : Room 2 Perspective View

Room 2 : Colour Scheme and Lighting

The room's colours are kept greenish to give a calm and clean feel like in an operation theater in hospitals.

The room is dimly lit with 4 long rectangular lights which gives enough focused light to the centre where the tables with mannequin and First-Aid Kit is placed

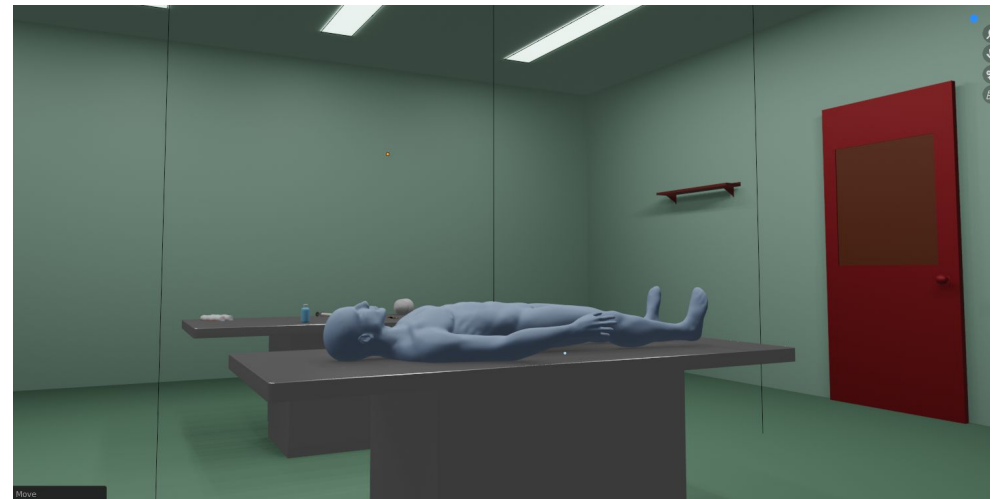


Fig 10.3.b : Room 2 Rendered Images

10.4 Design of Room 3

Room 3 : Test Scenario

In this room, the user is undergoing a test session and is required to recollect their knowledge from previous rooms, the basics and the tutorial. The location is a general store with no First-Aid kit. The user is required to find alternative things which can function as First-Aid kit equipments. This is to test their critical thinking ability and the time they take to complete the task is calculated for providing a feedback or result. An option to get clues is also provided if the user has no idea how to proceed.



Fig 10.4.a : Room 3 Perspective View

Room 3 : Colour Scheme and Lighting

The general store is stocked with shelves and plenty of goods stored in it. The injured person is placed on a higher level for the comfort of user to inspect the injury. The colours are chaotic to create a sense of randomness to the scene. The shelves are kept plain white so that the objects stored is easily visible and distinguishable.

The room is well lit so that the objects are visible and focus is given to the shelves.



Fig 10.4.b : Room 4 Rendered Images

10.5 Design of Result

Room 4 : Test Feedback

The feedback for test conducted is shown in a simple plain room with only plain green screens showing the time the user used to complete each task and providing marks out of ten. The shorter the time, higher the grade.

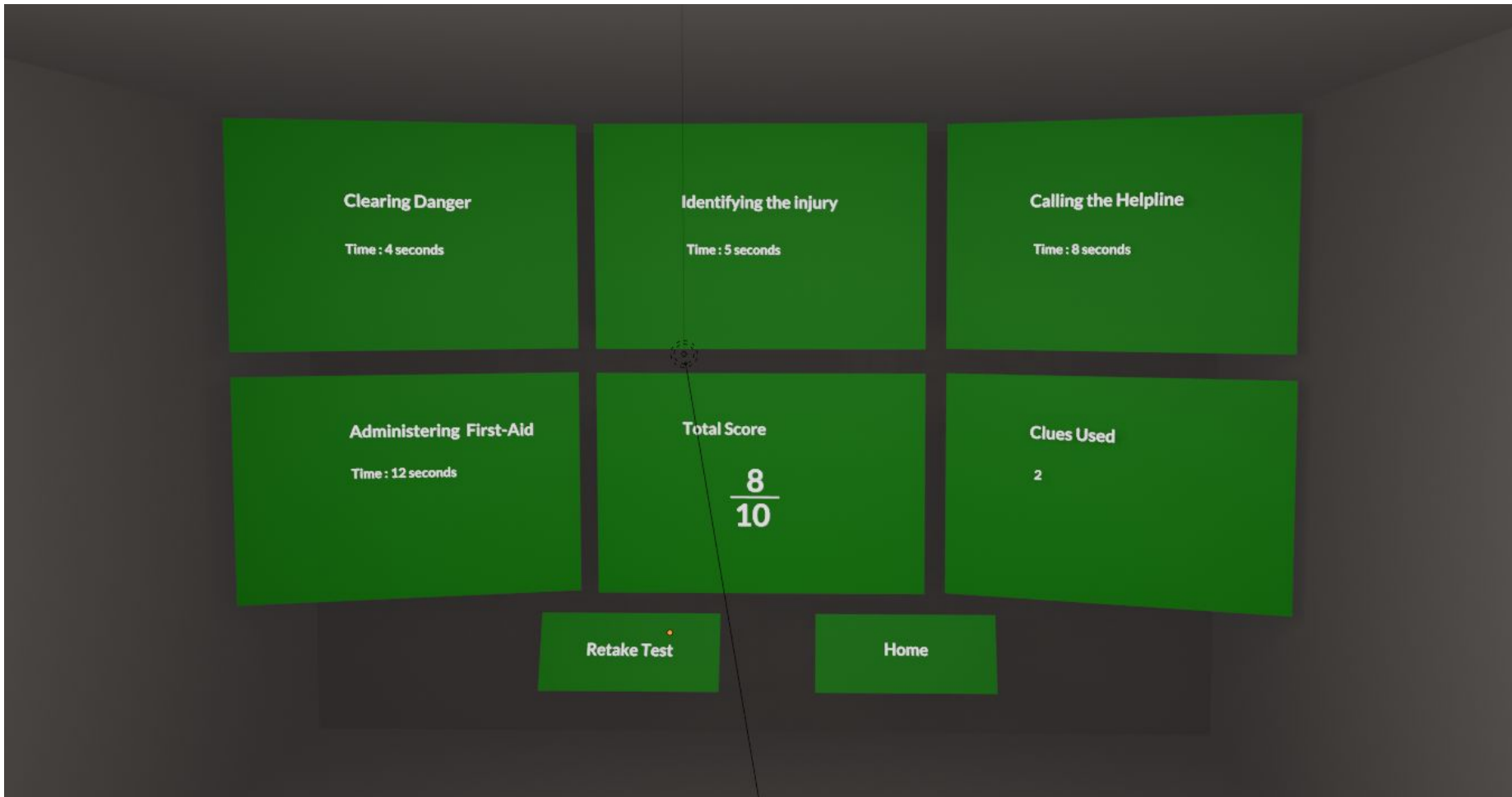


Fig 10.5 : Rendered image of Result

11.0 UI & Interaction

11.1 User Interface

The instructions for using the app is provided on plane screens with texts on it. The Screens appear at eye level height near the walls and is easily spotted due to its bright red and white colours.

Font Used - Lato Bold

Colours



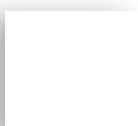
Reticle Gaze Pointer



Screen Background - Primary



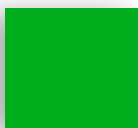
Font- Primary



Screen Background - Secondary



Font- Secondary



Screen Background - Results

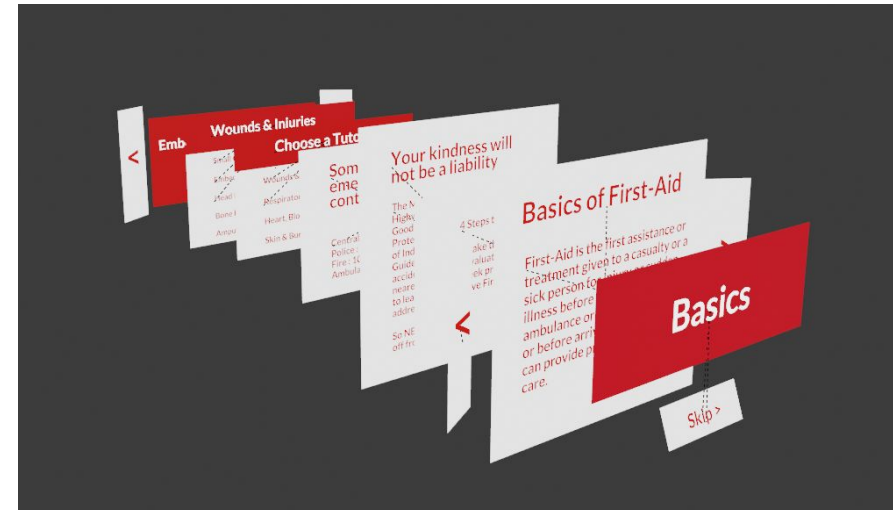


Fig 11.1.a: UI screens of Room 1



Fig 11.1.b: Rendered UI screens in Tutorial Room

11.2 Interaction

The mobile VR provides only limited options for interacting with the device. A reticle gaze pointer is a easy to use interaction method and requires no extra equipments to control the scene and interact.

The green circle in the centre of images is the pointer which changes size when interaction happens. The interactable objects and screens will blow up in size for a fraction of a second when the gaze pointer is hovered over it, indicating it is interactable. To interact with it, the user has to focus the gaze pointed for 2 seconds, during which the green circle will reduce it size to 0. As soon as the size becomes 0, the animation of the object is triggered and the circular pointer comes back to its default size.

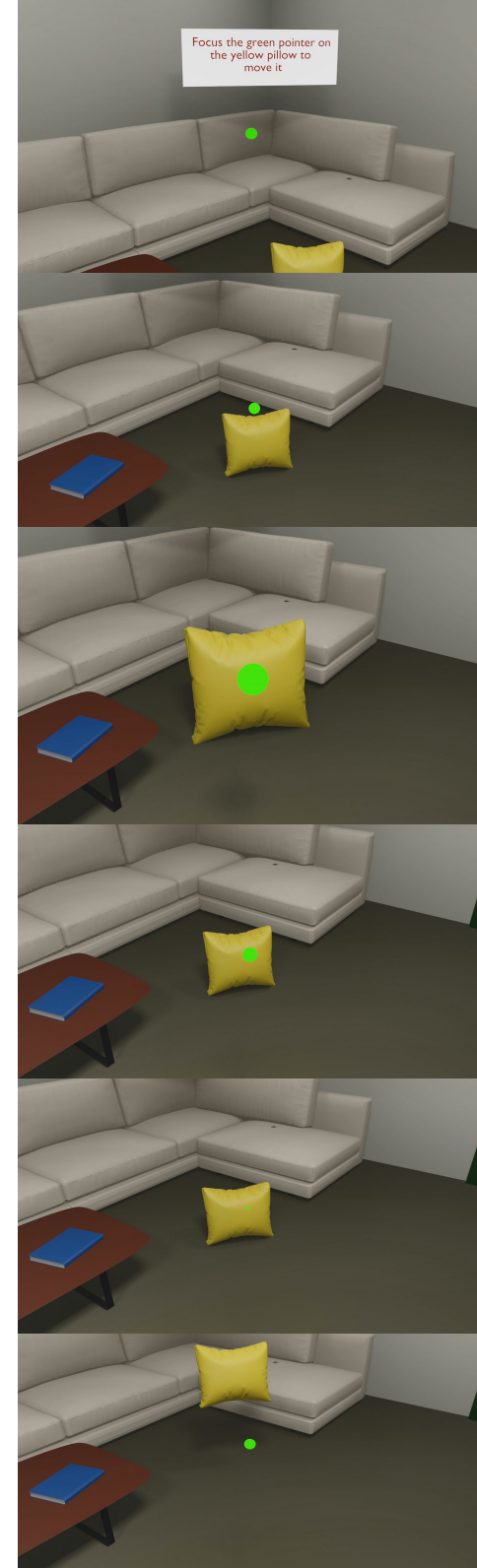


Fig 11.2 : Rendered UI screens in Tutorial Room

12.0 App Development

The development of the application was halted due to constraints that arose during the global pandemic situation. The basic structure of the Tutorial Room with static objects are visible with no interaction of any kind in the images. These images are screenshots of the incomplete mobile app from an Android device. Finishing the app is realistically possible with more time to learn and correct the coding errors. But since this was my first attempt at coding and due to time constraints, the final product of this project will be a Video Prototype which visualises every action of a user using the VR First-Aid App.

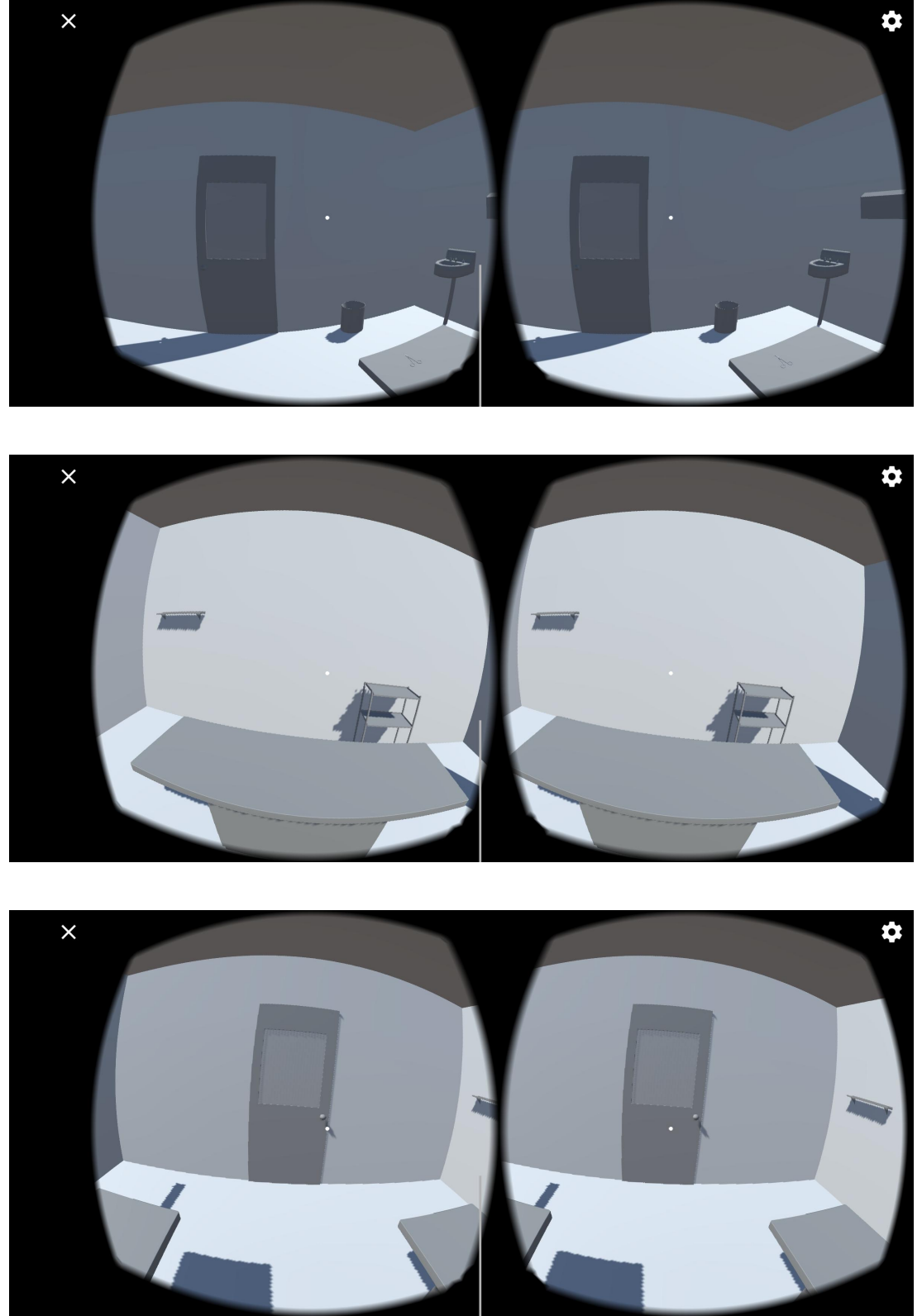


Fig 12 : Screenshots from Mobile which runs the application

13.0 Animation

The animations for the final prototype video was fleshed out in a story board.

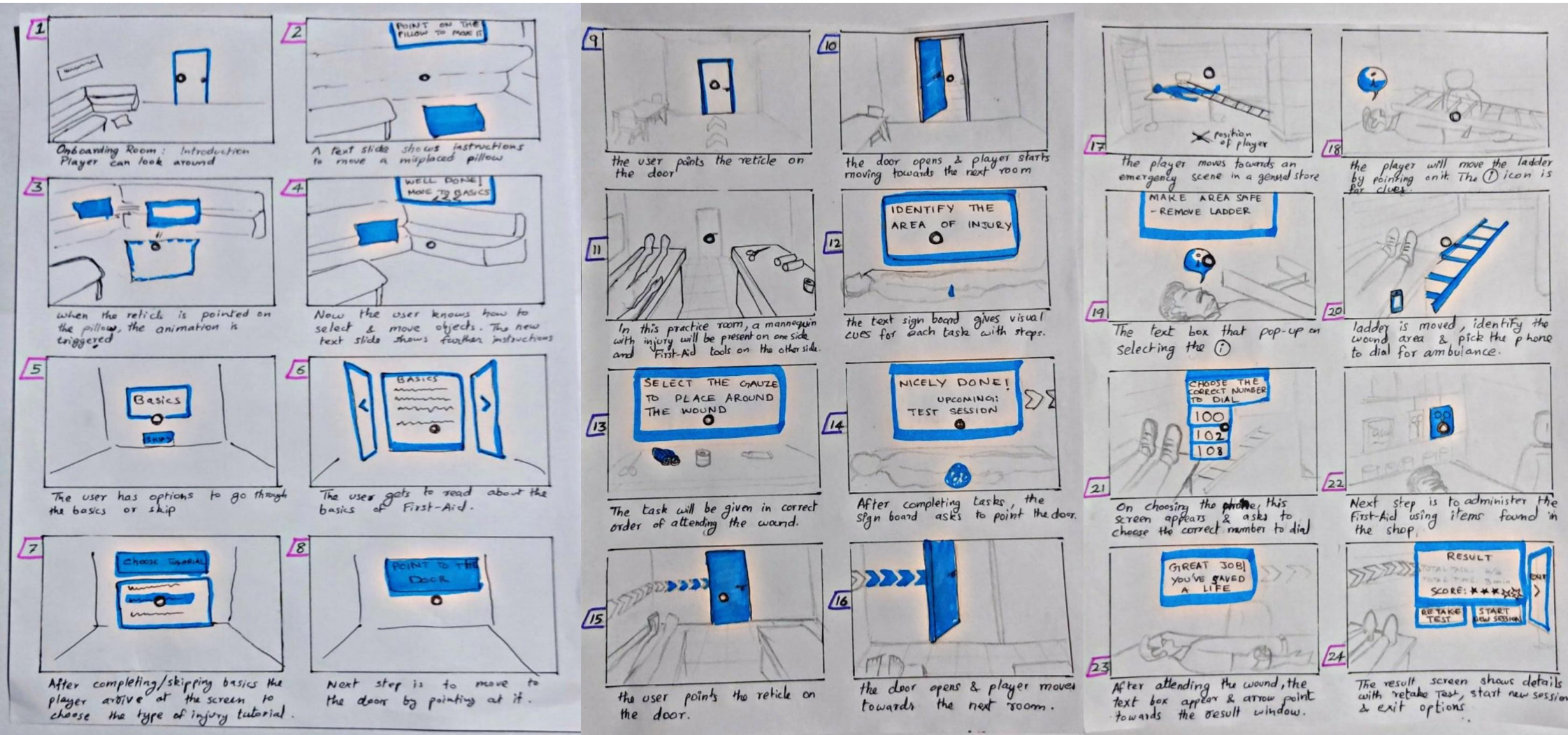


Fig 13 : Story Board

14.0 Final Video Prototype

The video prototype was made on Blender 2.8. The video is a documentation of each step that a user can have throughout one session of using the app to learn basics, give test and get result.

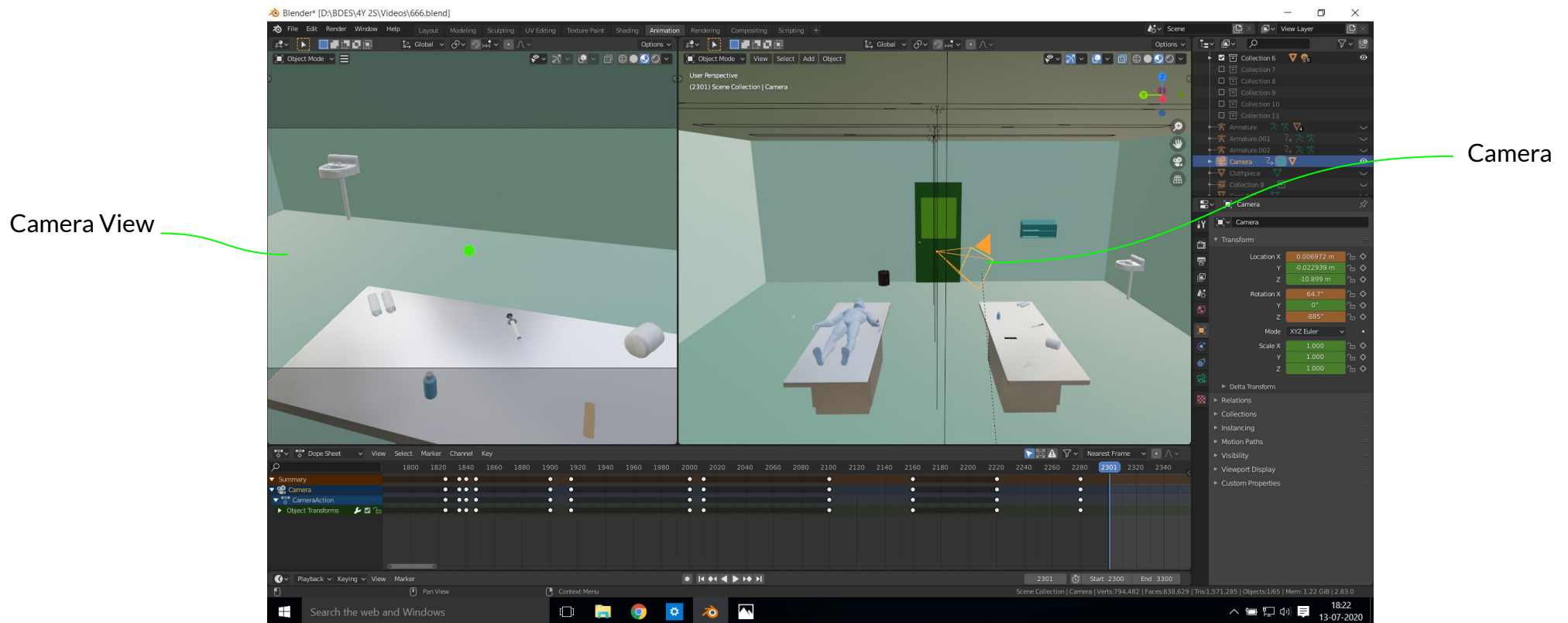
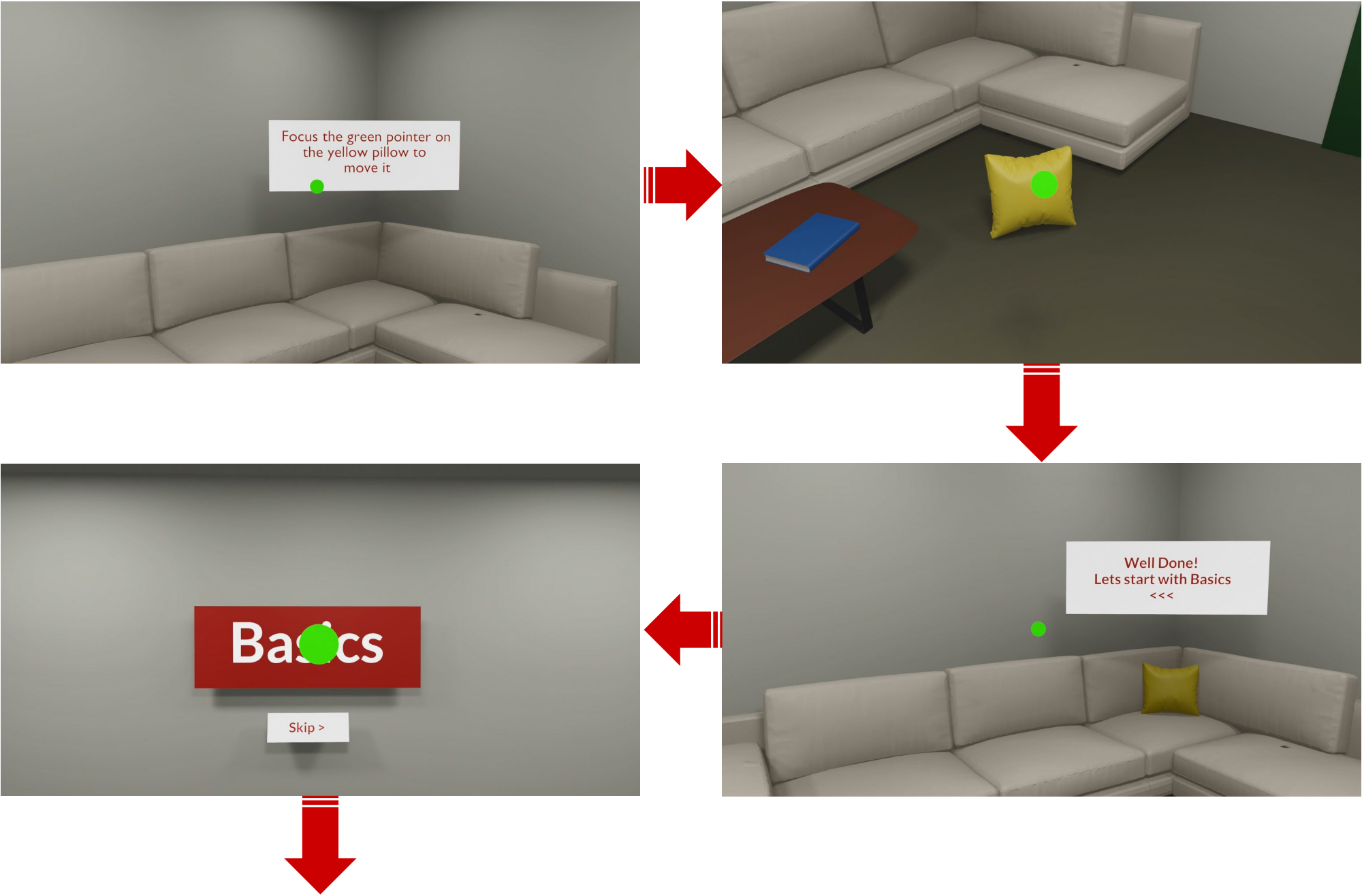
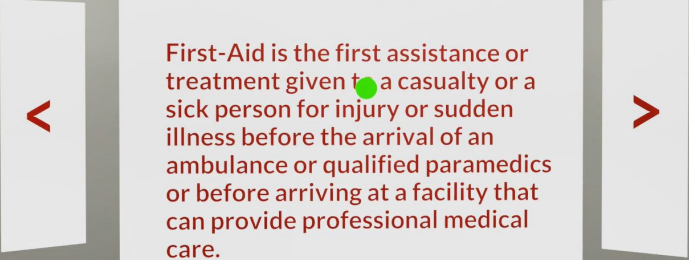


Fig 14 : Screenshot of making Video Prototype

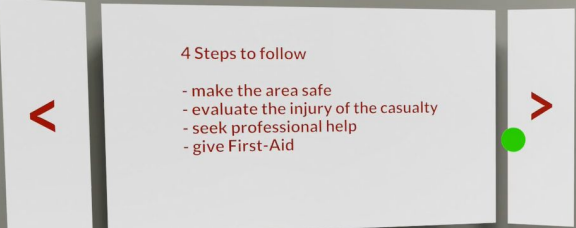
14.1 User Journey through Screenshots





Basics of First-Aid

First-Aid is the first assistance or treatment given to a casualty or a sick person for injury or sudden illness before the arrival of an ambulance or qualified paramedics or before arriving at a facility that can provide professional medical care.



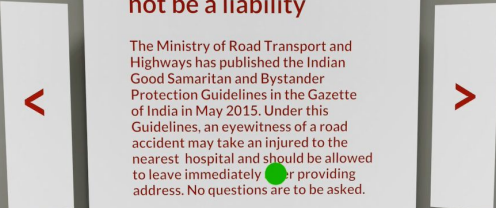
4 Steps to follow

- make the area safe
- evaluate the injury of the casualty
- seek professional help
- give First-Aid



Some important emergency service contact numbers:

Centralised Helpline : 112
Police : 100
Fire : 101
Ambulance : 102



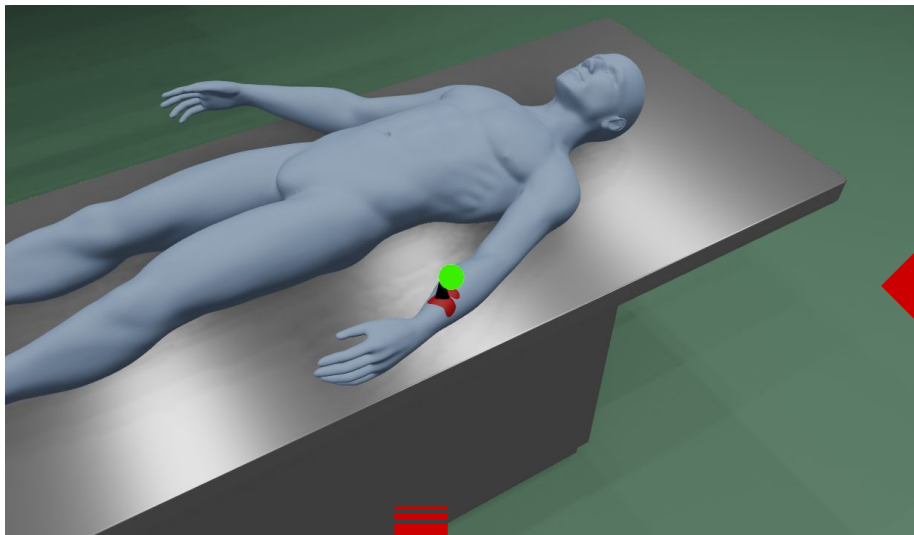
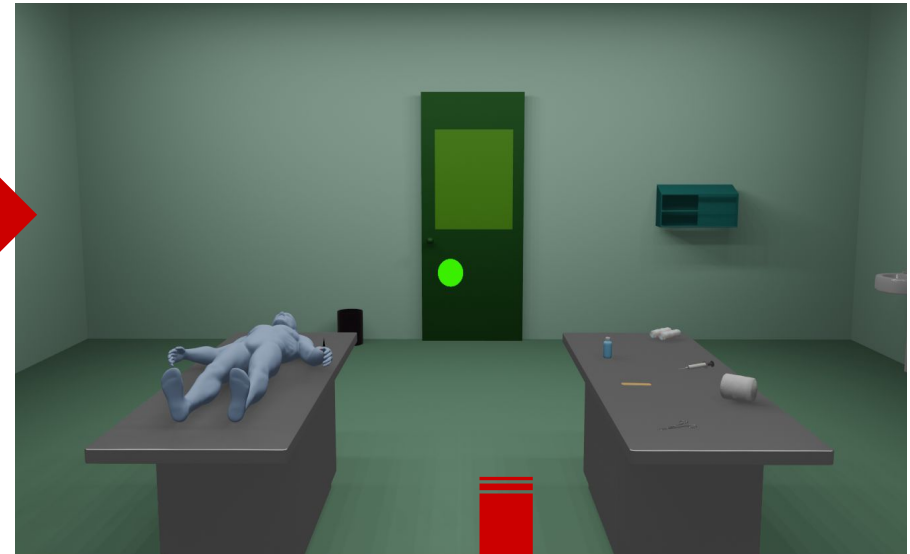
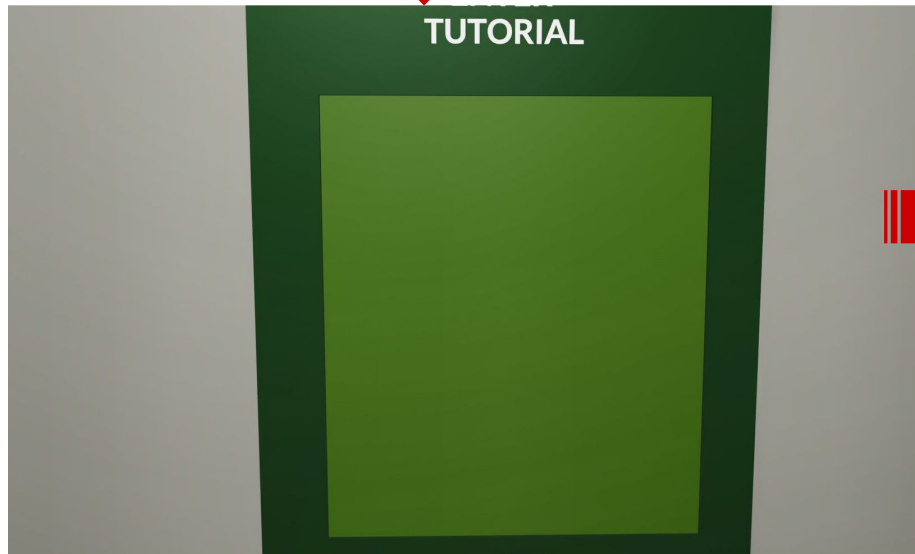
Your kindness will not be a liability

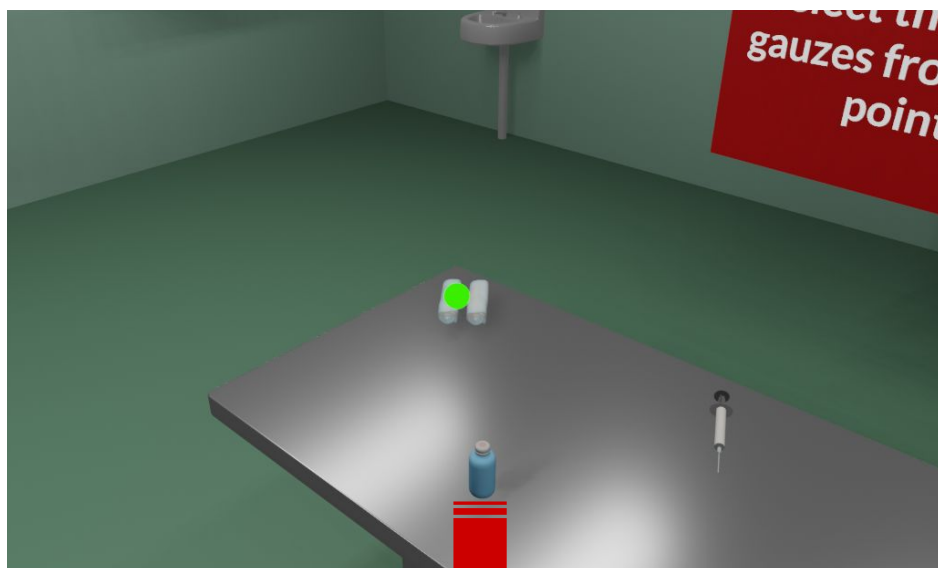
The Ministry of Road Transport and Highways has published the Indian Good Samaritan and Bystander Protection Guidelines in the Gazette of India in May 2015. Under this Guidelines, an eyewitness of a road accident may take an injured to the nearest hospital and should be allowed to leave immediately or providing address. No questions are to be asked.

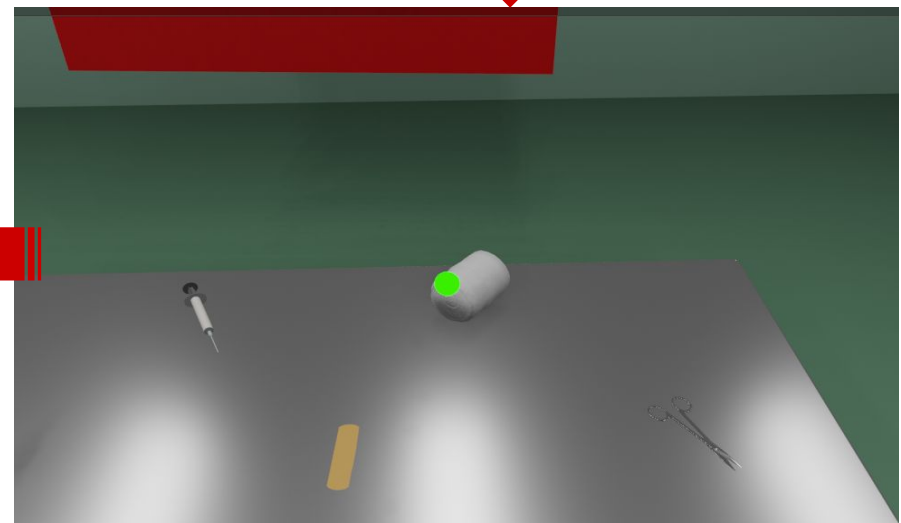
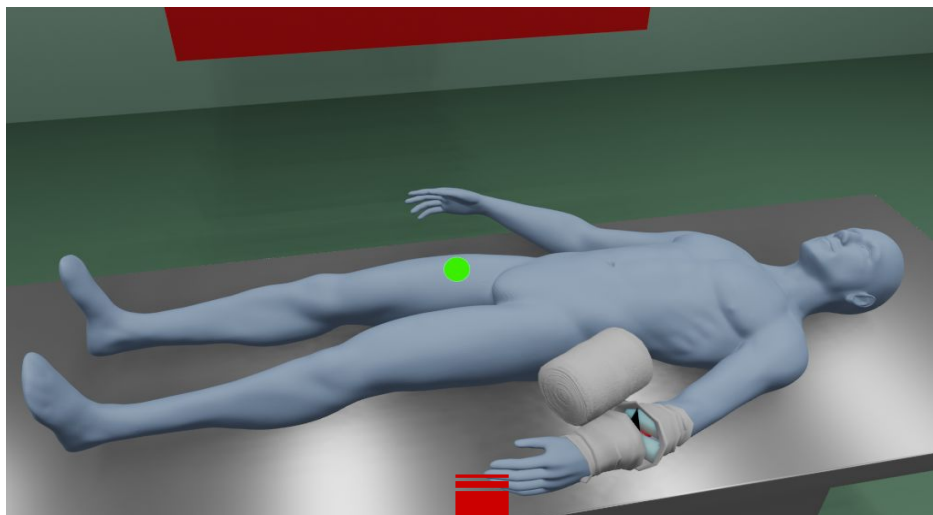
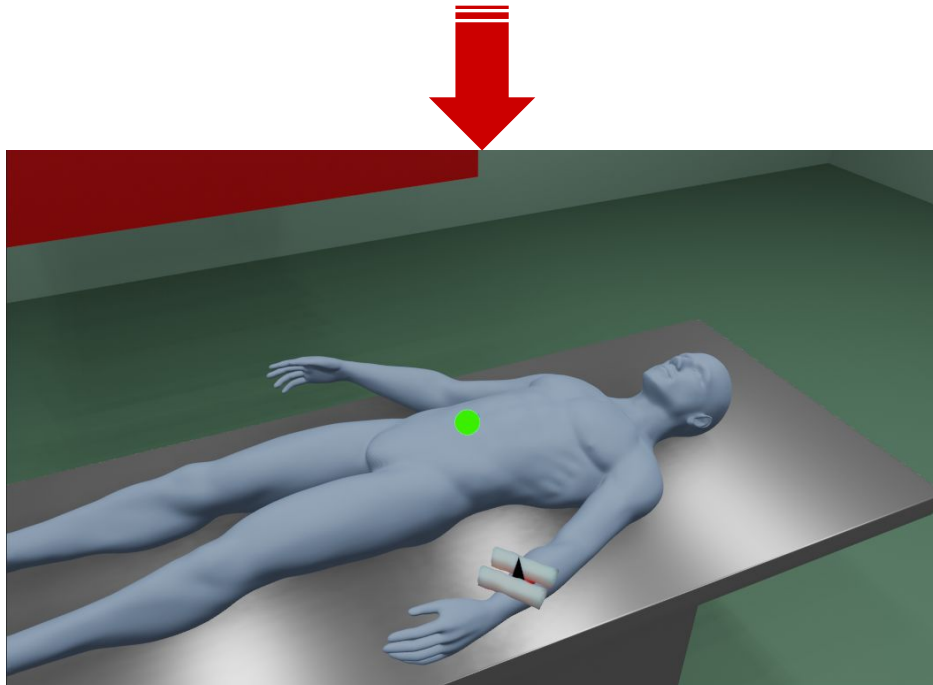
So NEVER hesitate to take few minutes off from your precious time to save a life

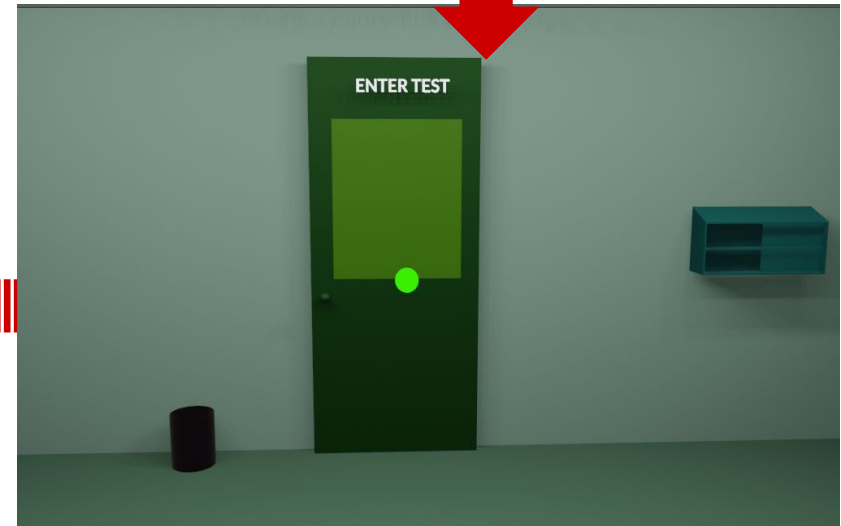


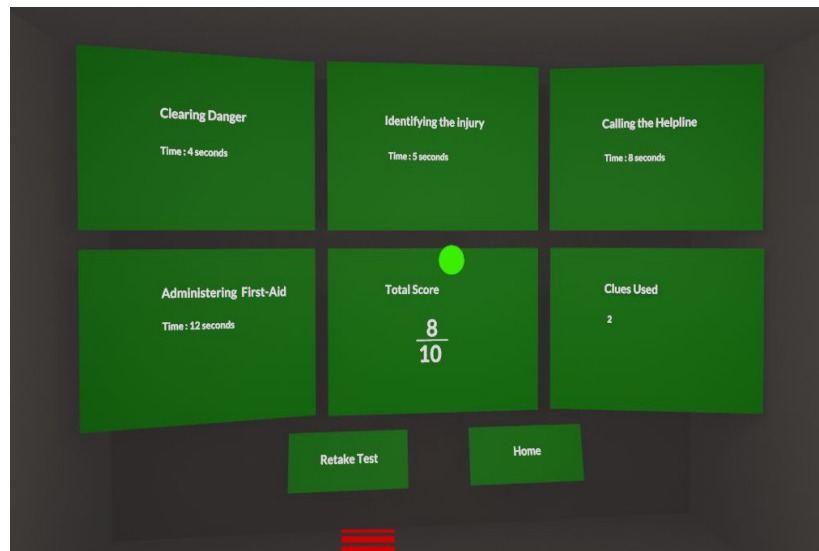
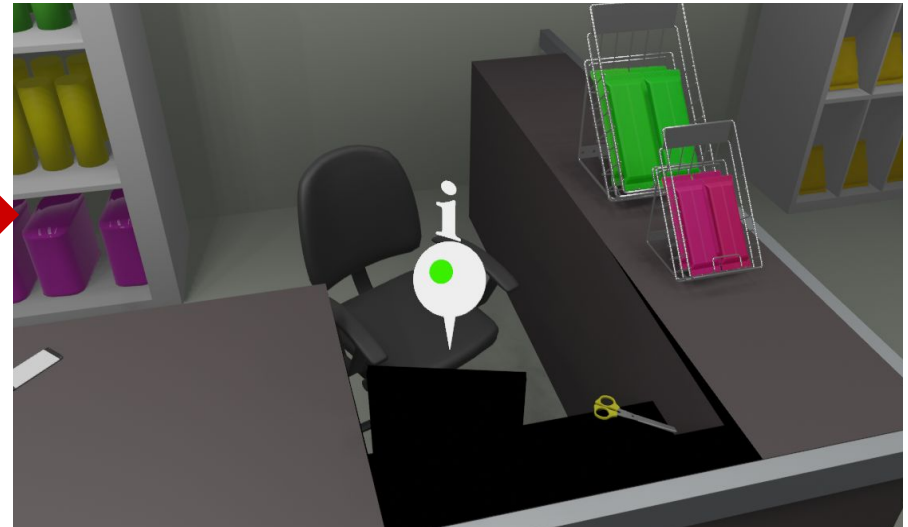


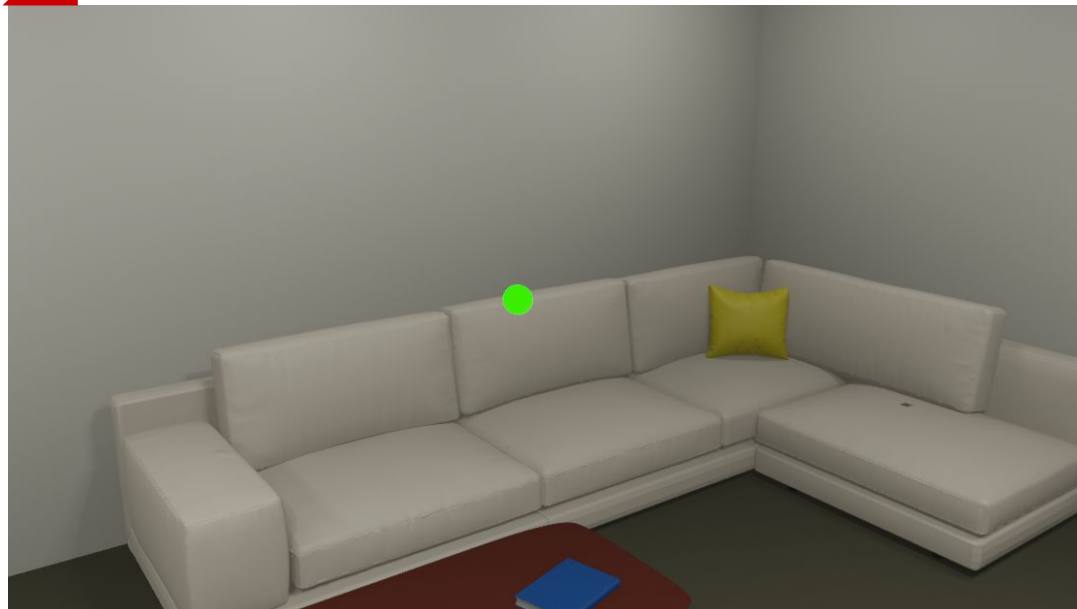
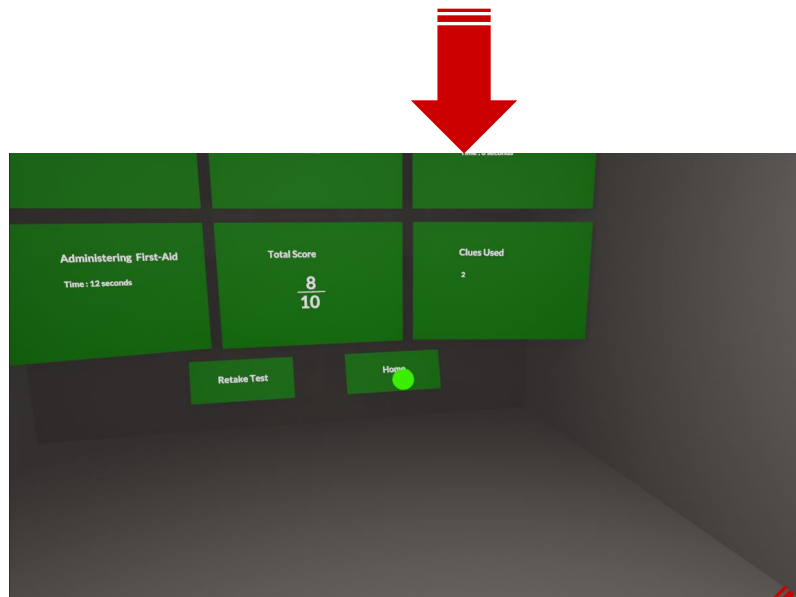












Back to Home Room

15.0 Conclusion

The app is a pioneer effort to inculcate interactive virtual reality learning in First-Aid. It was an exciting and good learning experience for me to learn Unity and Blender 2.8. The final video prototype is a complete visual guide of how the user uses the final product.

16.0 Future Scope

Audio and sound effects can be added to increase the engagement while using the app. The app has the opportunity to add more types of wounds and casualty. Even mixing two or three types of injuries or emergency situation can be explored.

The inclusion of technology in education purposes is bound to increase in the coming years, especially with the current global pandemic situation. Educators and teachers are in need of more innovative ideas in applying the use of new technology to increase the student's engagement and help him or her to have a better idea of the concepts.

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