

AR BOOK: LEARNOPEDIA

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ABSTRACT

AR (Augmented Reality) Book: Learnopedia is an android based project which consists of a book containing array of image targets with contents including Science and Technology. It includes an android application which is used to scan the book making it interactive with combination of visual, sound and animations. The book includes multiple pages for interacting with the user using an android application which includes 2D to 3D image conversion, video player and opening website using virtual buttons. All the image targets will be stored in the online Vuforia database which can be easily downloaded and extracted. A single Vuforia database can only be used for a single project and the image target must also be scaled to improve the quality of the image target. The android application and the PDF version of the book will also be available over the internet on the official project website and at the end of the project completion will be deployed on the Google Play store positively. Since AR Book: Learnopedia is an open source project the website will also include the source code of the complete project.

The 3D models for the project will be made from blender software which later, can be deployed on the Unity application. The motion and interactive interface will be controlled by the programming Language C# which is a flexible language for controlling 3D objects and other interactive objects.

Keywords: Image Target, User Interface (UI), Virtual Button, Ray Cast, 3D Plane.

I. INTRODUCTION

Augmented Reality is an interactive experience of a real world environment where the objects that reside in the real world are enhanced by computer generated perceptual information. The purpose of the project is to educate about basic Science, Technology and Engineering topics in an interactive way with the help of 3D models, audios, videos, UI buttons other visual effects. The system is based on a android application which will take the input of the system camera and display the 3D models on the screen. A local database storage will hold the contents. Above all, we hope to provide a comfortable user experience along with the best education content available without any cost.

The goal of Augmented Reality is to create a system in which the user cannot tell the difference between the real world and the virtual augmentation of it. In traditional educational books we must read the contents completely to have a basic understanding about a topic and even after that we can't guarantee that the person reading it will understand the topic completely, since the topic may include various diagrams and technical contents which the user may not be familiar. To make the learning process much better and interactive the introduction of "AR Book: Learnopedia" paves way in which, is a fun way of learning and understanding difficult topics and concepts. The book contains topics including Science and Technology. There are various image targets in every pages of the book which when clicked will display 3D models, animations, sound and videos which makes the learning process much more fun.

The image targets are all stored in the Vuforia cloud database which is a free website for creating and scaling image targets. All the image targets can be downloaded in a single file which is in ".unity package" extension. It is in unity file format so it can be directly deployed onto the Unity 3D application. The 3D objects and animations will be created using Blender application and additional features and effects will be added using C# programming. The final product including the android application and the PDF version of the book will be available in the official website.



Figure 1: Application Menu

II. METHODOLOGY

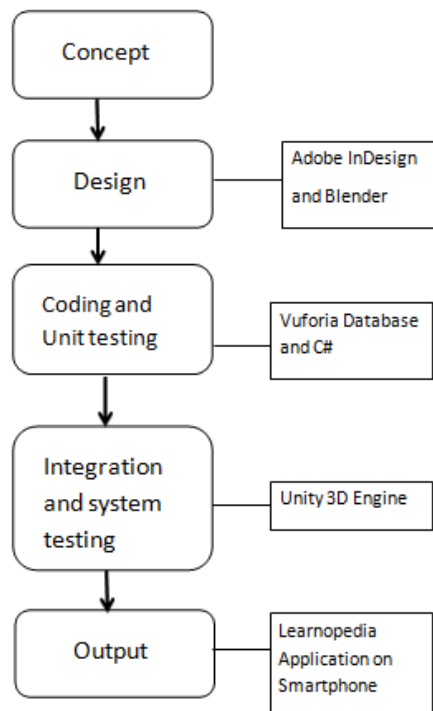


Figure 2: Flow Chart

Concept–We came up with the idea of this book as there was a need of interactive learning for the students. We started with exploring the softwares and Augmented Reality applications. We came to know that Augmented Reality can help the students to learn things interactively. So we came up with the concept of this book and started with the design.

Design- After Exploring AR we started designing the format of the book with Adobe InDesign and creating the models and animation using Blender. Since the pages of the book are the image targets we tried to add more features to the image target so that the camera can recognize the image faster.

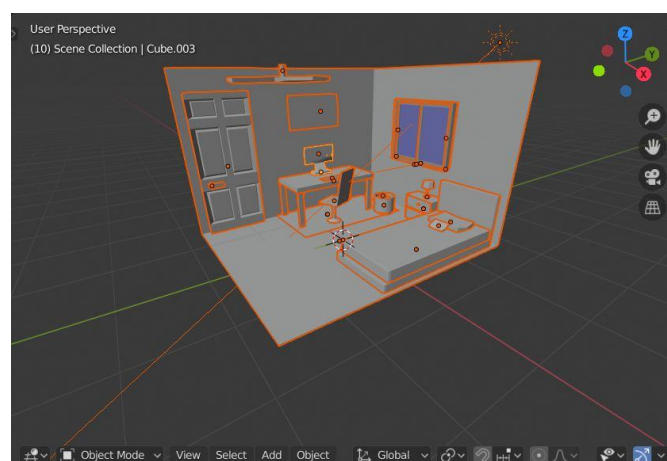


Figure 3: Designing in Blender

In Figure 3. We can see a 3D room created in blender. This 3D model is exported to Unity 3D and attached to the image target.

Coding & Unit Testing- Vuforia database is used for storing the image targets (the image which will act as a base of recognition for the 3D model). The image targets are stored in the Vuforia Database are represented by a single database name. This database is then exported into the Unity 3D software so that the models creating in blender can be placed on top of these image targets.

Integration and System testing- Unity 3D engine is used for integration of all the modules and building of the final application. All the 3D models, audios and the Vuforia database is imported and integrated with the help of Uniy3D.

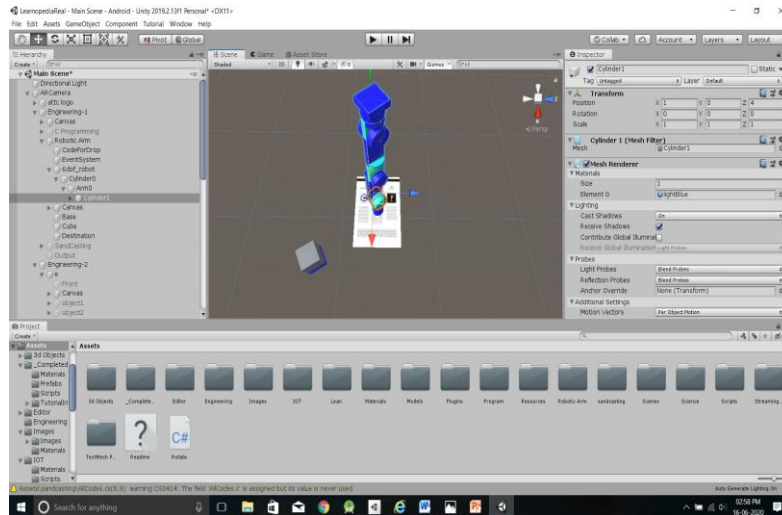


Figure 4: Integrating a 3D model

Output- The final complete mobile application is ready and functional and can be used to start learning all the different topics of the AR Book.

III. SOFTWARE FUNCTIONS

The different functions of the software includes –

1) Storage

The application stores the information of all the image targets locally into the system during installation. It helps the application to recognize these image targets without the need of the application to connect to the internet at all times. It makes the application very useful when learning.

2) Visual Stimulation

The main function of the application is to recognize the image targets and display the respective 3D model for that particular image target. The application displays the 2D image into interactive 3D models which may include audio, animations or various buttons to interact with the object.

3) Interface

The application provides an interface to the user in order to interact and view the 3D models. Since the models are stored locally the application acts as a medium between the user and all the models. It also provides a menu for the users which also provides a guide for new users and link to the official website.

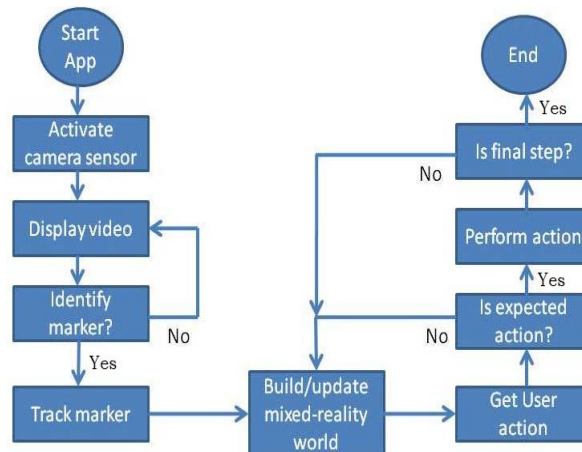


Figure 5: Functional Diagram

In Figure 5, we can see the functional Diagram of our application. The diagram shows the working of our app and how different steps are performed throughout the application.

IV. DISCUSSION

TECHNOLOGY

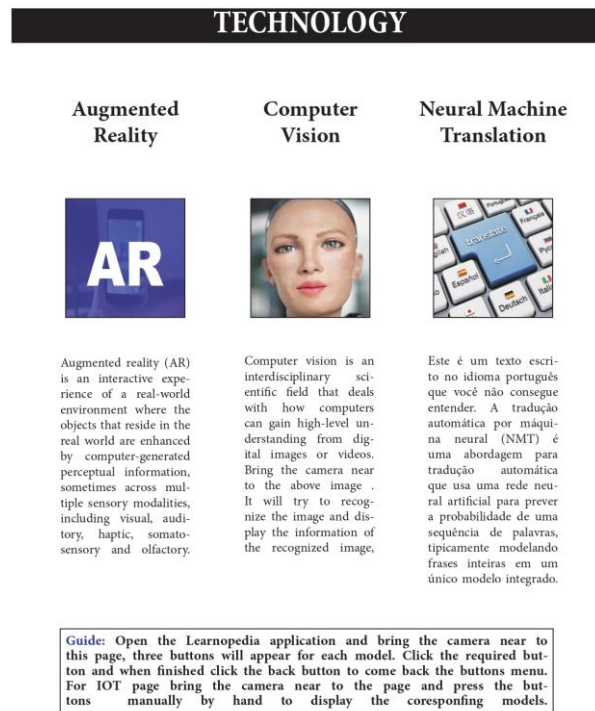


Figure 6: Page 1 of Technology topic, and Image Target from AR Book: Learnopedia

In Figure 7, we can see the 1st page of technology topic we have three modules which includes a AR based video plane, a computer vision simulation and Neural Machine Translation emulation. The page itself is an image target and when the camera detects the image target three UI buttons are displayed, one for each subtopic of the page.

The first module is a video played in a 3D plane. The video explains about Augmented Reality, its applications and how Augmented Reality can change the aspects of the future.

The second module explains the concept of computer vision with 3D simulation. It simulates the working of image recognition by recognizing the image of the page and displaying information about it.

The third module explains the concept of Neural Machine Translation with simulation. It simulates the working of Neural Machine Translation by recognize the foreign language on the page and translating it in English Language.

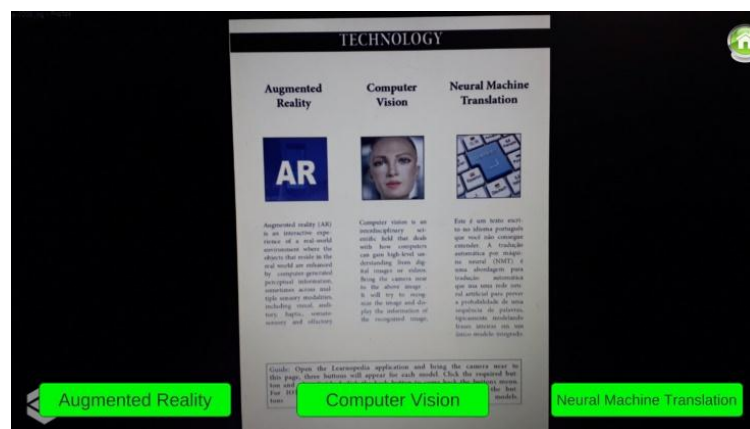


Figure 7: UI buttons displayed after the image target page is recognized

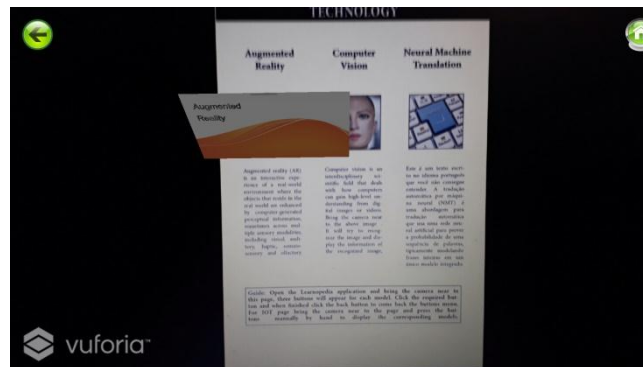


Figure 8: Augmented Reality video is played after pressing the Augmented Reality UI button

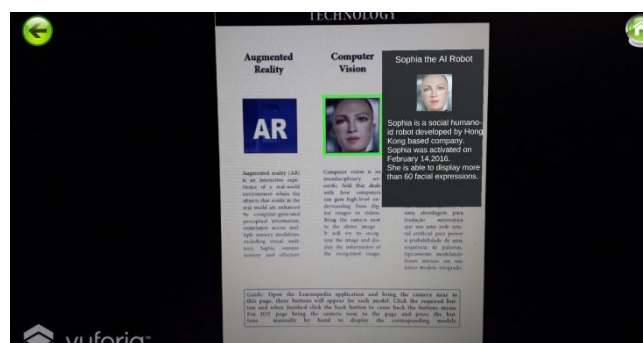


Figure 9: Computer Vision is Simulated using Augmented Reality

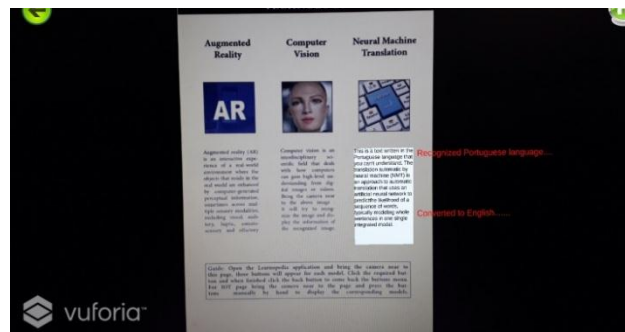


Figure 10: Neural Machine Translation is simulated using Augmented Reality

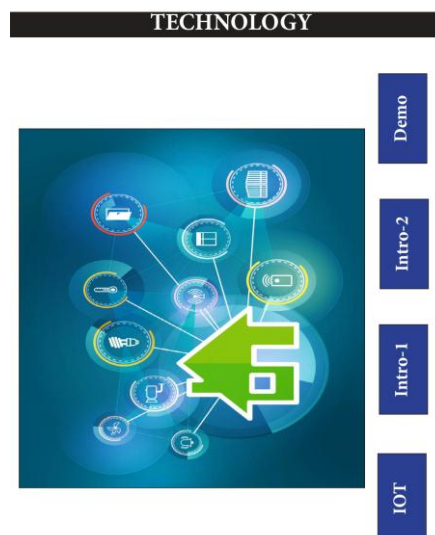


Figure 11: Page 2 of Technology topic, and Image Target from AR Book: Learnopedia

The second page of technology simulates Internet of Things with the help of 3D simulated room. This page includes the use of virtual buttons, which are buttons which needs physical interaction to perform certain functions. In other words a person needs to touch the button manually with their hand to perform the required functions. The four virtual buttons on the page have four different functions which includes-

IOT button – It displays a 3D Plane with information of Internet of Things.

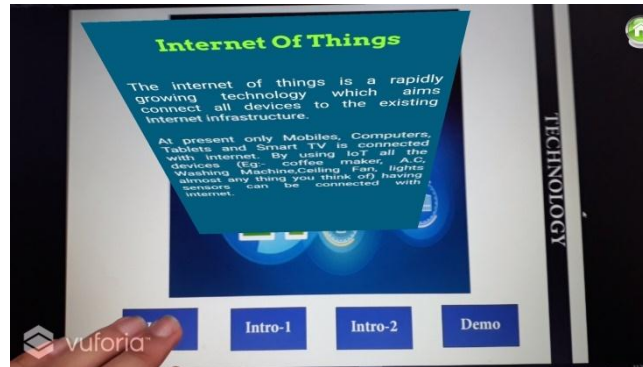


Figure 12: A 3D plane which is displayed after IOT virtual button is pressed

Intro-1 – It displays a 3D Plane with information of the demo.

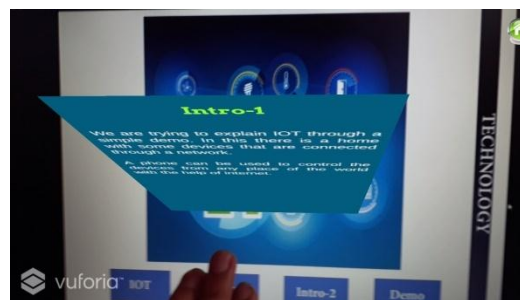


Figure 13: A 3D plane which is displayed after Intro-1 virtual button is pressed

Intro-2 – It displays a 3D Plane with information of the demo.

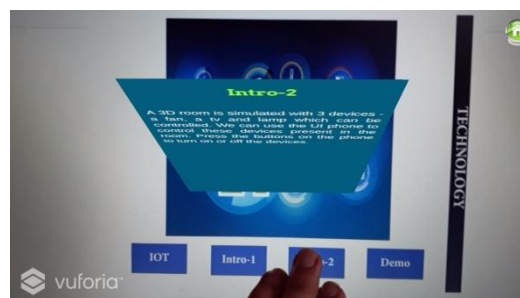


Figure 14: A 3D plane which is displayed after Intro-2 virtual button is pressed

Demo – It displays the simulation of a 3D room and a phone, the different components of the room can be controlled by the phone. The phone consist of the following buttons-

Turn on light – This button will turn on the lamp of the 3D simulation.

Turn off light – This button will turn on the lamp of the 3D simulation.

Turn on Fan – This button will turn on the fan of the 3D simulation.

Turn off Fan – This button will turn off the fan of the 3D simulation.

Turn on TV – This button will turn on the TV playing a video on the 3D simulation.

Turn off TV – This button will turn off the TV playing a video on the 3D simulation.



Figure 15: A 3D Simulated Room is Displayed with UI buttons to control components of room

ENGINEERING

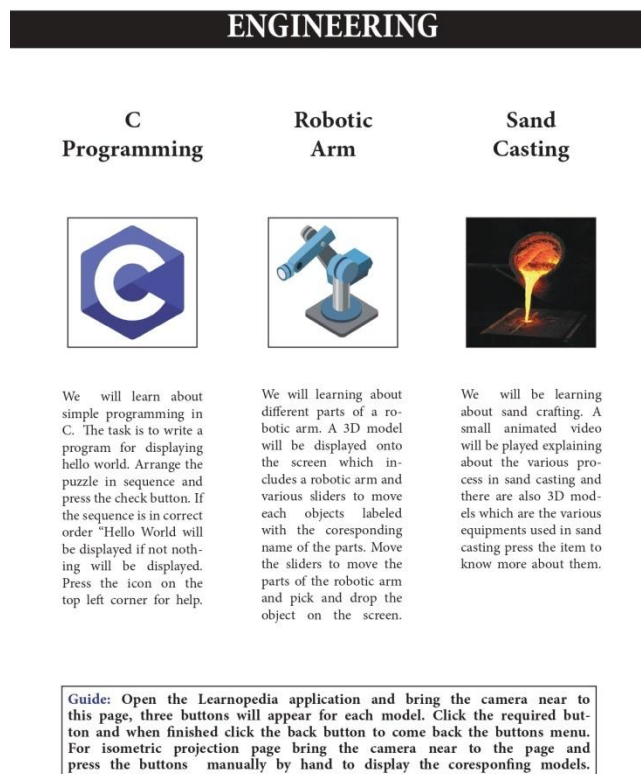


Figure 16: Page 1 of Engineering topic from AR Book: Learnopedia

In this Figure. We can see the 1st page of Engineering topic we have three modules which includes a C-Programming module, A Robotic Arm and Sand Casting . The page itself is an image target and when the camera detects the image target three UI buttons are displayed, one for each subtopic of the page.

- 1) The first module is C-Programming. In this the user have to drag and drop the pieces of a simple "Hello World" code, if the syntax of the code is correct the user can press the check button, if its correct a "Hello World" text is displayed else nothing will be displayed. The module also consist of an info button which when pressed will display information about header files, main function and printf function.
- 2) The second module displays an interactive 3D Robotic Arm model which can be controlled through sliders and also pick objects as soon as it touches the object or drop objects in front of it using drop button.
- 3) The third module explains the concept of Sand Casting. In this various 3D models are used to simulate the sand casting process. When we press the Start button The simulation starts along with an audio explaining about the sand casting.

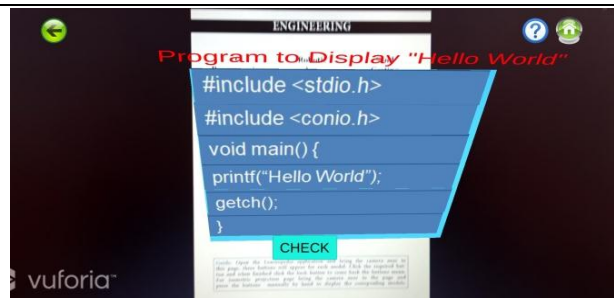


Figure 17: C-programming module of Engineering Topic

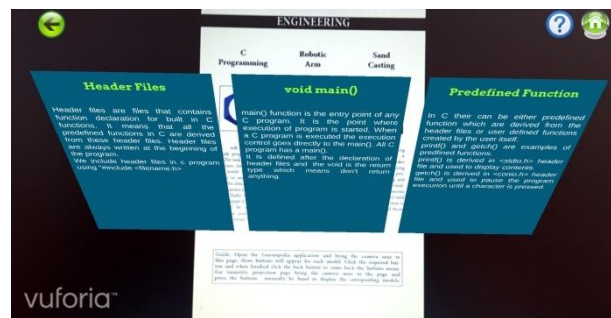


Figure 18: C-programming info module of Engineering Topic



Figure 19: Robotic ARM module of Engineering Topic

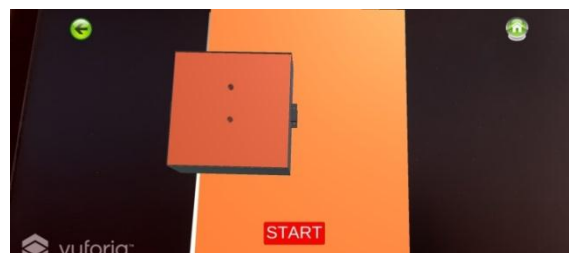


Figure 20: Sand Casting module of Engineering Topic

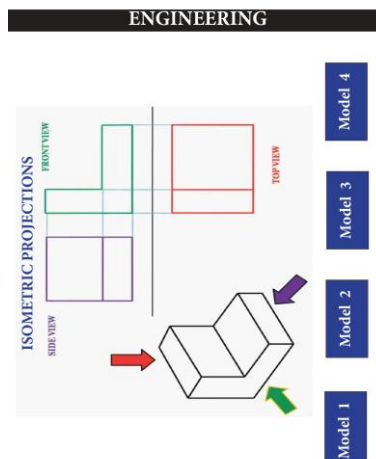


Figure 21: Page 2 of Technology topic, and Image Target from AR Book: Learnopedia

The second page of technology simulates Isometric with the help of 3D models and planes. This page also includes the use of virtual buttons, which are buttons which needs physical interaction to perform certain functions. In other words a person needs to touch the button manually with their hand to perform the required functions. The four virtual buttons on the page have four different functions which includes-

Model 1 – It displays the 1st model on top of the image target

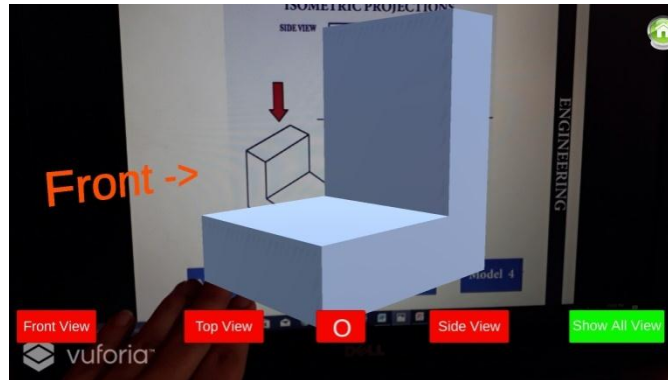


Figure 22:Default View of Model 1

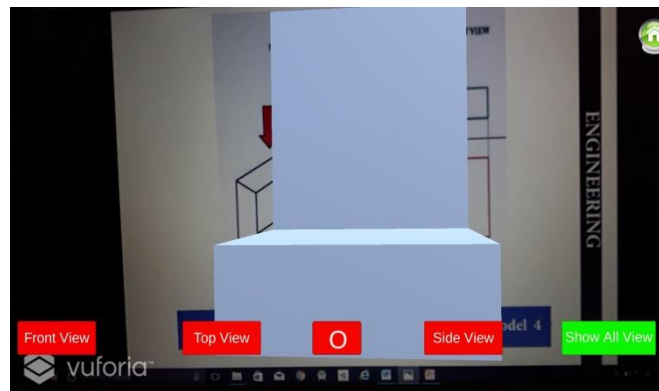


Figure 23: Front View of Model 1

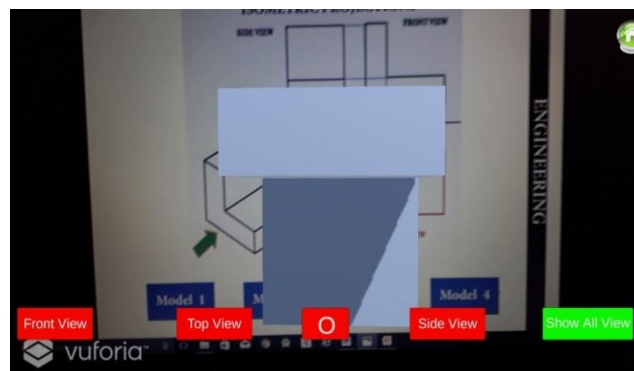


Figure 24: Top View of Model 1

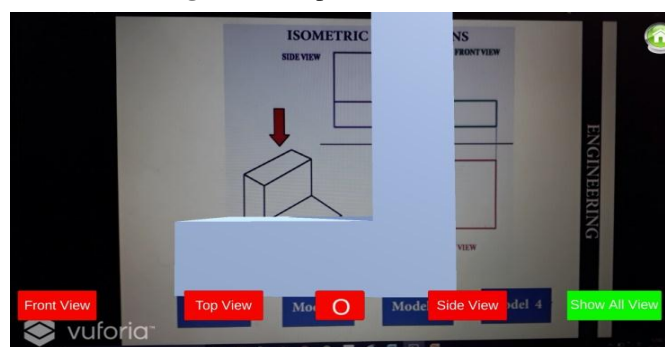


Figure 25: Side View of Model 1

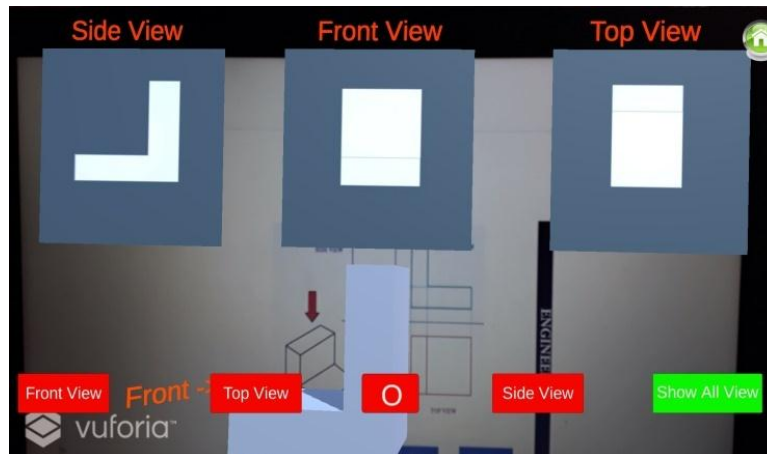


Figure 26: Displaying all Views of Model 1

As we can see after pressing the virtual button a model is displayed on the screen with some UI Buttons which includes-

- 1) Front View – Displays the front projection of the model.
- 2) Side View – Displays the side projection of the model.
- 3) Top View – Displays the front projection of the model.
- 4) Default View – Displays the default projection of the model.
- 5) Show all Views – Displays all the views on three different 3D planes.

Model 2 - It displays the 1st model on top of the image including the same UI buttons and functionality of Model 1.

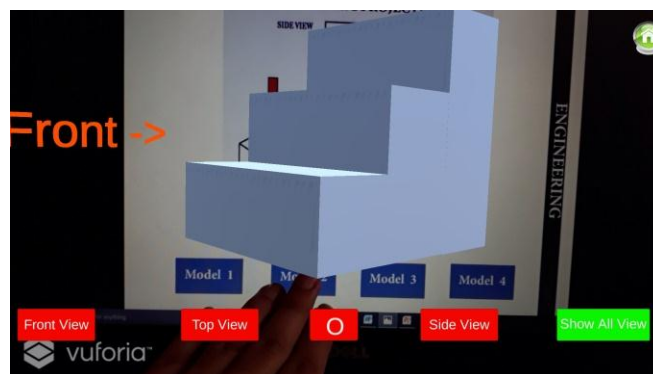


Figure 27: Default View of Model 2

Model 3 - It displays the 1st model on top of the image including the same UI buttons and functionality of other models.

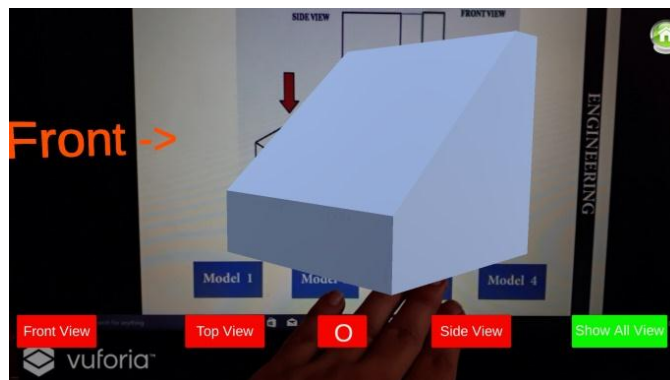


Figure 28: Default View of Model 3

Model 4 - It displays the 1st model on top of the image including the same UI buttons and functionality of other models.

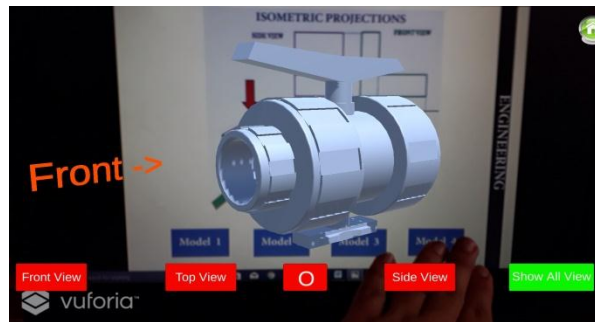





Figure 29: Default View of Model 4

SCIENCE

SCIENCE

Science	Atoms	Electric Circuit
		
<p>Science is the study of nature and behaviour of natural things and the knowledge that we obtain about them. It includes physics, concerned with nature and properties of matter and energy. Biology, that studies life and living organisms. Chemistry, that studies of matter, its properties and how substances interact with energy.</p>	<p>Atoms are the basic units of matter and the defining structure of elements. The term "atom" comes from the Greek word for indivisible, because it was once thought that atoms were the smallest things in the universe and could not be divided. We now know that atoms are made up of three particles: protons, neutrons and electron.</p>	<p>When a circuit is complete, or closed, electrons can flow from one end of a battery all the way around, through the wires, to the other end of the battery. In order to start flowing, you need a closed circuit. Therefore, the switch in the circuit enables the flow of electrons from the battery to the bulb and makes it glow.</p>

Guide: Open the Learnopedia application and bring the camera near to this page, three buttons will appear for each model. Click the required button and when finished click the back button to come back the buttons menu. For Human Skepage bring the camera near to the page and press the buttons manually by hand to display the corresponding models.

Figure 30: Page 1 of Science topic from AR Book: Learnopedia

In this Figure. We can see the 1st page of Science topic we have three modules which includes a Science Intro module, Atoms and a Simple Circuit Module. The page itself is an image target and when the camera detects the image target three UI buttons are displayed, one for each subtopic of the page.

The first module is a video played in a 3D plane. The video explains about Sciences and its different branches.

The second module is Atoms. It displays the 3D module of an atom including 4 UI buttons-

- 1) Electron – It displays the Electron model.
- 2) Proton – It displays the proton model.
- 3) Neutron – It displays the Neutron model.
- 4) Atom – It again displays the Atom model.

The third module is a simple circuit. It includes the use of ray cast where we can press the 3D object on the screen to perform the lights to turn on and off.

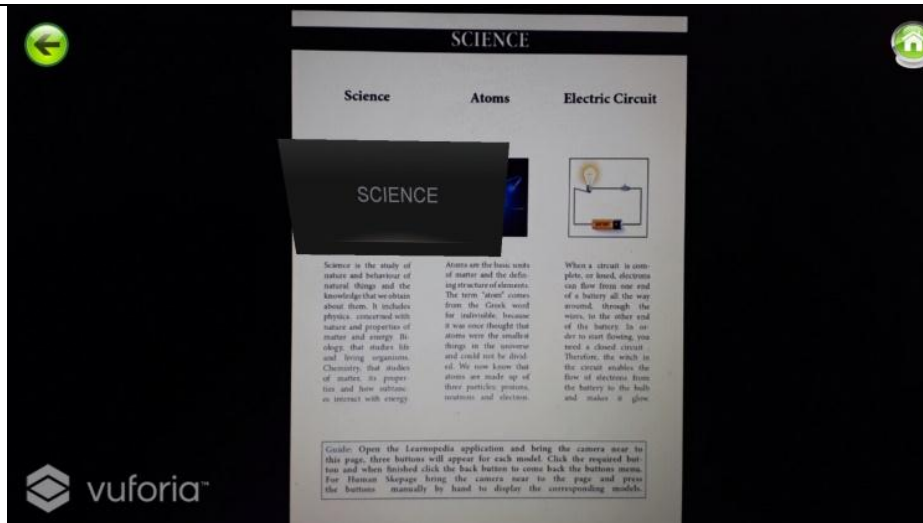


Figure 31: Augmented Reality video is played after pressing the Augmented Reality UI button

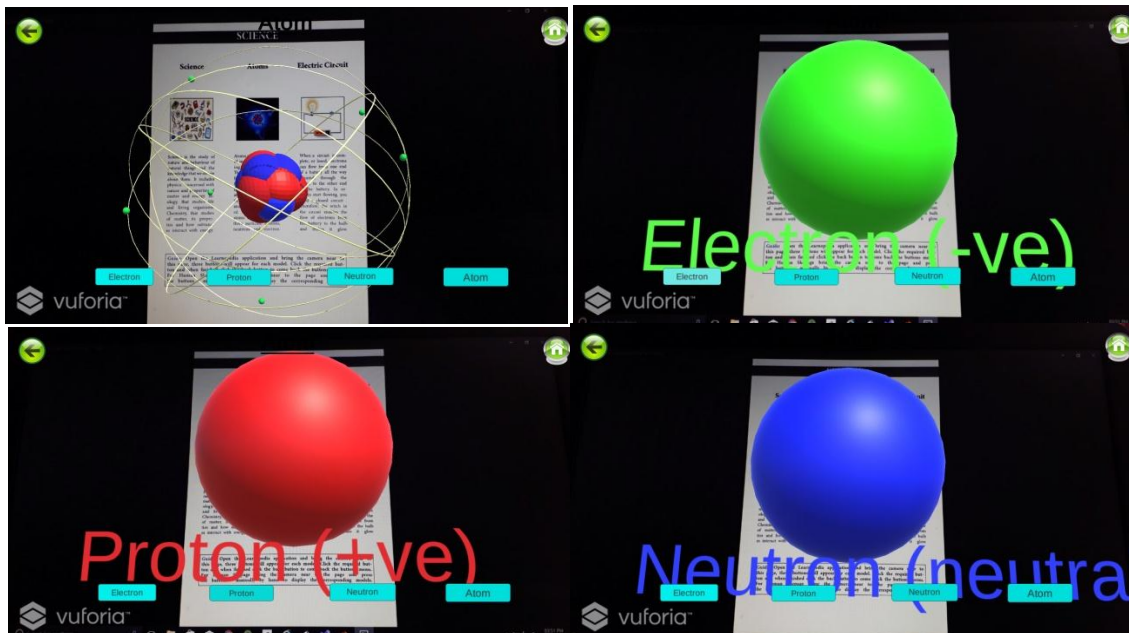


Figure 32: Atom, neutron, proton, electron model with UI buttons

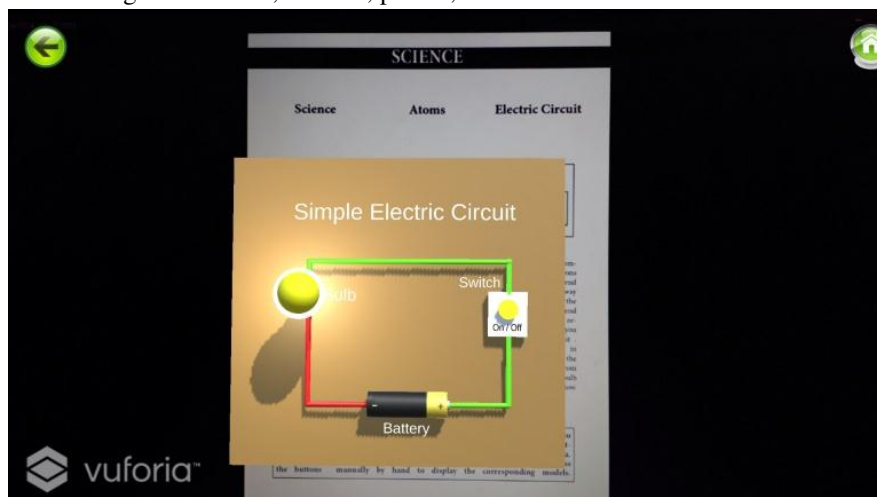


Figure 33: A simple Circuit model is displayed with Ray Cast

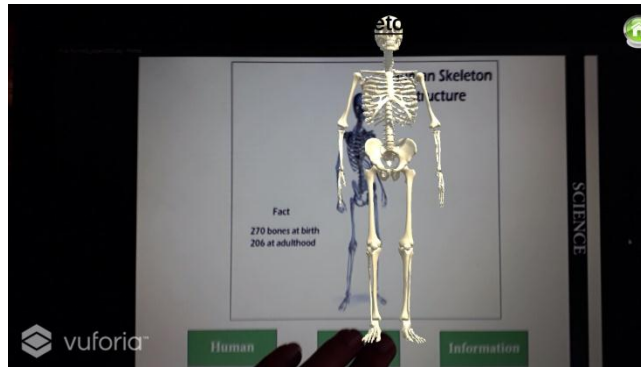


Figure 35: A Skeleton model is displayed on top of the image target

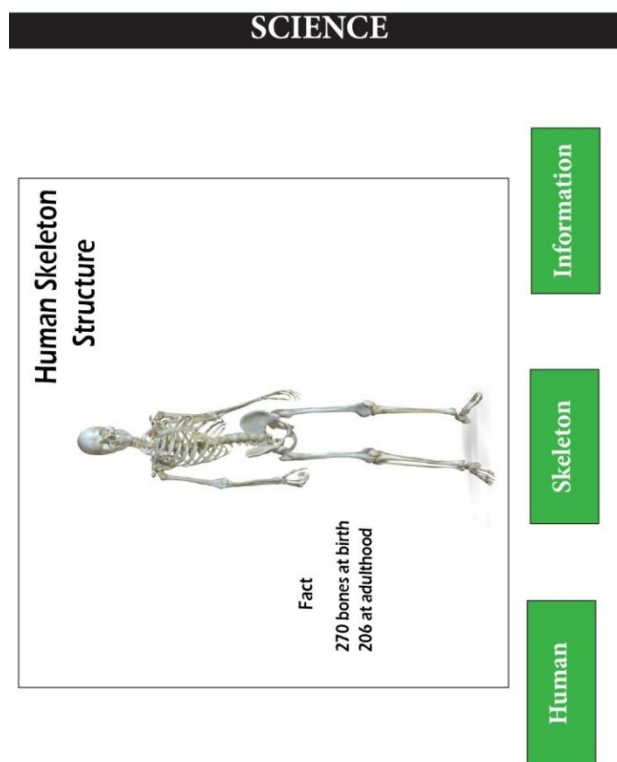


Figure 34: Page 2 of Science topic, and Image Target from AR Book: Learnopedia

The second page of technology simulates Isometric with the help of 3D models and planes. This page also includes the use of virtual buttons, which are buttons which needs physical interaction to perform certain functions. In other words a person needs to touch the button manually with their hand to perform the required functions. The three virtual buttons on the page have four different functions which includes-

- 1) Human – This virtual button displays the Human model on top of the image target.
- 2) Skeleton - This virtual button displays the Skeleton model on top of the image target.



Figure 36: A Human model is displayed on top of the image target

3) Information – This Virtual button displays information of Human Body, skeleton, and other information on top of the image target..



Figure 37: Information about Human Structure

V. CONCLUSION

Augmented Reality is just starting to break out of its infancy, because of this the possible applications in the future are tremendous. Augmented Reality could fundamentally change the industry as well as ease our normal life.

ACKNOWLEDGMENT

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