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A Study of Augmented Reality in Education: Technologies & Applications

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Abstract: ***Even though the physical world is three-dimensional, for the most part, we like to utilize two-dimensional media in education. The mix of AR innovation with the educational substance makes new kinds of computerized applications and acts to upgrade the adequacy of what's the more, engaging quality of educating and learning for understudies, all things considered, situations. Augmented Reality is another medium, consolidating angles from universal registering, substantial processing, and social figuring. This medium offers one of a kind affordance, consolidating physical and virtual universes, with nonstop and understood client control of the perspective and intelligence. This paper gives a prologue to the innovation of augmented reality (A.R.) and its opportunities for education. Essential technologies, what's more, strategies are talked about inside the setting of education.***
Keywords: Augmented Reality, Technologies for Augmented Reality Systems, Augmented Reality in Education, Application of AR in several fields, Limitations of AR

I. INTRODUCTION

Inundating students to the genuine world and connecting them with that world, particularly, isn't convenient. Although the normal world is three-dimensional, we want to utilize two-dimensional media in education, which is extremely convenient, familiar, flexible, portable and inexpensive. However, it is static and doesn't offer a dynamic experience. Then again computer produced three-dimensional virtual environment can be utilized yet these scenes requires superior computer designs which is more costly than others.

Although lots of chances of virtual universes may introduce for instructing and learning, it is difficult to give enough degree of realism. When the users are fully immersed in such an environment, they become separated from the real-world environment. So, it offers you with virtual things by shaping the real-life you are experiencing. This study has a dual intention. Firstly, the definition of augmented reality (A.R.) is given about this an artificial and augmented environment. Attributes of the augmented reality system are provided, and technologies are categorized used in this system. Secondly, it's potential in education within this context.

II. AUGMENTED REALITY

These days another medium "Augmented Reality" offers us exceptional affordances, consolidating physical and virtual universes. This is a better approach for controlling how we interface with that world. Without supplanting this present reality you're encountering, this innovation expands virtual data on this present reality with ceaseless and verifiable client control of the perspective and intuitiveness. It gives a composite view to the client with a combination of the genuine scene saw by the client and computer-produced virtual scenes. This is an expansion of a genuine world by connecting with a conventional spot, space, thing or occasion in a way that is halfway unmediated. We can offer students' consistent cooperation between the genuine and virtual universes by consolidating augmented reality interfaces with the educational substance. This new methodology improves the viability and allure of instructing and learning.

The capacity to overlay computer-created virtual things onto this present reality changes how we interface, and training has turned out to be genuine that can be found progressively instead of a static encounter. Augmented Reality carries virtual data or articles to any roundabout perspective on the client's certifiable environment to upgrade the client's discernment and connection with this present reality. Augmented Reality attempts to increase virtual articles on genuine ones or scenes for expanding normal and natural client involvement with ongoing. It is an intelligent environment where a genuine environment is improved by virtual things constant. As indicated by Azuma (1997), Augmented Reality must have three qualities: consolidating the genuine and virtual universes, having a continuous association with the client, and is being enrolled in a 3D space. Augmented Reality permits the client to see this present reality and expect to enhance reality without totally submerging clients inside an engineered environment.

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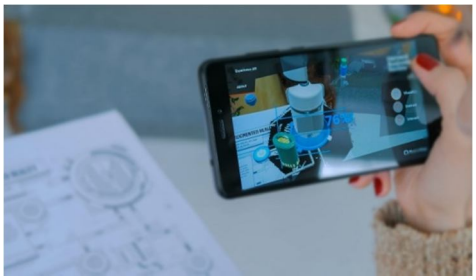

(ARPost,2017)
Fig 1: Augmented Reality in action

III. TECHNOLOGIES FOR AUGMENTED REALITY SYSTEMS

Augmented Reality and Virtual Reality utilize the same equipment technologies and offer loads of variables like computers produced virtual scenes, 3D items, and intelligence. The principle contrast between them is the place computer-generated reality plans to supplant this present reality while augmented reality deferentially supplements it. The principle gadgets for augmented reality are displays, computers, input and tracking devices. See-through and Monitor-based displays are two significant sorts of displays utilized in augmented reality. See-through displays place the two pictures of the real and virtual environment over the client's perspective on the world. Video see-through and Optical see-through systems are two kinds of see-through displays.

A. Head-Mounted Displays

The head-mounted device is a sort of display put on the head or as a feature of a helmet. It has a little display optic before one or each of the eyes.

Video see-through systems
(Trivisio,2011)

Optic see-through system
(Inition,2011)

Fig 2: Head-Mounted Displays

Video-see through systems are useful when you must encounter something remote or employing a picture improvement system. Optical see-through systems join PC generated scenes with "through the glasses" picture of this present reality. By and large, an inclined semi-transparent mirror is utilized for this. This mirror technology permits eyes.

B. Handheld Displays

Miniature computing devices that have a display that the client can grasp in their hands.

A handheld AR system displaying a three dimensional graph registered to the cones and table.
(CSM, 2011)

Smart AR, a visual technology that is capable to capture visual objects through its smartphone webcam and project it out as Moving subject over an actual 3D space. (Sony,2011)

Fig 3: Handheld Displays

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Another kind of device use video-see-through methods to overlay illustrations onto the genuine condition is Handheld Displays. These are little computing devices with a display that the client can grasp. The two principal focal points of handheld Augmented Reality is the versatile idea of handheld devices and the universal nature of camera phones. The hindrances are the physical limitations of the client holding the handheld device out before them consistently just as twisting impact of traditionally wide-calculated cell phone cameras when contrasted with this present reality as saw through the eye (Feiner, 2011). Smart-phones, PDAs and Tablets with cameras, advanced compasses, GPS units for their six-level of opportunity following sensors and fiducial marker frameworks utilized as a handheld display in augmented reality.

Spatial Displays are for the utilization of video-projectors, optical components, holograms, radio frequency labels, and other following technologies to display graphical data legitimately onto physical items without requiring the client to wear or convey the display (Bimber, Raskar, and Inami, 2007). Another path used to join physical articles and PC created data is Projection Displays. Right now, the dimensional model PC picture is anticipated to make a sensible-looking item.

Pinch gloves, wand with buttons and smartphones that flags its position and direction from camera pictures are fundamental info devices utilized in augmented reality. Pinch is a couple of stretch-texture gloves contains sensors in every fingertip which distinguish contact between the digits of your hand. It is an astounding new framework utilized signals for a wide scope of control and intelligent capacities and connecting with 3D reproduction.

C. Pinch Gloves

A pinching gesture using a pinch glove can be utilized to grab a virtual item and provides a dependable and low-cost method of recognizing physical gestures.

Pinch Gloves (Inition, 2011) Data Glove (CyberGloves, 2011)

Fig 4: Pinch Gloves

Digital cameras or potentially other optical sensors, accelerometers, GPS, spinners, strong state compasses, RFID and remote sensors are utilized as GPS beacons for situating and orientating of the client's head, hand(s) or a handheld information device. These innovations offer changing degrees of exactness and accuracy. PCs, for the most part, used to investigate the detected visual and other information. They blend and position increases and afterward reflect clients' show devices.

Sort of devices and association of system between the client and the virtual substance of augmented reality applications characterize systems interface. There are four fundamental methods for connection in augmented reality applications: tangible, community-oriented, half and half and developing multimodal interfaces. Utilizing these devices, we can create five distinctive augmented reality systems. These systems fixed indoor/outdoor systems, mobile indoor/outdoor systems, and mobile indoor and outdoor systems. Mobile ones are the systems that permit the client for development with the assistance of a remote system and Fixed ones are the systems in any place they are set up without having the adaptability to move.

IV. APPLICATION OF AR IN SEVERAL FIELDS

This segment presents a survey of the surviving exploration on the use of AR. This audit is sorted out as indicated by the utilization of AR advancements in a few fields of study in instruction, in particular, Medicine, Chemistry, Mathematics, Physics, Biology, Astronomy, and history. Research on the utilization of AR in these fields is checked on to assess the capability of AR in instruction. Table 1 abridges the meta-examination of the exploration directed on AR in various fields. The investigation incorporates instances of how the AR innovation was actualized in the individual fields.

TABLE I
A meta-analysis of research on the use of AR in different fields of education

Author/s	Field	Purpose of AR Use	AR Features Used
Chang et al. (2011)	Medical Education (surgical training)	To provide training and to plan and guide surgical procedures	AR-image guided therapy
Yeom (2011)	Medical education (anatomy)	To teach and test anatomy knowledge (of the abdomen in particular)	Interactive 3D anatomy pictures and haptic feedback
Hedegaard et al. (2007)	Medical education using the electrocardiogram (ECG/EKG) AR system (called the EKGAR system)	To extend medical students' spatial awareness concerning specific myocardial diseases by enabling users to navigate through and slice open 3D representations of a patient's heart	Vision-based 3D tracking technologies and interactive features
Singal et al. (2012)	Chemistry Education	To provide an efficient way to represent and interact with molecules, leading to a a better understanding of the spatial relation between molecules	AR technology for exhibiting the models
Cerqueira & Kirner (2012)	Mathematics	To teach geometry through the use of 3D geometrical concepts	Head-mounted display and personal interaction panel
Mathison & Gabriel (2012)	Biology (School in the Park project)	To teach participants that habitats are connected like links in a chain (food chain)	AR Experience
Coffin et al. (2008)	Physics	To overlay graphics on top of the physical props to visualize these forces (speed, velocity, acceleration, pressure, friction, energy changes) invisible to the human eye	Augmented video, videoconferencing, tracked physical props (e.g. toy cars)
Fleck & Simon (2013)	Astronomy	To show augmented views of the celestial bodies and support learning using spatial-visual guides and views from a terrestrial observer	AR learning environment
Martin et al. (2011)	History	To gather information and enhance the experience of visitors to cultural organizations (museums and archaeological sites)	Mobile AR educational games

As shown in Table 1, there are many fields in which AR technology has been adapted and utilized for teaching and learning. Most of the research studies showed positive feedback from the contestants regarding the AR system under review. In conclusion, more research on the integration of AR in teaching and learning should be conducted because of its clear benefits not only to students but also to teachers. With the aid of AR technology, the teaching of subjects that involve visualization will be enhanced, compared to the use of traditional methods alone.

V. FUTURE SCOPE OF AR

The future of Augmented Reality (or AR) in education is not just to keep students up to speed with the world's growing economy but it is vital in order to nurture the learning curriculum with modern technologies.

AR can make educational environments more productive, pleasurable and interactive (Lee, 2012). It not only has the power to engage a learner in a variety of interactive ways that have never been possible, but also can provide each student with rich content from computer-generated three-dimensional environments and models (Lee, 2012).

AR can also improve the extent and quality of information in educational settings by making the environment more productive. It has the potential to promote the efficiency of education by providing information at the right time and right place as well as offering rich content using 3D imagery (Lee, 2012). In the near future, AR will make our entire learning environment look technologically augmented (Bitter & Corral, 2014).

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A. Benefits

The future of AR in education will increase students:

1) Knowledge base
2) Participation
3) Interest in learning the content
4) Intellectual curiosity

VI. CONCLUSION

Augmented reality can change how we use computers. Augmented reality makes the inconceivable conceivable and its potential in education is simply starting. Augmented reality interfaces offer a consistent connection between the real and virtual universes. Utilizing augmented reality frameworks students connect with the 3D data, items, and occasions in a natural manner. The educational experience offered by Augmented Reality is distinctive for various reasons as Mark Billinghurst (2002) referenced:

A. The backing of consistent cooperation among real and virtual environments
B. The utilization of a substantial interface similitude for object control
C. The capacity to progress easily among reality and virtuality.

It is basic to facilitate a group of pro to conceivable augmented reality arrangements in educational issues. To accomplish realistic arrangements, we have to plan and organize multi-disciplinary research activities to upgrade substance and environments. Teachers must work with researchers to create augmented reality interfaces. Programming and equipment advancements play a significant and key job to create augmented reality applications. There are engineers, who can structure distinctive augmented reality environments. Anyway, for learning, in the educational innovation field, there is a major requirement for instructional originators, who can configuration learning exercises for augmented reality.

AR technology can be additionally evolved in education. This is because the favourable circumstances and gainful employments of AR highlights can draw in understudies in learning procedures and help improve their perception aptitudes. The highlights can likewise assist instructors in explaining great and make the understudies effectively comprehend what they are educated. The utilization of AR technology has likewise gotten positive input from members and understudies who have demonstrated their enthusiasm for utilizing AR in their learning forms. These great reactions are significant because they show the ability of understudies to effectively take part in their examinations through AR devices. AR technology is still new in education, subsequently, there are still a few constraints. Notwithstanding, the audit of the research demonstrates that the vast majority of the constraints are identified with specialized issues. Such confinements can be defeated after some time as research on the mix of AR in education is reproduced and improved. At the point when the capability of AR advancements is all the more completely investigated, the gainful elements of AR can start to be utilized broadly in all fields of education and the productivity of the instructing and learning procedure will be improved.

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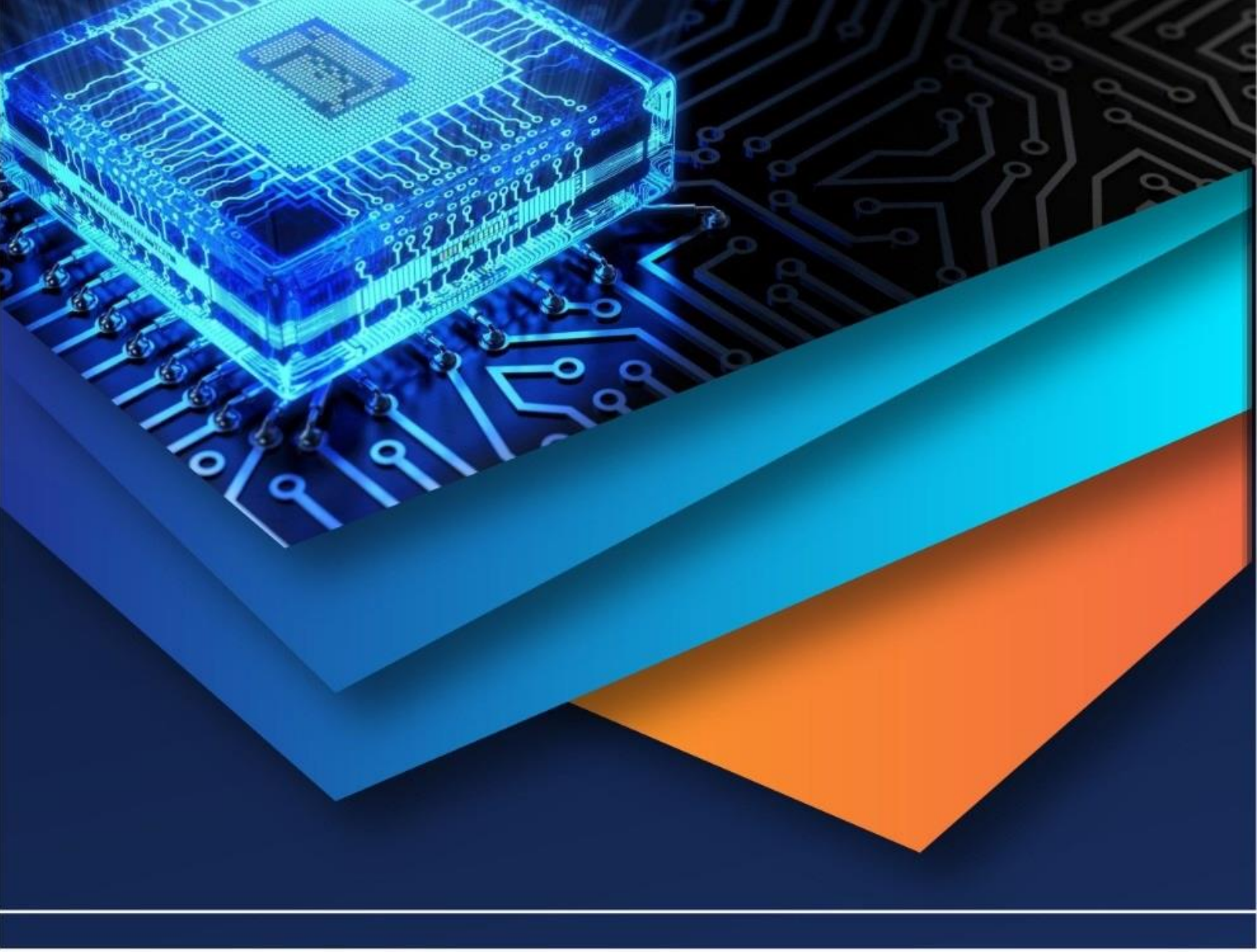

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