

AN INTERACTIVE AUGMENTED REALITY SYSTEM FOR ENHANCING SPATIAL VISUALIZATION SKILLS IN EDUCATION

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ABSTRACT

The enhancing and improving of the visualization abilities of students is important for their development of creativity skill in various fields in Education. Technological innovation throughout education can certainly impact on college students to understand any concept effectively and can persuade the concepts, create a trending strategy of understanding. Prior literature studies has recognized the issue that innovation in technologies will make an inactive learning procedure, if the strategy used does not encourage for critical decision taking, awareness and understanding of visualization skills. Due to the fact the benefits, augmented reality technology has already proven that it have good potential that create the education system more dynamic, successful, productive as well as meaningful. Moreover, the particular mixing of augmented reality with education allow students to learn in very trending and in an interactive way. We proposed Augmented Reality system that is very transparent and smooth, cost effective, as well as easy to understand. Augmented reality system identifies the gesture, and then supplies the information based on recognized gesture menus.

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

1. INTRODUCTION

In recent years, technology enable learning exploration has progressively focus on various trending technologies like augmented reality, mobile learning, E-learning, learning analytic intended for improving the particular fulfillment as well as activities on the users in improved learning environments. Most of these experiments take advantages of advancements in equipment or devices as well as software for portable gadgets and their trend among people and effective improvement of different stages of student's learning process. Lessons that are upheld by technology will result in additional impressive kinds of educating and learning. This is due to the utilization of techniques includes real world difficulties, sources of information recreations of ideas and discussion with experts in the field. Furthermore, embedding technology to the learning provides interactive learning mechanism as compare to conventional learning and teaching.

The coordination of innovation in technology tool into the education is turning out to be a piece of good teaching. Instructor not simply devotes a great deal of individual time for using the services on computer and also needs a higher level of creativity as well as self-assurance to utilize the modern trends that are inlaid in modern training system. The incorporation of technology additionally gives a way to upgrade scholar learning experiences and motivate student to participate in education activities. Consequently, current subjects have targeted to higher perceive the applications used through instruction according to the consideration of students, along with animation, computer generated graphics, simulation software.

Augmented reality is another innovation that has risen with benefits for application in education and learning. Augmented Reality is the new technology that can be understood as a advancement of Virtual Reality. In Virtual Reality whole world is synthetically created, where the users are totally engaged within a virtual world without seeing their neighborhood, augmented reality allows users to experience a new version of the world. The Augmented reality system enables integrating real world data with virtual objects as well as new information that put over the existing information. As a result, virtual data appear to exist together in the same space with real world

data. However, augmented reality is not limited to the feeling of sight, it can be connected to all senses like hearing and touch.

While lots of investigation has been carried out upon augmented reality, several studies happen to be carried out in the education discipline. The research studies of augmented reality in trend because of the effectiveness of augmented reality in various fields. Specifically, augmented reality provides a successful approach to signify some sort of style that really needs visualization. Specifically, augmented reality exploration has developed to a level that now it can be found in both Hand-held devices, Desktops and other non-mobile devices. Research on augmented reality has also proven its extreme practical use intended for improving the student inspiration in the learning procedure.

2. LITERATURE SURVEY

Conventional education system using chalk and the use of printed books are not sufficient to explain any concept, also resulting in inadequate understanding benefits in students. According to students point of view it is exhausting to simply hear the teacher talking before them [10]. The students thought that the embedding technologies could assist them in their learning practice [4][20]. In this way, lecturer have started to look for technologies that can possibly be embedded in training so as to offer students some assistance with learning effectively and to enhance their understanding in various subjects. Lot of studies has been carried out on augmented reality, from them only some researches have been carried out on augmented reality in the education system. The following are the problems that have occur in traditional learning and teaching process.

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

The investigation of Science is a complicated procedure that incorporates recognizing an issue, researching the issue, making theories, arranging the information gathering technique, testing the speculations, gathering the information and carried out the summary and results [6]. Engage in above mentioned procedures assists the student to understand every process clearly that helps to achieve best results. Because of the well-known observation in scholars is that Science stream is very difficult to understand; only some scholars are interested to taking their degree in the Science stream.

2.2 Students Problems In Visualizing Abstract Concepts

Visualization is term that is used to communicate with the data. This means which the data should come from something which can be abstract or not quickly visible. The most essential criteria are that the visualization must give an approach to learn something about the information. Any change of non-trivial information into a picture will leave out data; however there must be in any event some significant parts of the information that can be perused. Confusion among students must be considered because it meddles with students learning approach [5]. Thus, the appropriate teaching technique play important role in avoiding or reducing the students confusion. It is found that is possible to enhance students visualization skill simply by representing various conceptual visual pictures and permitting the scholars to operate and investigate the picture [11]. Illustrations of visualization technologies which have been analyzed inside preceding analysis include computer animation, virtual environment and 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 mechanisms can be utilized to solve the issue of misunderstanding and offer students to figure out the concept in efficient manners. Examination has shown that the advantageous utilization of technology as a method for visualizing unique ideas. Visualization mechanisms give a way to building noticeable wonders that are too little, huge, quick or moderate to see with the unaided eye [9]. Wu et al. (2001), produced a great animation to aid scholars to understanding the theoretical ideas in Chemistry [16]. As indicated by them, this sort of innovation permits scholars to visualize the collaborations between particles and to comprehend the relevant synthetic ideas. Stith (2004) creates animation using computer programs for teaching biology [22]. These days, from many technologies that show incredible advantages in educating particularly in imagining core ideas is Augmented Reality. Augmented Reality is another innovation that is liable to affect training [12]. AR is not quite the same as virtual reality on the grounds that AR mixes real environment with the computer generated artworks, while virtual reality engaged user with the computer generated graphics. Augmented Reality displays various 3D models and ideas in many ways and from distinct observing angles that offers the scholars to effectively understanding the subjects [15].

2.3 Hardware limitations

An Augmented reality provides the real environment data along machine-generated virtual 3D models that exist in the exact area as the real environment [18]. There are various categories of displays for viewing the embedded virtual and real data like head worn display, handheld display, and projective display [18]. In augmented reality system, movement can be track by using Kinect. It is a gesture sensing input devices by Microsoft. In previous work, Sensor based AR proposed for autism spectrum disorder children [23]. Kinect sensor is expensive hardware that needs to achieve augmented reality. There is also application Augmented Reality based racing game, where the player uses a tracked video see-through head-worn display, which is also expensive [15]. There is also application Magic mirror using Hand-held and wearable devices focuses on handheld (like tablet) and wearable devices like HMD (Head Mounted Display) [3]. Augmented reality can be useful for Study of human body by using HMD [19]. Digital sketching as well as study of Orthographic projection can easily accomplish by using Hand held device [23][22]. Immersive Augmented Reality system embedded with a book is a new smart way of learning method by engaging as many of the students activities as possible using hand held [14]. Hand held devices have many limitations like computing power, battery life; Storage etc. also wearable devices are expensive that everyone cannot afford it. Augmented reality can be used in archaeological sites by using client server architecture, that track GPS location to provide information related to archaeological sites through SIS (Site information server) [13]. This required information related to archaeological site must be present on SIS.

3. PROPOSED SYSTEM

The proposed system presents a desktop based augmented reality system that helps student to easily understand the concept access via hand gesture. The proposed system elaborates the augmented reality system which have low price and very simple to implement. Fig.1 shows the architecture of the proposed augmented reality system. We had proposed a system includes hand gesture detection and recognition and the data is access from the system as highlighted in Figure 1. Each user can easily use system, manipulate and control the system, view and access all information. At First user access Augmented reality Application. As well as user enter the screen area; the webcam will grab the video and start the process of Hand gesture detection and Recognition. User just need to use hand to access the system within the Screen area, and when user use hand gesture to choose the different menus and the system fetch the information and display to the user.

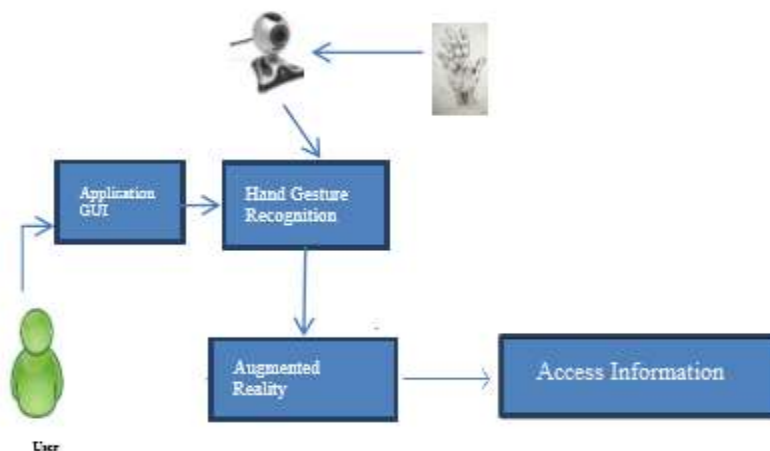


Figure -1: System Architecture

4. IMPLEMENTATION DETAILS

In this section we will describe the detail of how to detect hand gesture and recognition technique. First, the Images are grabbing from the video and are passed through different steps such as blurring an image, Grayscale Conversion, Grayscale to Binary conversion, and blob detection. Finally once the gesture is detected then the action associated with the detected gesture is then executed. Now we will discuss Hand gesture detection and recognition process in brief step by step.

4.1 Blur an Image

When Web camera extract an images of user hand Gestures, all images get blurred to reduce sharpening effects. Reducing sharpening effects is necessary to get more accurate result. We split all Red, Green and Blue value separately from the images and calculate the RGB average of surrounding pixels and assign this average value to it. Repeat this above process for every pixel and finally we get blurred images. The steps for blurring an image are as follows.

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 Grayscale Conversion

The transformation of color image to grayscale is important because it's very straightforward to work on grayscale images. To convert image into grayscale it needs to be go over the whole provided picture array. After that it checks each independent picture elements colour value. For calculating grayscale value it needs to be dividing the pixel value into respective Red, Green and Blue 8-bit values. This can be achieving through following formula:

Blue = pixel 0xff; For Blue conversion

Green=(pixel >> 8)0xff; For green conversion

Red = (pixel >>16) 0xff; For Red conversion

After getting all values, measure the grayscale values (8-bit) for given Red, Green and Blue pixels applying a following equation. Grayscale = (Red + Green + Blue) / 3;

Again form a 24-bit pixel value from 8bit grayscale value. Red = Green = Blue = Grayscale;

And finally Store the new result at exact position in resultant image.

Output =(r << 16)|(g << 8)|b;

4.3 Grayscale to Binary Conversion

The conversion of Grayscale to binary will convert each pixel to either black i.e. 0 or white i.e. 1. This step is needed to detect edge. The popular and easiest method is absolute threshold. If value of pixel intensity is larger than the predefined threshold intensity, the output will be white pixel (255); otherwise value will be black pixel (0). Once grayscale value gets calculated, it just needs to be check with threshold value. If the grayscale value is less than to the threshold value, pixel value gets set to the 0, other wise to black.

4.4 Blob detection

Once after calculating binary image which consist of only Black and White pixel, we get black blob and remaining white (Vice versa), we must have to find out these blobs. For finding blob, Starts scan from the first line of the image and detect the groups of one or more black (or white) pixels. Collections of one or more black or white pixels are called as lineblobs. Detect X, Y co-ordinates value of every those blob .Number the every of these groups. Repeat this process on next all lines. While collecting the lineblobs, find that whether the lineblobs that detected before current line or not and check if that whether these blobs overlap to each other or not. If so, then merge these lineblobs by using there X co-ordinate value and Y co-ordinates value to one blob it will act as a whole blob. Repeat this step for each line and the final output is a collection of blobs.

4.5 Gesture Recognition

The gesture detection and recognition module tracks the moving hand gesture features by using Image Subtraction method, identifies the movement, and find out which menu is choose. Then the recognized gesture is then send to the AR system being used which is determine which menu is selected and what action is associated to that menu, which then transfer the information to the student.

5. EXPERIMENTAL RESULT

To calculate the various aspects of usability, a set of questions divided into two different categories was presented to participants using a scale: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. To assign a quantitative measure value to these, positive integer values from 1 which is used for Strongly Disagree to 5 which is used for Strongly Agree were used, which is then used to calculate the mean and standard deviation to evaluate the interest of participant.

The questions in the Table-1 category were used to calculate the effectiveness and efficiency of the proposed AR system. The questions in the table-2 category were used to check the user satisfaction levels by means of the AR technology. Efficiency, Effectiveness and satisfaction levels are calculated using the mean and standard deviation of the response received from the participant's points.

Table-1 Questions And Results Of Effectiveness And Efficiency

	Question	Mean	Standard Deviation
A1	The system is presented in a clear and concise manner and the system is well structured.	4.5	0.60
A2	The Augmented Reality technology is easy use and intuitive	4.52	0.66
A3	The Augmented Reality application is responsive.	4.66	0.56
A4	The Augmented Reality application is stable and works well (doesn't freeze).	4.71	0.45

The majority of participants considered that the system is appropriate and well structured, and that the AR technology system worked good. None of the participants face any difficulties to interact with system or to operate the AR system. This means the most students reported that the proposed AR system is intuitive and simple to use.

User satisfaction questions and the result from respondent are shown in Table -2. At last question, participants were asked to give score to the overall quality of proposed AR technology.

The participants give a very positive reaction. The overall opinion was that AR technology is very important, engaging, and useful to improve visualization skills.

Table-2 Questions And Results Of User Satisfaction

	Question	Mean	Standard Deviation
B1	The use of three dimensional tools can increase attention and motivate students to study.	4.57	0.65
B2	Augmented Reality is a good tool to help students to improve visualization skills.	4.85	0.34
B3	The use of Augmented Reality technology can be beneficial for students in any technical courses.	4.71	0.54
B4	Overall Opinion of the material (Very Bad, Bad, Average, Good, Excellent)	4.76	0.42

The frequencies of the students responses are shown in Table-3.

Table-3 Frequencies Of Participants' Responses

	Neutral	Agree	Strongly Agree
A1	1 (0.05)	8 (0.4)	11 (0.55)
A2	2 (0.1)	6 (0.3)	12 (0.6)
A3	1 (0.05)	5 (0.25)	14 (0.7)
A4	0	6 (0.3)	14 (0.7)
B1	2 (0.1)	5 (0.25)	13 (0.65)
B2	0	3 (0.15)	17 (0.85)
B3	1 (0.05)	4 (0.2)	15 (0.75)
B4	0	5 (0.25)	15 (0.75)

6. CONCLUSIONS

The proposed system shows that the adoption of Augmented Reality shows the strength to become a useful system to provide interactive learning approach. Augmented reality tool gives an enticing, effective and engaging modern technique which is alter to and improve conventional chalk and talk method, which inspiring education system one walk near to the technological understanding of new generation's scholars. The proposed system is implemented to be low in price and very simple to handle. One can easily understand the system almost instantly and the manipulation of the 3D model becomes fast and very excellently. The interactive GUI of the system assures that the students always concentrated on the certain work they are doing and without getting any inference by different components. In the future, according to a technical viewpoint, the proposed system will further enhanced by exploring the embedding of many 3D virtual models, different animations, and other visualization.

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