

HCI BASED AUGMENTED REALITY SYSTEM FOR EDUCATION

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ABSTRACT

The upgrading and improving of the visualization capabilities of students is key factor for their development of design skill in different areas in Education. Technological innovation throughout education can certainly impact on college students to understand any subject effectively and can persuade the subject, create a trending strategy of learning process. Prior literature studies have shown that the issue that innovation in technologies will make a poor understanding of subject, if the technology that is used in education system does not encourage to students for critical verdict making, depth of perception and understanding of concepts that needs visualization skills. Due to the fact the many advantages, augmented reality(AR) technology has already proven that it have excellent potential that is very helpful to create the education system more dynamic, effective, well-off, productive as well as meaningful in superior way. Also, the embedding of augmented reality(AR) with education system allows students to learn any subject in very trending and in an interactive manner. In this paper we proposed Augmented Reality system that is very transparent and smooth, cost effective, that anyone can easily to understand it. Augmented reality system recognizes the Speech/Gesture, and then provides the information based on recognized gesture/speech menus.

Keyword: - Augmented reality, Spatial skills, Technology, Education, Virtual reality, Visualization

1. INTRODUCTION

In recent years, technology empower learning investigation has progressively concentrate on different trending technologies like augmented reality(AR), Smart-Phone learning, E-learning, learning analytic planned for enhancing the particular fulfillment as well as activities on the students in well learning situations. Most of these exercises take advantages of tremendous advancement in equipment or devices as well as software for portable gadgets as well as their trend among students and effective improvement of different stages of student's learning process. Education system that is upheld by technology will bring about extra amazing sorts of teaching and learning. This is because of the use of the techniques includes real world issues, origin of information recreations of ideas and communication with experts in that area. Furthermore, embedding technology in the education provides intelligent learning mechanism as contrast to traditional learning and teaching.

The coordination of development in technology tool into the education is ending up being a bit of good teaching. Teachers not simply commits a great deal for utilization individual time for using the software on computer and also needs more elevated amount of creativity as well as confidence to utilize the latest trends that are inlayed in new trending training system. The fuse of technology additionally gives an approach to upgrade student's learning experiences and encourage student take interest in education activities. Thus, current subjects have focused to higher used the applications used through instruction as per the view of students, along with animation, Different graphics as well as simulation software.

Augmented reality (AR) is another technology that has risen with many advantages for application in education and learning process. Augmented Reality is the new technology that can be seen as a advancement of Virtual Reality (VR). In Virtual Reality entire world is synthetically created, where the users completely connected with inside a virtual world, augmented reality permits users to encounter a new version of the augmented world. The Augmented reality system empowers the incorporating real world data with virtual environment and new information that overwrite over the existing information. Accordingly, virtual environment seem to exist together in

the similar space with real world information. Be that as it may, augmented reality is restricted to the sentiment of sight; it can be connected with all senses like hearing and touch.

While lots of research has been completed upon augmented reality, a few of them carried out in the education area. The investigated studies of augmented reality is doing boom in a market due to the effectiveness of augmented reality in different areas. In particular, augmented reality gives an effective way to deal with mean some kind of style that truly needs visualization. In particular, augmented reality technology has invented to a level that now it can be easily embedded in Portable devices, Desktops PC and other non-mobile gadgets. Research on augmented reality has also additionally demonstrated its extreme practical use intended for improving the inspiration and encouraging to students in the learning procedure.

2. RELATED WORK

Traditional education system utilizing chalk and the use of printed books are not adequate to clarify any idea, also resulting in insufficient understanding benefits in scholars. As indicated by student's perspective it is boring to simply hear the instructor teaching to them [10]. According to students perspective the embedding technologies could help them in their education procedure [4][20]. Along these lines, teacher have started to search for advancements that can be implanted in training in order to offer students some guidance with learning effectively and to improve their understanding in different subjects. Lot of studies has been done on augmented reality, from them only few researches have been done on augmented reality in the education field. The following are the issues that have occur in traditional learning and teaching process.

2.1 Diminishing the Total Number of Scholars Involved In Science Related Study

The study of Science is very difficult processes that consolidates perceiving an issue, researching the issue, making hypotheses, gathering the information, sorting it and conclude with the summary and results [6]. Take part in previously mentioned procedures help the student to understand every step clearly that helps to see each procedure obviously that accomplishes best outcomes. Because of the well-known observation in students Science stream is extremely hard to see; just a few researchers are intrigued to taking their degree in the Science stream.

2.2 Students Problems In Visualizing Abstract Concepts

Visualization that is utilized to speak with the information implies which the information ought from something which can be conceptual or not quickly visible. The most fundamental criteria are that the visualization must give a way to deal with learning something about the data. Any change of non-trivial information into an image will leave out data; but there should be in any event some important parts of the information from the picture or something that can be perused. Perplexity among students should be taking into account because it create problems with students learning approach [5]. Hence, the proper teaching technique play important role in avoiding or reducing the students confusion. It is found that is possible to enhance student's visualization skill simply by representing various conceptual and abstract visual images and allow the students to operate and investigate the picture [11]. Illustrations of visualization technologies which have been analyzed inside previous research include 2-D/3D animation, virtual world environment as well as computer based simulation. Animation along with useful information engaging moderator helps the students to grasp the final outcome of an investigation of data. These visualization strategies can be used to overcome the problem of misunderstanding and allow students to figure out any concept in efficient manners. Examination has shown that the advantageous utilization of technology as a method for visualizing unique strategies. Visualization strategies provides a way to create noticeable wonders that can be too small, big, fast or unaided eye can not to see it [9]. Wu et al. (2001), created an awesome animation to aid students to understanding the hypothetical thoughts in Chemistry [16]. As showed by them, this type of innovation allows students to visualize the coordinated efforts amongst particles and to understand the relevant ideas. Stith (2004) creates an awesome animation using computer software program for teaching biology concepts [22]. Nowadays, from numerous technologies that show effective advantages in educating particularly in visualizing core ideas is Augmented Reality. Augmented Reality is another technology that is liable to affect education [12]. Augmented Reality is not quite the similar as virtual reality that AR mixes real world environment with the computer generated data, whether virtual reality supplies computer generated graphics to the user. Augmented Reality displays different 3D objects and ideas in different ways and from various observing angles that offers the students to easily understand the subjects [15].

2.3 Hardware limitations

An Augmented reality creates the real environment data along computer-generated virtual 3D objects that appears in the same area as the real environment [18]. There are many different categories of displays for accessing the embedded virtual and real data, e.g. handheld display, projective display and head worn display [18]. In augmented reality system, gesture movement can be track by using Kinect Sensor. In previous studies, Kinect based AR proposed for children who suffers from autism spectrum disorder [23]. Kinect sensor is very costly hardware that needs for augmented reality applications. There is also Augmented Reality based game for racing, where the users uses a video see-through head-worn display, which is also very costly [15]. There is also innovation called Magic mirror using Mobile and wearable devices [3]. Augmented reality also very useful for Study of human body by utilizing HMD [19]. Digital sketching and study of Engineering graphics can easily done by using Hand held device [23][22]. Augmented Reality framework embedded with a book is a new trending way of education by engaging as many of the scholars activities as possible using hand held gadgets [14]. Hand held gadgets have numerous restrictions like computing power (RAM/Processor), battery life; Storage etc. as well as wearable devices are very costly that everyone cannot buy it. Augmented reality can also as a part of archaeological sites by using client server framework, that track GPS location which is used to provide information related about the archaeological sites through SIS (Site information server) to the client[13]. This required data about the archaeological site must be available on SIS.

3. PROPOSED SYSTEM

The proposed Augmented Reality system is a desktop based application that helps student to easily visualize the any concept via hand gesture as well as speech. The proposed framework expounds the augmented reality system which has low cost and very easy to execute. Fig.1 demonstrates the architecture of the proposed augmented reality system. We had proposed a system includes hand motion detection and recognition as well as speech recognition and the information is access from the system as shown in Figure 1. The proposed system works such that each user can easily use system, control the system, access and view all information through augmented menus and speech. At First user get to augmented reality system. As well as user enter the webcam zone; the webcam will capture the video and begin the process of Hand motion/pose detection and Recognition. User simply need to use hand poses to access the augmented reality system within the webcam zone, and when user use hand poses and speech to select the various menus and the system bring the information and show to the user.

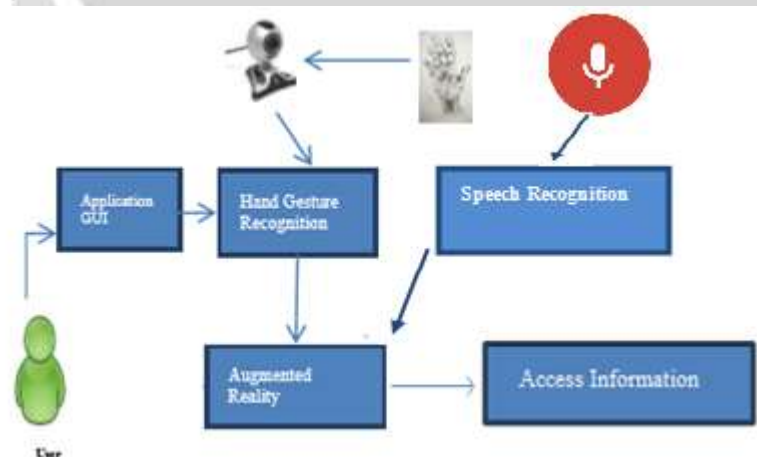


Figure-1: Augmented Reality System Architecture

4. IMPLEMENTATION DETAILS

In this section we will describe the detail of how to detect hand poses and motion technique. First, the Images are fetched out from the video and then these images are goes through different image processing algorithms. Finally once the hand pose is detected then the command associated with the detected pose is then executed. Now we will discuss Hand pose and motion recognition process in brief step by step.

4.1 Blur an Image

At the point when Web camera fetch video and extract images of user hand gesture, all images get obscure to diminish sharpening effects. This step is necessary to get more exact outcome. We separate all Red, Green and Blue values from the images and calculate the average of RGB values of surrounding pixels and assign average RGB value to it. This process is repeated for every pixel and final outcome is blurred images. Followings are the steps for blurring an image.

Steps 1: Iterate through whole input image array.

Steps 2: Extract every single pixel color value which is 24-bit.

Steps 3: Separate the color value into individual Red, Green and Blue 8-bit values.

Steps 4: Calculate the average from RGB value of all nearby pixels and assign this average value to it.

Steps 5: Go to step 1 until all pixels get traverse.

Steps 6: Store the calculated value in output image

4.2 RGB to HSV Conversion

Image processing is performed on either RGB color model or HSV color model. RGB color model elaborates colors in terms of the amount of red, green, and blue color present in the image. HSV color model elaborates colors in terms of the Hue, Saturation, and Value. In condition where color description plays very important integral role for accuracy, then the HSV color model is used. The HSV model defines colors such that how exactly the human eye tends to perceive color. HSV model is strong than RGB model because it offers a more intuitive representation of the relationship between colors. HSV select more specific color. In HSV model value of 'Hue' and 'Saturation' remains constant if the value of 'Value' changes, but value of RGB changes with the change in 'Value'. After blurring an image then image get converted to HSV color model. Followings are the steps for converting RGB image to HSV:

Step 1: Load Image.

Step 2: Read each pixel from image.

Step 3: Separate Red, Green and Blue color for each pixel.

```
Red = col & 0xff;
Green = (col >> 8) & 0xff;
Blue = (col >> 16) & 0xff;
```

Step 4: Find minimum value and maximum value from Red, Green and Blue.

Step 5: Assign max to value.

Step 6: If value equal to zero, Assign hue=saturation =0. Then Set pixel in image again.

Step 7: Else, Find saturation= $255 * (\text{Max}-\text{Min})/\text{value}$.

Step 8: If saturation is zero then, Assign hue is zero.

Step 9: If max equal to Red then hue = $0 + 43 * (\text{Green}-\text{Blue})/(\text{max}-\text{min})$.

Step 10: If max is equal to Blue then hue = $171 + 43 * (\text{Blue}-\text{Red})/(\text{max}-\text{min})$.

Step 11: If hue is less than zero then hue=hue+255.

Step 11: Set each pixel again on image.

4.3 Thresholding

The basic idea behind thresholding is to select those pixel values whose value is larger than threshold value and reject other pixels. Image pixel set to the 1 if it is larger than threshold value otherwise set to 0. Since the selected area is indicated by 1 and rest by 0 called as a binary image.

4.4 Morphological Operations

There are two principal of morphological operations called dilation and erosion. Dilation allows objects to grow itself, due to this it potentially filling in small holes as well as connecting disjoint objects. Also Erosion shrinks objects itself by eroding their boundaries. These two operations can be customized for an image processing by choosing the proper structuring element, which depicts exactly how the image object will be dilated or eroded.

Dilation can be represent as $A \oplus B$

Erosion can be represent as $A \ominus B$

4.5 Gesture Recognition

The gesture detection and recognition module tracks the moving hand gesture, identifies the pose, and find out which command is to execute. Then the recognized gesture is then send to the AR system being used which is determine which command is selected and what action is associated with that command, which then transfer the information to the student.

Gesture Recognition part starts with the monitoring the motion of the finger within a predefined oval. Then the next step is to calculate the deviation of angle between the fingers that are detected. The sine and the cosine of the angle are calculated which are further used to draw lines that are used for vector calculation. For this purpose a variable called currStat is used to store the value for the gesture recognized. Initially it is set to zero. If a single finger vector is recognised, then we check further angle of deviation of the finger.

- If the angle is less than 150 and greater than 210, then currStat=4 and currStat=5 respectively.
- If the finger vector recognised is 2, then currStat=1.
- If the finger vector recognised is 3, then currStat=2.
- If the finger vector recognised is 4, then currStat=3.

Once the currStat value get, the action associated with that value is then send to application that get executed.

Commands and their currStat values :

- If currStat=1, Zoom In.
- If currStat=2, Zoom Out.
- If currStat=3, Polygon Representation of 3-D model.
- If currStat=4, Left Rotation.
- If currStat=5, Right Rotation.

5. EXPERIMENTAL RESULT

This section presents experimental results that are carried out on the speech and hand gesture recognition modules. The purpose of these tests was to check the reliability of the proposed Augmented Reality System.

5.1 Hand Gesture Recognition

Hand Gesture recognition was tested using two different gestures:

- 1) **Left Rotation gesture**, a gesture rotate from right to left.
- 2) **Right Rotation gesture**, a gesture rotate from left to right.

Table-1 shows the result of gestures and poses detected when test was performed. The tests were performed in three different light conditions: outdoor environment with direct sunlight, outdoor environment with diffused sunlight and indoor environment. A result is depicted as *true positive* if the gesture or pose was correctly recognized, *false negative* if the gesture or pose was not recognized or Incorrect Detection if the wrong gesture or pose was recognized.

Also, some different poses were defined that is use in the Experimental Result:

- 1) **First pose**, when all the five fingers are closed into a fist
- 2) **Second Pose**, Only one finger is use.
- 3) **Third Pose**, Two fingers are use.
- 4) **Fourth Pose**, Three fingers are use.

5) **Fifth Pose**, Four fingers are use.

Table-1 GESTURE RECOGNITION TEST RESULTS EVALUATED 25 TIMES

Environment	Gesture			Pose		
	<i>true positive</i>	<i>false negative</i>	<i>incorrect detections</i>	<i>true positive</i>	<i>false negative</i>	<i>incorrect detections</i>
Indoor	96%	4%	0%	100%	0%	0%
Outdoor, Diffused Sunlight	84%	16%	0%	92%	8%	0%
Outdoor, Direct Sunlight	64%	36%	0%	88%	12%	0%

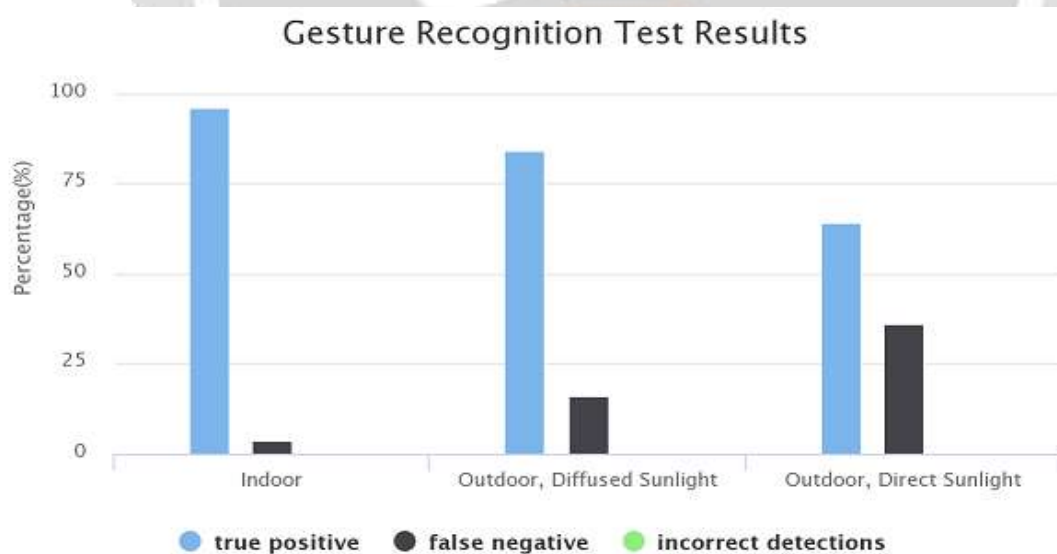
5.2 Speech Recognition

Speech recognition is implemented using the Java Speech API (JSAPI). The application used consisted of 6 different commands. Each command was uttered 5 times, for a total of 30 utterances. The recognized result is differentiating as *true positive* (correct detection), *false negative* (no detection) or *incorrect detection* (detection of the wrong word). Table-2 shows the percentage of words detected in the different environmental conditions, relative to the total number of words detected.

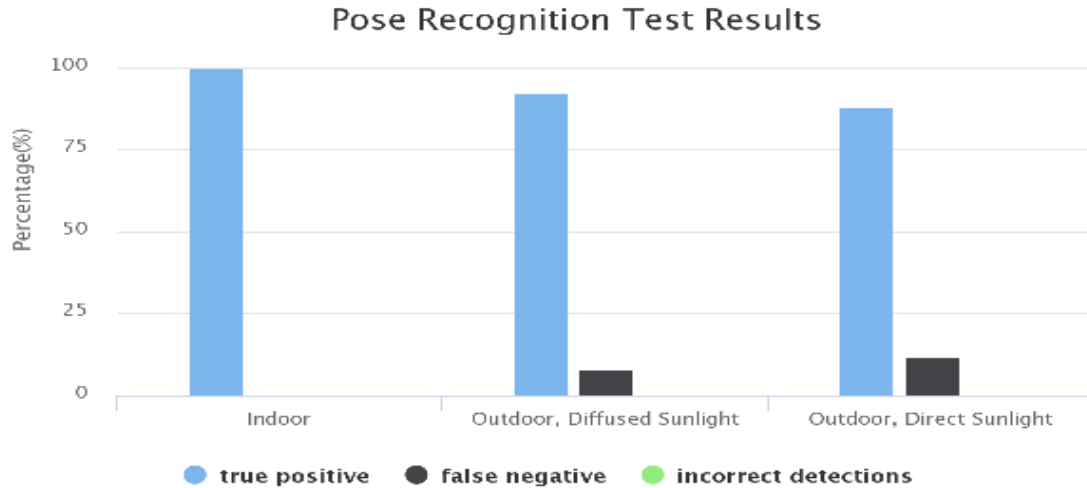
Table-2 SPEECH RECOGNITION TEST RESULTS

Environment	<i>true positive</i>	<i>false negative</i>	<i>incorrect detections</i>	<i>false positive</i>	Total Words
Quiet	100%	0%	0%	0%	30
Indistinct Noise	90%	0%	6.66%	3.34%	30
Chatter	66.67%	6.66%	3.34%	23.33%	30

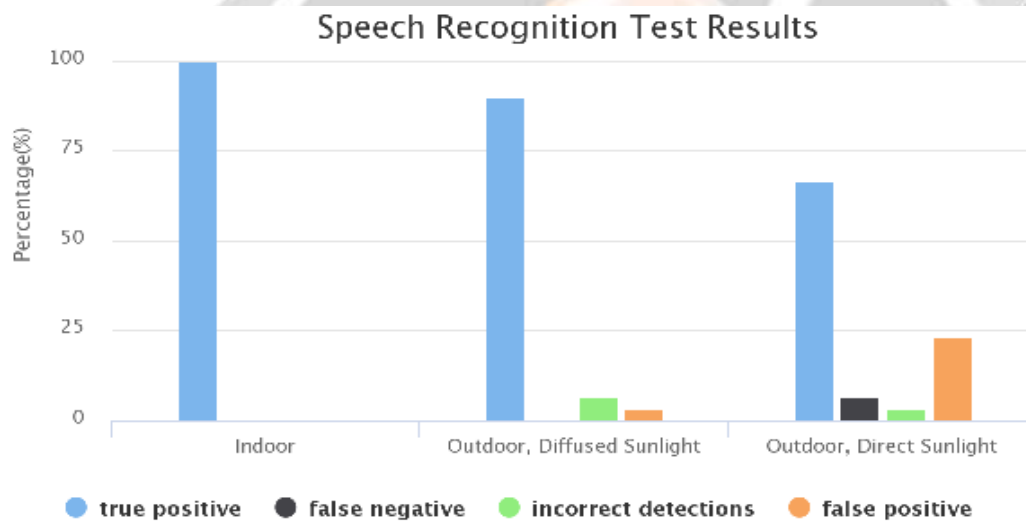
Graph-1 Gesture Recognition



Graph-2 Pose Recognition



Graph-3 Speech Recognition



6. CONCLUSIONS

The proposed system demonstrates that the adoption of Augmented Reality demonstrates the quality to end up distinctly a valuable framework to give interactive learning approach. Augmented reality tool provides an tempting, effective and engaging latest trending technique which overcome to and improve traditional chalk and talk teaching approach, which promoting education system one step near to the technological understanding of new generation’s students. The proposed system is implemented to be low in cost and extremely easy to handle. Anyone can easily understand the system easily, almost instantly and the control of the 3D object becomes quick and very fabulously. The intuitive GUI of the system guarantees that the students always concentrated on the specific work that they are doing and without getting any inference by other various parameters. In the future, according to a technical viewpoint, the proposed system will further improve by exploring the embedding of many 3D virtual models, different animations, and other visualization.

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