



Interactive Learning Using Augmented Reality

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Abstract— Education plays an important role in student’s life. Sometimes education through printed textbooks makes the students get bored. Smart phones and tablets are no longer used as a communication device, but can be used for much more activities. especially for the school students. As hardware embedded in smart phones can perform significantly more work than the traditional phones, they can be considered as a powerful computing device, which has the ability to capture images, record video and surf the internet. With such powerful computation capacity in one’s hand, large scale of students can get benefit out of it. Besides, technology is advancing through many evolutions, it has a potential to play a major role in education. One of those technologies is Augmented Reality. A learning platform through Augmented Reality(AR) is an exciting way of learning. The application will provide a better way of learning with 3D model of the contents which the students will use in day-to-day life. And another feature to be added is OCR (Optical Character Recognition), which is used in many public and private sectors for recognition. This feature will give a brief definition of words that a ward can’t understand. Thus, by combining these two technologies we achieve a greater deal in revolutionize the education system in a better way of learning.

Keywords— 3D model ; Optical Character Recognition(OCR); Augmented Reality(AR).

INTRODUCTION

Augmented Reality (AR) is one of the new innovations that is acquiring increasing interest in the real world by blending virtual with the present reality in various extents, AR frameworks are now used in numerous applications like Surgery, Inspection of Hazardous conditions, and Engineering. The essential upsides of AR define the parts of the digital world to be combined with an individual's impression of this present reality. Normally, it isn't pretty much as straightforward as show of information, however coordinating the vivid sensations saw as regular pieces of a climate.



Fig .1 An example of AR displayed on a Tablet

Augmented Reality adds electronic components to a live view frequently by making use of the camera on a PDA or on a tablet as displayed in figure 1. An illustration of extended reality comprises of snapchat focal points and the game named Pokemon Go. Virtual reality (VR) includes an experience that makes total submersion of the actual world. The VR gadgets like Oculus Rift or Google Cardboard, clients are changed often into various real world and suitable conditions, for example, center of a cackle penguin state or even the rear of a mythicalbeast.

Our proposed system uses motion tracking technology to live view the 3D elements wherein the Camera identify surface points, called features and tracks those points to move over time. Using AR SDK the device captures plane surfaceslikeaground,flattable,etc.,andplace3Dobjects so that it merges broadloom with the real world. [7] The estimation of the average lightning in the captured flat area shows a proper model with lightning and shading.

This paper is organized into four sections. Section 2 gives a broad definition of ARCS systems and discusses AR problems with respect to similar techniques of 3D world, Section 3 discusses the proposed system details, Section 4 corroborates the results of communication with mobile users and, section 5 provides the conclusion and limitation of this paper.

II REVIEW OF LITERATURE

The learning result of school children at rudimentary training level in rustic India is showing slow improvement. The yearly instruction report in 2018 shows the situation with learning levels in government schools, which are declined after 2010 and it is gradually turning around. Additionally, the enlistment in tuition based schools developed from 18.7% to 30.8% somewhere in the range of 2006 and 2014, has deteriorated at around 31% from that point forward. This is due to the lack in interaction between the students and the subject being learnt.[1] Most of such cases will lead to dropout in higher studies or in the upcoming years of education. Current learning rate is proven to be efficient and it also shows significant growth in literary rate. However, when it comes to the methodology of learning, it doesn't meet the standards to students on the basis of learning. The government made Right to Education Act in 2010 that no detention until class VIII for both private or

government schools and this is one of the main reasons in literary growth. The only thing that matters is the learning outcomes of such lenient education system, don't meet the standards. Figure 2 shows the survey based on ARCS technique which cited current educational practices and with interactive learning methods. From the figure, it is clear that there is an enormous rise in Attention and significant rise in confidence and satisfaction. This proves the students are expecting to learn in a new and improved way.[4] Also, this solution will provide a new path for interactive learning.

Consider a class of 30 students with one teacher. They learn what the teacher teaches and this has been followed since early period. But the learning capacity is diminishing over the time.

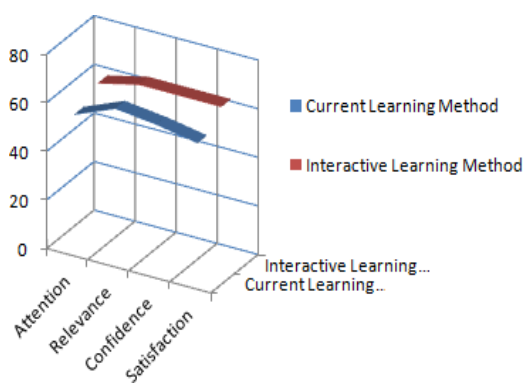


Fig .2 ARCS learning model

Due to the vast usage of internet, the development of online training is also increasing rapidly. Visual education is a most commonly used system not only for primary and secondary education, even for higher education. To do this, simple devices like tablets, smart boards and computers are used. There are few major advantages in visual education system. They are, 1) learning speed increases, 2) recalling or memorizing capacity increases, and 3) maintenance cost is cheaper due to its software base instead of hard copies. To attract and grasp the concentration of users or school students, it is mandatory to have the presentations with visual effects and animations by using latest or commonly used technologies.[7] Particularly, image processing plays a vital role for higher education, and is commonly applied in fields like Medicine, Science and Engineering. In medicine, it helps to visualize the diseased regions in an easier way via CT and MR images.[5] Successful results and clarity of images ensures more effective in learning process along with this, augmented reality further increases its contribution in the field of education.

In the paper [1] which is near blended reality that gives the representation and sound of real 3D models of products of the soil figures of the relative multitude of letters (both English and Bengali). We will furnish them with a stage to mess with every single 3D model, move them in all various points conceivable organic product figure to keep them intrigued.

The framework in [2] utilizes an increased reality sorcery reflect for showing life systems which utilizes a profundity camera for keep tracking the position of a client resting before a huge showcase. Utilizing motions, various cuts from the CT, a photographic dataset can be extricated for perception

and furthermore the framework can give 3D models of organs, printed data and pictures about lifestructures.

As indicated by paper [3] picture preparing has been proposed to improve enlightening quality in advanced education courses in the fields of Medicine, Engineering and Science. i.e., the picture preparing strategies can be utilized to show the ailing areas in a simpler manner in many pictures, for example, CT and MR pictures Furthermore, it very well may be effectively liked and applied in the field of science like Chemistry, Biology and Geography. In this investigation, image Processing based methodologies have been created to guarantee more successful learning in advanced education

III SYSTEMMODEL

Based on the virtual reality and memory, University of Maryland provides a study report, which states that there is around 8.8 percent increase rate by the students recall capability, when working in immersive environments rather than traditional computerscreens.

The system proposed uses combined technologies of AR and OCR in a mobile application which provides an interactive learning platform for students. The application uses marked AR to obtain the surface which will be a topic being discussed in classes. The surface will be recognized by the application and the relevant 3D object is shown in the screen. The words that are hard to be understood by the child will be recognized by the help of OCR module and a brief definition will be displayed in the application. Hence, we use the major technology that are rising in this modern world, we can improve the rate of learning with such interactiveclasses.

A Image Targeting

Image targeting is carried out by the vuforia engine integrated into the system. To recognize and track targets through the analysis of various contrast-based features that is visible to a camera can be performed effectively with the vuforia engine. The presentation of an image can be improved by upgrading the perceivability highlights through changes in accordance with the target's design. By default, the conditions of lighting in the test environments can significantly affect the detection and tracking of target.

B Targe tSize

The situation such as tabletop, near-field, and a physical printed image of target should be at least 5 inches or 12 cm in width and that should be of proper height for a good AR experience. The recommended size of a target can be varied based on the actual target size and the distance of the physicalimage.

C Viewing Angle

Detecting target features becomes harder and tracking would be difficult , if a user looks at the target from a very steep angle or the target appears very oblique with respect to the camera. While

defining user scenarios, it should be kept in mind that a target should face the camera, whose normal camera viewing direction must be well aligned, to get detected and tracked in a better way as shown in figure 3.

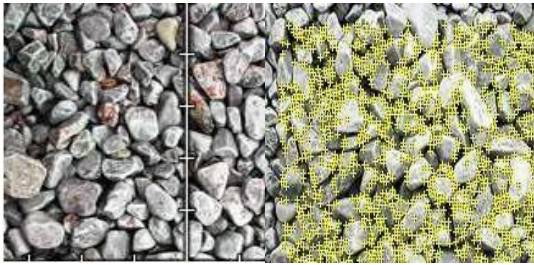


Fig .3 Target image in the database vs features or hotspots

The following are the various attributes, that specifies image targets to have best detection and tracking performance of the Vuforia engine.

TABLE I

Attribute	Example
Rich in detail	Street scene, group of people, collages and mixtures of items, and sport scenes
Good contrast	Bright and dark regions, and well-lit
No repetitive patterns	A grassy field, the façade of modern house with identical windows, and a checkerboard
Format	Must be 8- or 24-bit PNG and JPG formats; less than 2 MB in size; JPGs must be RGB or greyscale (no CMYK)

Marker Detection

A decent marker is effectively perceivable under all conditions. Utilizing machine vision methods contrasts in luminance (splendor) are more handily recognized than contrasts in chrominance (colour) which is because of the helpless equilibrium of the cameras: the tones will be enrolled inaccurately, and an item might change its tone in the picture contingent upon what is accessible in the view. Moreover, the lighting changes the noticed shades of the articles that makes the shading discovery a difficult one. At whatever point the difference is more in the luminance the items are identified all the more effectively, consequently making highly contrasting markers ideal.

There are two types of tracking

i) Marker based tracking

In augmented reality, information can be represented as an exact real-world context. To accomplish this, the framework has to identify the situation of the client and what the client is taking a gander at. Ordinarily, the clients take a gander at the climate through a showcase that depicts the picture of the camera along with expanded data. Along these lines, by and by, the framework needs to distinguish the area and direction of the camera. By calibrating the features of camera, the system will be able to provide virtual objects in the correct place.

ii) Optical flow tracking

The movement assessment issue is to decide the movement of every pixel between two successive frames. The movement of every pixel that is assessed autonomously from the developments of different pixels is called optical stream (or optic stream). While an overall optical stream technique gauges the movement of every pixel, a more normal methodology is to restrict the following to specific provisions as it were.

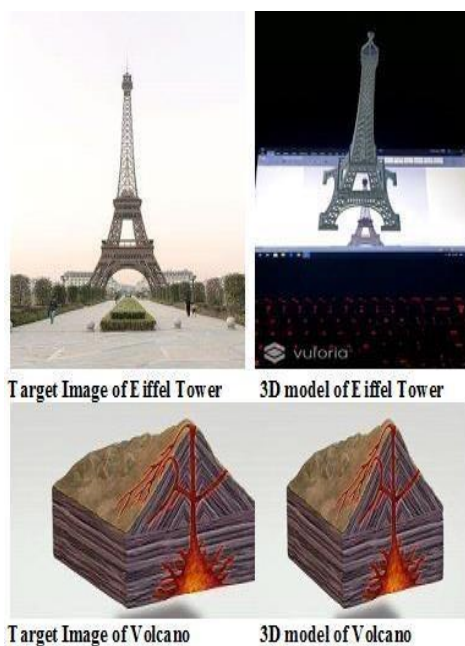


Fig.4 Target image vs Images in 3D model

IV WORKING OF THE APPLICATION

The application uses marked AR to obtain the surface. The surface will be recognized by the

application and the relevant 3D object is shown in the screen.

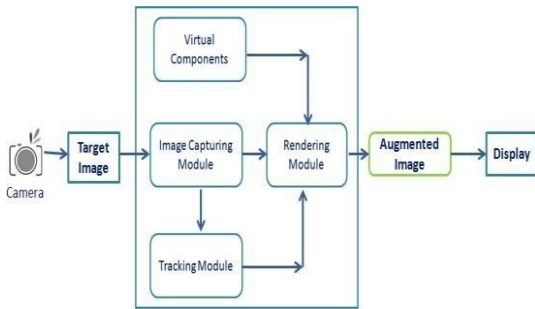


Fig .5 Workflow of the mobile application

Steps involved in the mobile app based Learning Model are

- Steps : 1 The camera in our mobile device scans the surface with target image
- Steps : 2 The targeted image will be identified at instant
- Steps : 3 Now the mobile application starts its processing
 - Steps : 3.1 Image Capturing module will capture the targeted image from the device's camera module
 - Steps : 3.2 The image is traced along its outline and with the features represented with Vuforia
 - Steps : 3.3 All these processes are done in an instant that generates the result using the rendering module
- Steps : 4 Augmented image of the corresponding target will be acquired by the augmented image module
- Steps : 5 Finally, on the display of the mobile phone/tablet, the results are displayed

Android App is a software that is to be designed to run on any Android device or emulator. The software file named APK, in zip format contains app code, resources, and meta information and can be written by users with languages like Java, Kotlin and C++ and are executed in the virtual machine. The Android Studio is an official development environment, which will provide a bridge for the students to interactively learn their subjects.

Unity is a game engine that can make three-dimensional, two-dimensional, virtual reality, augmented reality, and simulation games, as well as software and other applications using its environment.

Vuforia is a mobile software development kit (SDK) that aids in the development of augmented

reality applications.

Blender is a free, open source software toolset for creating 3D graphics in computers with visual effects, art, 3D motion and interactive 3D apps.

A Processing

AR requires a CPU, a GPU, flash memory, RAM, GPS, Bluetooth/Wi-Fi etc. Also, it is required to measure speed, angle, direction, orientation in space, and so on.

B Cameras and Sensors

User's interactions can be traced out by collecting data from different sensors and then sending it for processing. Later, camera of each user device is scanning the surroundings. With this information, each device identifies the physical objects and generates its respective 3D models.

C Projection

On AR headsets, this process refers to a small projector that collects data from sensors and projects digital content which is the result of processing onto a viewing surface.

D Reflection

Some AR devices have mirrors that allow users to see virtual pictures through their own eyes. To reflect light to a camera and a user's eye, some arrange an array of small curved mirrors, while others have a double-sided mirror.

E Optical Character Recognition

Optical Character Reader or Recognition (OCR) is the electronic transformation of pictures that are in composed form, written by hand format or printed text into machine-encoded text format. This is regardless of whether from an examined archive, a photograph of a record, a scene-photograph or from caption text superimposed on an image [6].

F Surface Detection

Marker based and marker-less are the two types of technologies used for the detection of real-world surfaces. A computer generated image that is used for the creation of AR is referred as augogram. A science/software applied for making augogram in AR is referred as augography.

G Marker Pose

The posture of an object indicates area and direction where the area can be communicated with three coordinates (x, y, z) and direction with three revolution points DEJ around the three axes (Fig. 7). Accordingly, a posture has six levels of opportunity (6 DOF). The posture of an adjusted camera can

not really settled from at least four coplanar yet non-collinear focuses. Accordingly, a framework can ascertain a marker's posture in 3D directions utilizing the four corner points of the marker in picturefacilitates.

H Tracking and Scaling

A feature based tracking system can't expect the scale from the pictures it sees but only from the environment which could be a brief scale model or an enormous space; just the overall extents can be reasoned from pictures. The scale will be fixed if the physical distance between two points is known. A marker tracking system that knows the physical magnitude of markers can have the correctscale

FEATURES SHOWN IN PLANT CELL AS MARKER

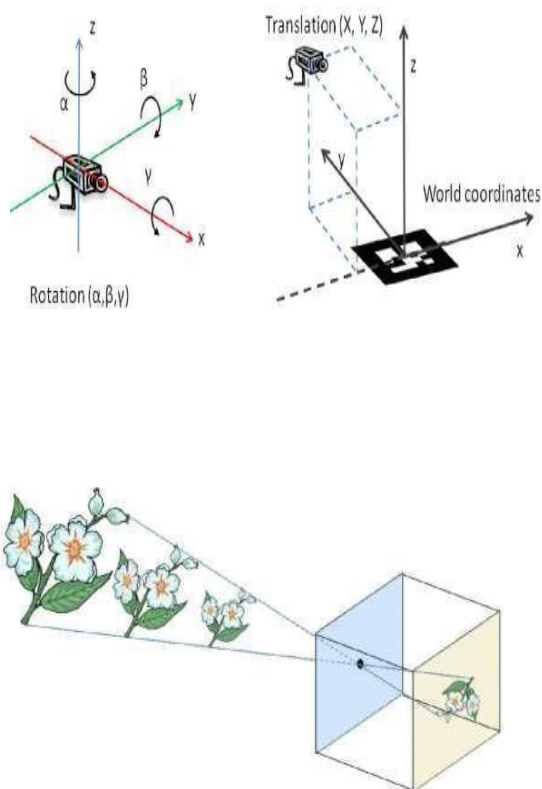


Fig 8 . Scaling and Position

Without any further clues, a visual tracking system cannot derive earth coordinates from what it is observing (i.e. which direction is up, down, or horizontal). As a result, a feature tracking system's origin and coordinate directions are random. As is typically the case, markers placed on a floor, table, wall, or other known flat surface create a reference frame for world coordinates.

The KLT tracker (Kanade-Lucas-Tomasi tracker) is a commonly used feature recognition and tracking optical flow technology. This method is implemented in OpenCV. Lucas-Tomasi refers to the optical flow portion of the method, while Shi-Tomasi refers to the selection of useful features. Now, consider a environment where the 3D model and its target are progressed as shown in figure.9. figure 10 figure 11 and figure.12.

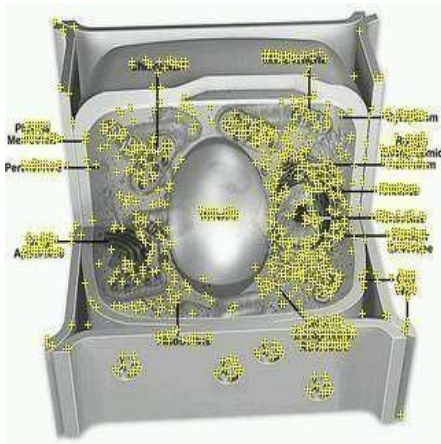


Fig.9 . Image Target of Plant Cell



Fig. 10. 3D model of Plant Cell

The OCR approach works very well with typewritten text and fails miserably when confronted with unfamiliar fonts. Feature extraction is the process of breaking down images into "features" such as lines, closed loops, line direction, and line intersections. The extracted characteristics lower the representation's dimensionality, making the recognition process more efficient. These characteristics are compared to a character's vector-like picture, which may be reduced to one or more image prototypes. This sort of OCR, which is widespread in "intelligent" handwriting recognition and most modern OCR software, uses feature detection algorithms similar to those used

in computer vision. To compare two objects, closest neighbour classifiers such as the k-nearest neighbour method are utilized

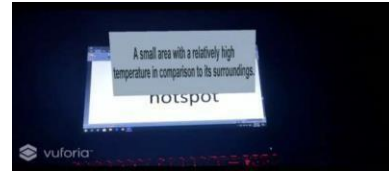
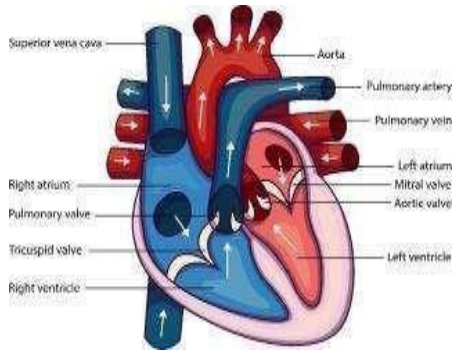


Fig.11 . Image Target of Heart

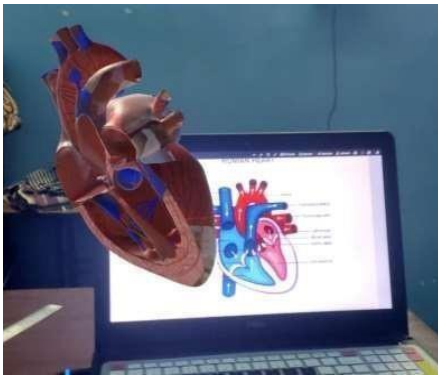


Fig. 12. 3D model of Heart

A ranked list of candidate characters can be generated using two types of fundamental OCR algorithms. The Matching Matrix compares a picture to a recorded image pixel by pixel; it's also known as "pattern matching," or "pattern recognition," or "image correlation. This involves isolating input image from the rest of the image, and on the stored image having similar font and at the same scale. This is similar to that of character recognition. Instead of image targets, the system will acquire words as their targets and hover above the target about the word's brief definition as shown in figure 13 and figure 14. Such a way our proposed system is implemented to its fullest

FIG. 13 Placement of character target along with its relevant definition.

In this example, word hot spot and its definition is being worked

invertebrates

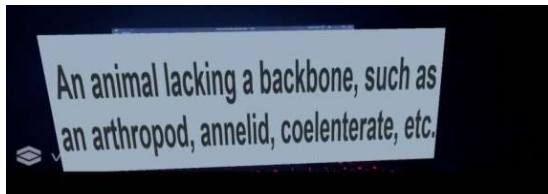


Fig.14.Abriefdefinitionofword-invertebrates|hoversondisplay

V CONCLUSION

The solution we proposed will change the way of learning in our educational system. Prerequisite is simply a mobile phone or tablet that runs on Android OS. The system has the clear view of learning and interaction of students with immersive way of understanding simple things. We targeted this application for school students graded from 1 to 8, which is an important phase in a student's educational life. Our real-time application uses augmented reality to improve the way of learning methodology. Also, character recognition is used to detect some specific words which are in the student's syllabus. These features make the interface and application created as robust, easy and simple. Moreover, we used certain preloaded words like ribosomes, which provide a brief definition of a particular word. All features mentioned above come under a simple apk file, to be used by android mobile or tablet users. Hence, our application will be a path towards our next phase of education. Currently, our application and interface has been built for only devices operated on android OS. In future, it can be extended to support iOS and windows devices.

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