

# “TeachAR” Smart way to Learn.

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Abstract Information Technology (IT) has started to focus on exploring how people design, implement, and use interactive computer systems and how computers affect individuals, organizations, and society. These days innovation has turned out to be an imperative piece of our life. Consistent changes come up every day like online classes, digital books, kindle editions etc. But changes like this rarely thought about how much it's efficient or the user understands the concept in the book or paper. We go through a lot of papers, books, articles, newspapers, etc. but sometimes some concept, story or idea remains unclear due to lack of explanation or lack of words to present it. Similarly, is the case with students irrespective of degree we read concepts which are harder to understand but if they are visualized in a proper way it is easy to grasp and remember. We often experience that understanding a concept or an idea gets difficult when we have to read through huge paragraphs, but when it's depicted in the form of a real-world object it's easy. Unfortunately, we still use hardcopy of textbooks in our school/colleges etc. that consist of complex concept diagrams. To solve this problem, we are presenting a solution, which is TeachAR. Here we can convert confusing diagrams into Augmented Objects so it's easy for students to visualize them. This will also help them to interact with the concepts through 3D objects which will help them to visualize the details and texture precisely.

**Keywords** — *Augmented reality, textbook, education, augmented book, learning.*

## I. INTRODUCTION

Due to the present pandemic situation, students had to learn being isolated at one place, which led to lesser interaction with the concepts. Every year we go for Industrial Visits which help students to interact with the real-world things and receive clear knowledge about the field. This is only possible when they interact with the objects in the real world. When objects are examined in real life, questions, doubts, new solutions, deep understandings take place. Our solution is to provide the same realistic feel of the concept which will allow students to interact with the concept and have a deep understanding about it being isolated.

Our project uses technology called as augmented reality. The user will be provided with an app which will be enabled with Augmented Reality; later the user has to point the camera towards the concept image and the 3D Object will start appearing. This 3D Object will be fully interactive with details added and an exact replica of how a real-world object looks like.

## II. PROBLEM STATEMENT

We often experience that understanding a concept or an idea gets difficult when we have to read through huge paragraphs, but when it's depicted in the form of a Real World Object it's easy. Now-a-days even students understand a

particular concept easily when they can visualize it. Unfortunately, we still use hardcopy of textbooks in our school/colleges etc. that consist of complex concept diagrams. To solve this problem, we have thought of a solution, that is TeachAR.

Here we can convert confusing diagrams into Augmented Objects so it's easy for students to visualize them. This will also help them to interact with the concepts through 3D objects which will help them to visualize the details and texture precisely.

## III. TECHNOLOGY STACK

### A. Unity 3D

Unity3D is a robust platform for designing 3D and 2D based applications and is developer-friendly to use. Unity3D is proficient for rendering 2D and 3D models and scenarios. The engine can be utilized to form both 3D and 2D based scenarios as well as simulations. The quality offered by Unity3D is far better compared to any other applications for 3D development. Using Unity3D we can develop cross-platform applications, which are mainly applications like games for PC, consoles, mobile devices and websites which inherit the use of 3D objects or animation majorly. Unity has features like scripting, scene creation, animation, app architecture development, level design, motion design, and physics implementation which lets the developer make a

game or 3D model implementation very easy and rich featured.

### B. C# Language

C# is a general-purpose, multi-paradigm programming language encompassing static typing, strong typing, imperative, declarative, functional, generic, object-oriented, and component-oriented programming disciplines.

### C. Vuforia

Vuforia SDK is a software development kit specially used for Augmented Reality based mobile device. It enables the creating of Augmented Reality application. It can recognize different track planar images also known as target image, and simple 3D objects, such as boxes, cubes, cone etc. This recognition is all done in real time with the use of CV (Computer Vision).

## IV. RELATED WORK

In World full of Technologies where Artificial Intelligence (AI), Machine Learning (ML), RPA, IOT are in current Trends. Augmented Reality (AR) has gained a sudden growth in industry. Augmented Reality (AR) enhances the learning process and recreates a certain condition that may help students to understand and practice by interacting with Augmented Information like 3d object. With Augmented Reality Users are able to observe the real world and virtual objects at the same time.

The paper "Fun Learning with AR Alphabet Book for Preschool Children" proposed that how AR make learning easy. In this paper the author has developed an application which the help student of age 4-5 to understand and visualize Alphabet in fun and interactive manner using the pattern markers. The developer created an AR Alphabet book and used ARToolKit software to develop AR Book Application. To view the 3d object and related contained of alphabets students need to scan the AR book which comprises of two different section "Alphabet introduction and Exercise". Each section has its different role like first section introduce letters of the alphabets to the user. Each page consists of two part, one which displays "Instructions on how to play" and second part is used as "Marker to display 3d Objects".

For Each Letter, two markers are provided for displaying uppercase and lowercase letter. The user can also learn simple and familiar vocabularies of each words which start with the respective alphabet letter. For example, if the marker shows letter "A" then 3d models respective of the letter will be show such as Axe, Apple, etc.

The students get the information about the letter like how it looks, words starting from that letter, which helps them to understand the concept easily. An animated view is given of letter so that students get to know actually that letter is

drawn. Next the exercise section allows students to revise what they learned in previous section.

It's basically a gaming approach designed by developer for students so that they can implement what they have learned in previous section. In this section different pattern marker, each pattern marker is divided into two part. First part is provided in the book and students are required to find the right missing half of the pattern. A correct guess will result in the display of the correct object for the letter over the complete marker.

Using Augmented Reality to Teach Kindergarten Students English Vocabulary

The paper "Using Augmented Reality to Teach Kindergarten Students English Vocabulary" Lap-Kei Lee, Cheuk-Him Chau, Chun-Hin Chau, Chun-Tim Ng, describes that how Augmented Reality can be used in pre schooling of students. It's described how virtual 3d objects can be used and display in through mobile camera to make education more attractive and interactive. Its show how augmented reality can be used to educate student from their early childhood. It allows kindergarten students to learn English vocabulary in any place and at any time using mobile device. As children use mobile allot the application provides a monitoring system which allow parents to have control over the child's usage and allows them to stop the application a real time.

## V. PROPOSED SYSTEM

This project is based on using augmented reality to its best in educational purpose and solve the current problem that is faced by the learners. Now-a-days every user expects that access to the information should be easy and not restricted to the situation they are currently in, it can be based on location, internet availability, physical presence etc. So the aims is to provide an easy to use mobile application for the students or users. We all know that visualizing a concept gives us a better understanding to remember it and also to implement it in real life. To get this goals cleared we are developing and application to get a realistic view of the concept using advance technology of augmented reality. Getting this app developed we are using main two open-source applications called Vuforia (SDK) and Unity3D v2019.

Vuforia SDK is an augmented reality software development kit which enables us with two main features as follows:

1. Camera SDK which helps but implement augmented reality based camera.
2. Portal for implementing images on which the augmented reality camera should work on.

The vuforia sdk holds different features like Image target, Vumarks, Multi targets etc. from which we are using in this project are AR camera and target image. This technology

uses computer vision to detect, recognize and track normal image and 3D models in real time environment. This feature of registration enables the developers to adjust or set the position and orientation of the augmented models such as 3D models, video, buttons etc. in such a way that it will look as same as its viewed in real world through the camera of mobile phone.

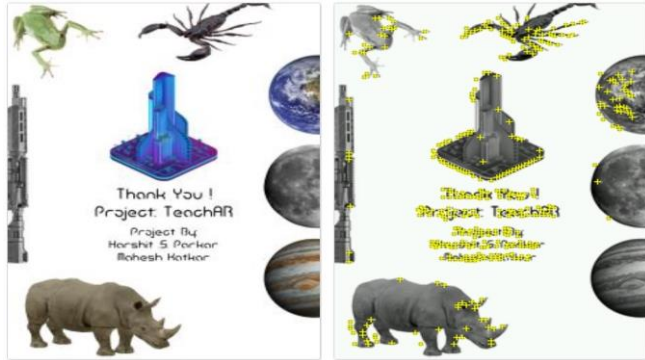


Figure 1: Features extracted for AR camera to recognize

Vuforia portals enables developer for storing Target Images. In (figure 1) we see that Target Images should have some uniqueness in them so that the AR camera can distinguish between different pages. Vuforia has certain parameters that help system show whether the image is suitable for being augmented or not. Suitableness is defined by the accuracy that AR camera module can detect the image from distance and also differentiate it with different images. These parameters are as follows:

1. Image should be rich in details.
2. Image should have good contrast.
3. There should be no repetitive patterns.
4. Image format should be 8 or 24 bit .png or .jpg image.
5. Image size should be less than 2MB.
6. Image color should be RGB or greyscale.

Each target image that is added is judged on the above parameters and given a star based rating that can be seen in (figure 3) Images are detected on the bases of features that are fetched from the target image and this are later compared at run time with live camera image feature. This star rating ranges from 1 to 5 where 1-2 is low image quality but can detect and 3 to 5 are the best image quality that the camera will perfectly detect. This same target image will work as an identity point for Augmented Reality based 3D Models to pop-up. Target image can be of concept diagrams on which the 3D models has to be implemented.

The 3D models of the concepts are attached to the target image using unity3D this will help developer to compress models through unity which will indeed reduce the size of the application. If a new target image is to be added then admin can easily add it to vuforia image target dataset. The admin then has to update the datasets in unity and then add the models and description of the concepts on the target image using unity. Then the user will be able to point to the

image and models will be visible to the user in the app. The user needs to purchase the book to get the target images that will be enabled to show models. Once the user has book he/she will be able to interact with the mobile application and go through the various categories available. The user can see videos, links to the site, and detailed model of the concept.

From the (figure 2) here first the user will point the phone camera to the concept image he/she wants to explore in AR. As soon as the camera is pointed over the image a 3D model will appear. Students can use pinch gesture to zoom-in zoom-out of the models, swipe gesture to rotate the models. The AR features will let students click on the button through which the user will get access to the sites that will be recommended by the scholars of the topic so that students will know which study material to use. Other main feathers is the user will be able to see what the pronunciation of the topic is. User will be able to play and pause video which will be played in AR form too. If the user points to the image that is not augmented a pop up will be shown saying point to the image of the topic.

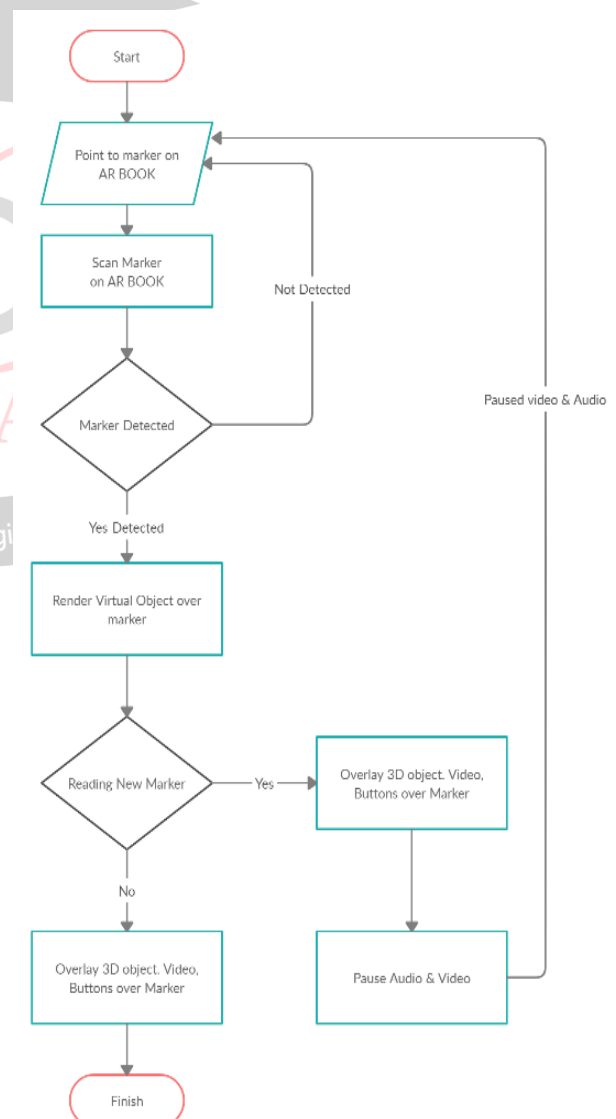


Figure 2: Flowchart diagram of the application.

## VI. IMPLEMENTATION DETAILS

The working of the system proposed above is shown with help of a flow diagram i.e. (figure 2). The system design is divided into three major modules.

Modules with respective implementation details are as follows: The first phase includes the work with image targets second phase includes the integration of AR camera and Unity with SDK and third phase shows how 3D models are implemented over target image and use augmented reality technology.

1. Setting Target Images in Vuforia SDK.
2. Integrating Vuforia with Unity3D
3. Implementing 3D models over Image Targets

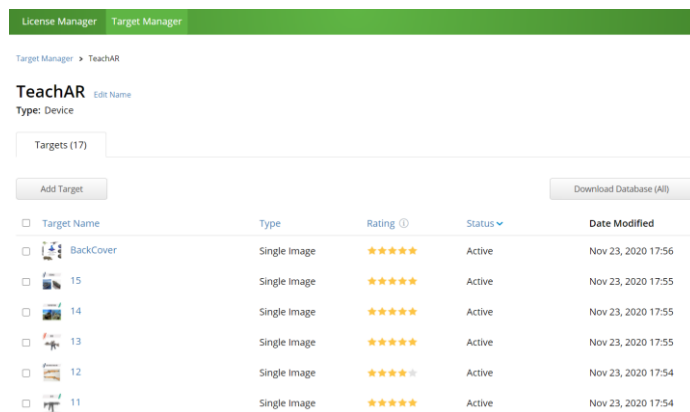


Figure 3: Vuforia target manager

### Module 1: Setting Target Images in Vuforia

Vuforia SDK is a software development kit specially used for Augmented Reality based mobile device. It enabled the creating of Augmented Reality application. It can recognize different track planar images also known as target image, and simple 3D objects, such as boxes, cubes, cone etc. This recognition is all done in real time with the use of CV (Computer Vision). The Target image is registered on to the Vuforia Target Manager as shown in (Figure 3). In (Figure 3) the stars shows the accuracy of the camera to detect the image when pointed through AR camera.

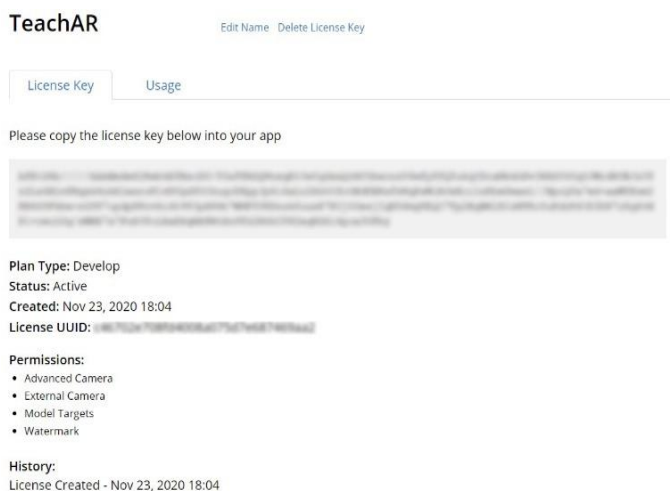


Figure 4: Setting license key in vuforia

### Module 2: Integrating Vuforia with Unity3D

After Target images are uploaded to target manager license for AR camera is needed. In vuforia at License manager project is created and details about plane type is added. When the project is created we get license for the camera which is basically a hash code as we can see in (figure 4) to recognize the Camera module. In unity3D package name " add-vuforia-package-9-8-5" is imported. This package imports all the assets that are necessary for AR project to work in unity.

This package also includes AR camera from vuforia. In unity3d we add AR camera to the scene through the assets drop down. Select camera we get option to insert a hash code which will connect vuforia camera license to unity. Now in target manager we have to download database which will then inserted into the camera module. This provides us with all the access to the target image that AR camera should recognize. The connection with vuforia and unity3d successfully done here.



Figure 5: Implementing 3D object on Image Target

### Module 3: Implementing 3D models over Image Targets.

Once vuforia package is imported successfully with unity3d, assets allows developer to use AR camera. We implement AR camera on to the scene under which image targets are placed. This image targets are fetched from the vuforia database package which we have to import after vuforia is imported. In assets option we can find Image Target option to be selected. In (figure 5) we have to choose image target the image target on to which the 3D model is to be displayed. Unity3D enabled developer to use .obj & .gltf format 3d object every efficiently with all the textures. For importing 3d objects into unity simply drag the object into assets folder.

Once the image target is selected we have to drag & drop the 3d object under the image target folder in scene. Perfectly fit the object using resize and rotate function. Similarly we have used buttons and panels for displaying AR based button and videos. Videos are streamed from the google drive for security purpose. User can then point the camera to the object and experience video, detailed 3D object and also interactive buttons very easily.

## VII. RESULT

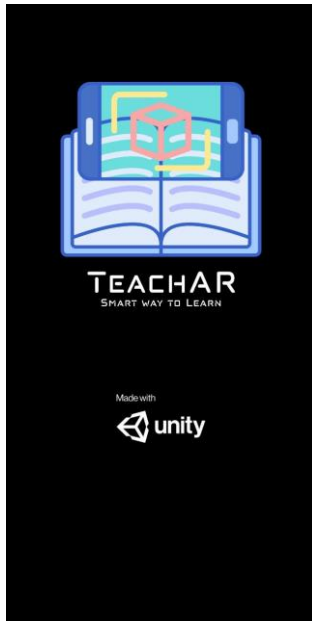


Figure 6: App Splash Screen

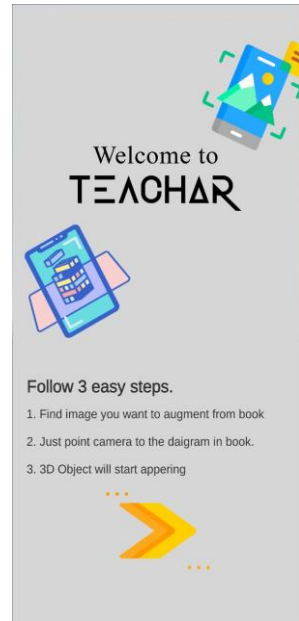


Figure 7: Step to follow for AR

In unity3d after we implemented our AR camera, 3d models and other links we converted this application into an .apk (Android Package) file. In above (figure 6) we have implemented a smooth welcoming screen showing “TeachAR” Smart way to Learn logo for 4 seconds. After the user is welcomed he/she is shown a follow step page as shown in (figure 7), it helps the user to know what exactly to do for using this application and that to in 3 easy steps.

1. User has to decide which topic they want to learn in AR from the TeachAR magazine.
2. The user have to point this camera over the magazine topic image.
3. The 3D model, related videos, AR buttons, audio and etc. will start appering.

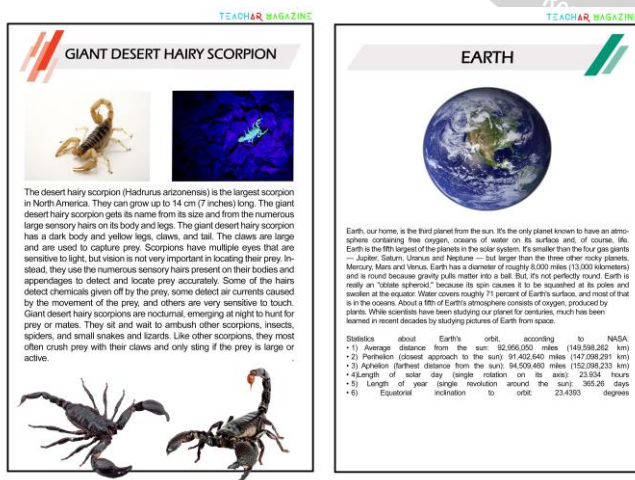


Figure 8: “TeachAR” Magazine designed for AR.

For project to be implemented and practiced we have designed a magazine as seen in (figure 8), on which user can practically apply the goals of the project. This magazine

can be found on the link given: <http://bit.ly/TeachAR-Magazine>.

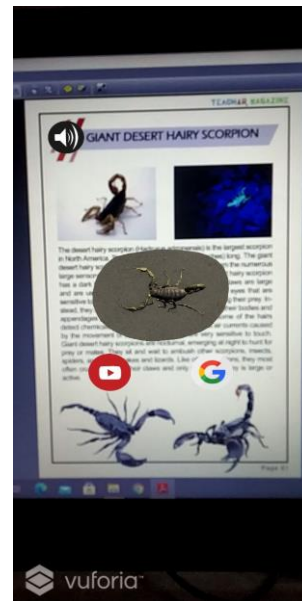


Figure 9: 3D Model & AR buttons

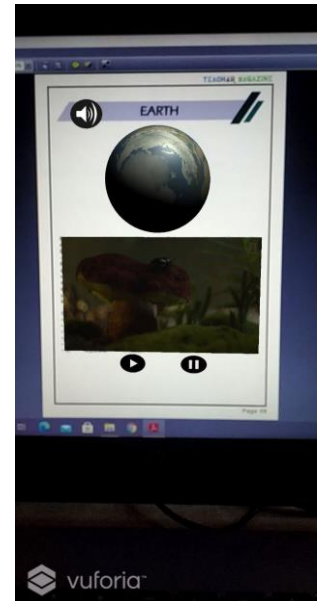


Figure 10: AR Video & 3D model

Once the users has decided with the topic they want to learn, simply point the camera over the topic image from the magazine. In (figure 9) we can clearly see the example if the user chooses the topic about scorpions they will be provided with AR 3D model which they can interact with through gestures. We have also provided with an audio button near the topic name to see the pronunciation of the topic. At the bottom there are 2 AR button depicting the YouTube button which when clicked will redirect them to the video of the topic and Google button will redirect when to the detailed reading information about the topic on Google or Wikipedia. Similarly in (figure 10) we can see 3D AR model of the earth itself that to can be interacted with gestures and AR videos directly streaming from YouTube which a play and pause button provided if the user want to control the video played.

## VIII. CONCLUSION

In this paper, we have demonstrated how augmented reality can be used for educational purpose based on the problem that students and other users are facing presently. There are many application that helps students learn various topics but it’s just through self-made videos and diagrams which can still make students get into doubt. There are various other issues like unable to visit places, being isolated etc. which are deeply analyzed, and a smart way to learn concept is being proposed. The proposed system is based on augmented reality which helps a learner to visualize the topic easily. Such system/ application will assist learners by providing a detailed visualization of the topic or concept they want to learn. The application had successfully overlaid the augmented 3d models, buttons, videos and audios onto the physical as well as softcopy of the book. This goal was also practically achieved in real- time

performance on the mobile application. There have been many benefits to the students or the users from this app such as there is no need of physical presence at the place, explore anytime, explore anywhere, detailed models to look into, direct access to the information suggested from scholars or teachers of that field and also video that will help with the explanation part of the object. We will further evaluate this application with core subjects like science, geography, history and many more. This concludes that the experimental results that were demonstrated efficiently to solve the promising and challenging problems in education and students are facing right now.

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