Augmented Reality (AR) - In the field of Education

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Abstract— In today's digital world, teacher face lack of attention in student as a major challenge in the learning process. With every student having own mobile device, Student demand interactive tools and teaching method. Upcoming Technology AR has significant potential to transform the way content is taught in classes. This paper covers the Introduction of AR followed with, Advantage and disadvantage of AR. This Paper gives a complete overview of what would happen if AR will use in Education and where it can be used. It further covers the benefits of AR and tells how it is used in education. It further introduces Stakeholder such as (Student, Teacher, Developer and Platform builder) it shows what problems they face currently and how AR would benefit them. Then it tells which are the different platforms available to build AR, followed by the problem which is faced by the developer and conclusion

Index Terms— **Augmented Reality, Education Field, gestural interfaces, AR Lab, DroidAR etc**

I. INTRODUCTION

1. Introduction to Augmented reality:

Augmented Reality is a real direct or indirect view of a physical real-world environment that has been enhanced/augmented by adding virtual computer-generated information to it through sound, video, graphics or GPS data. Augmented Reality is an enhanced image produced by putting a computer-generated display over a real-time view of one's surroundings.
Augmented reality displays superimpose information in your field of view and can take you into a new world where the real and virtual worlds are tightly coupled [1]. It is not limited only to Mobile, Desktop, Google glasses, it supports many other devices.
There is thin line of difference between Virtual Reality and Augmented Reality. Virtual reality shows the simulated version of real world objects, whereas augmented reality is conventionally in real time and include environmental elements.
Augmented reality is an old concept but with release of concept like google glass it's booming a lot. AR is best way to present the real-world information in an interactive way by placing the virtual information on top of real information.
Research on AR has also demonstrated its extreme usefulness for increasing the student motivation in the learning process [2].

However, AR concept is pretty old and has evolved over a period of time. Also like any other technology, it has its advantages and disadvantages. But if properly encouraged through governed coordinated between stakeholders, it does have effective application in various fields such as education.

2. History

AR concept was first introduced by scientist Mortin who is also referred as "Father of Augmented reality"[3]. He created first instrument – Sensorama simulator using AR concept in Aug 28,1962. The innovation gave a recreation of an affair by utilizing a visual picture, breeze and vibrations.
In 1997, Ronald T. Azuma's " [4] A Survey of Augmented Reality" inspected the fluctuated employments of increased reality, for example, therapeutic, producing, research, mechanical operation and diversion.
In 2011, AR contact lenses are made. Which allow the soldier to focus to on close-to-the-eye AR images on spectacles and also the distant real objects at the same time.
In January 2015 Microsoft introduce HoloLens which is an independent smart glasses unit.

3. Advantages:

 1. Increased Reality is set to change the portable client experience as did signal and touch (multi-modular collaboration) in cell telephones. This will rethink the versatile client experience for the cutting edge making mobile seek undetectable and decrease look exertion for clients.
 2. Enlarged Reality, as multi-modular association (gestural interfaces) has a long history of convenience examination, investigation and experimentation and in this manner, has a solid history as an interface method.
 3. Increased Reality enhances versatile ease of use by going about as the interface itself, requiring little association (this Interaction Design system is known as Direct Manipulation). Envision turning on your telephone or squeezing a catch where the space, individuals, objects around you are "detected" by your cell phone giving you area construct or connection delicate data with respect to the fly.

4. Disadvantages:

 1. Current execution levels (speed) on today's iPhone or near touch contraptions like the Google G1 will take two or three times to make Augmented Reality achievable as a general interface methodology accessible to the general populace.
2. Price – as the technology is still developing it may be quite expensive to use it in everyday life and it might be less accessible for small businesses.
 3. Threats to privacy and issues of the privacy control.

5. Augmented Reality in Education

Imagine living in the magical world where, the school hallways are lined with paintings that are alive and interactive. Imagine creating such an engaging Environment for your

students. Augmented reality makes it possible, it redefines the learning experience. AR enables educators and students to add layers of digital information above the physical world that can be viewed and accessed by an Android or iOS device.

Educators are aware that learning strengthens, not just through reading and listening, but also through creating and interaction. By making use of Augmented Reality lively learning experiences hitherto inconceivable, can now be created.

Augmented Reality is upcoming technology which has created all kind of buzz recently. Apart from gaming, several companies are exploring Augmented Reality applications in fields of education.

Lecture method is oldest way of teaching implemented in educational institutions. Student's involvement in this type of teaching method is to listen and take notes, thereby making it difficult to grab attention of students as they tend to zone out after max 15 mins of the lecture. Lack of attention leads to retention problems. Whereas, Augmented Reality is a completely new approach which is fun and engaging. Students have real applications of what they are learning, 90% of what we see and do is retained. Which is why Augmented Reality is beneficial in education, as it actively involves students in learning and increases retention. Several companies are currently working on innovations in this space; and the work that has been done so far is surely a good sign of things to come.

Researchers have been augmenting books for different subjects with all kind of educational material to enhance the learning process [5], [6]

Today, a number of professors and educators are applying augmented reality in different subjects like physics, astronomy, math's, biology etc. This technology is also being used in higher and K-12 education. Undoubtedly, AR technology is very much helpful in learning but this technology has been adopted by fewer number of schools. In one of the research, it was estimated that AR has not been approved in many educational establishments because the lack of awareness as well as the financial support from the government.

6. Benefits of using AR for education

A. EYE-CATCHING PRESENTATIONS

Using AR in to our lectures, it will help to stop the student from getting its mind diverted, this further helps the student to understand the topic well.

B. INTERACTIVE LESSONS

Student can be installed and access AR in the phone, they can also include other students for viewing the model. This helps in better understanding of the

concepts. It helps the student to earn the concept in more engaging and fun way which they have seen during class lecture.

C. PORTABLE AND LESS EXPENSIVE LEARNING MATERIALS

Models, physical models, and definite delineations and blurbs are all amazingly costly. As a rule, schools don't have enough cash to purchase all the supplementary learning materials they might want. Further, these learning materials get exhausted, lose their importance, and get lost after some time.
With Augment, you don't need to put resources into physical materials.

D. HIGHER RETENTION

With a single scan, students can get to enlarged models representing to anything from a part of the human life structures to a popular landmark to a particle. Additionally, understudies can get to sites specifically from the Augment's application. For instance, subsequent to checking a photograph connected with a 3D model of the Eiffel tower and survey the expanded Eiffel tower, students can go specifically to a page with more data on the well-known landmark. This experience makes a complete learning cycle. Your understudies will hold more learning for a more extended period.

E. FOSTER INTELLECTUAL CURIOSITY

Fusing Augment into your lessons will make your students amped up for learning. Conceived in the advanced time, your students will be ceaselessly fortified with expanded reality. They will be energized by new thoughts and ponder their general surroundings.
Acquainting increased reality with your students, will empower them to find obscure interests and move their future tries.
In spite of the fact that AR has made waves in different field, instruction field has rather been moderate to embrace this new innovation on the planet. With a specific end goal to enhance reception, it is critical to comprehend effect and point of view from various partner who will partake in AR ventures –Teachers, Students, Developers and Platform Providers.

7. Stakeholder Perspectives

There would be various categories of people who would be influence and benefited by using AR in the field of education but we would be focusing on Students, Teacher, Developer and Platform provider
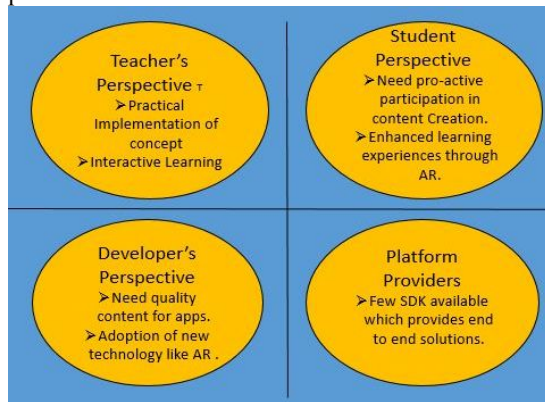
A. Students

Though student are very adaptive to new technology why AR is behind?

1. This is because of education system does not support new technology.
2. There is very less content available of augmented reality.
3. Student does not take part pro-actively in building AR Product

How can Students start using AR in classroom?

Using the different app which is available on different store, students can create their own AR experiences, and use them to enhance their learning experiences. For example, jazz up your school's art show, or math can be easily explained to student just by pointing the AR app to the math equation and then complete logic can be easily explained to the student with interactive participation. You could also provide the virtual tour of classroom by attaching a trigger image to google form and request the time from the school counselor.

And why exactly should Student start be doing this? It sounds like a lot of work.

AR app with quality content creates a mind-blowing experience for the student and endless learning possibility. The beauty of AR is depend upon the quality of content, student can decide their own complexity level which helps them to better understand the concept. Student can create their own apps, also student can download the created app to understand

the content creations. The most interesting thing about AR is student can create their own experiences within the minutes.

B. Teacher's perspective on augmented reality
It is little surprising that in present scenario around 71 percent of the student possess smartphone's. So teachers can use AR technology to engage their student which will be more effective. As augmented reality helps the teacher to add the digital content and also allow to add the geographical location of object. These digital information is presented on the paper and then by using AR technology information is delivered to the student. The information is collected from various 3d models, website, video etc.

1. **Allow students to dig deeper**

Augmented reality helps the kid to do more than just watching video. They become director of their own learning. They can do more of the analysis on the objects which helps them to better understand the concept and they can go in-depth of the object

2. Facilitate learning for students with different needs

AR apps helps the student to learn at their pace and revisit the material to multiple time as per their need. Families with autistic children can use augmented reality to show the tutorial about the different objects at home which will help children to better understand the objects and complete their task independently. The kids can watch the same tutorials multiple times and helps them to reinforce the learning.

3. Increase time on task and retention

Students spends lots of their time in plying game on pc, watching movies. AR helps the student to enhance their learning and can utilize their time effectively for learning the different real object. A student can take a printout of object like open up Anatomy 4D, and see the different part of human body on table. These helps student to utilize time and enhance their learning experiences.

4. Promote collaboration

Getting kids to work together is hard. In class, Student usually doesn't work together everyone have their own approach to solve the problem. AR helps the student to

come together and share their knowledge which helps them to solve the problem using different approaches.

C. Developers

Developer also play the vital role in creating AR app. And have their own unique challenges.

1. Availability of content for AR apps:

AR application is content delivery system that contain a lot of digital information in the form of text, audio, video .3D models and is finally superimposed on the real world. Creating quality and optimized content for AR app is most important as the experience of the app is depend upon the quality of the content.

AR content can be created using Audio, Video, Still photos. These types of content can be easily created using camera, computer and then multiple tools are available which can be easily use to convert it to AR content. Creating AR content also require powerful hardware and software and plenty of choices are available. Because of authoring solutions creation of AR content becomes easier.

2. Challenges faced by the developer

Today's smartphones have limited screen size and it is difficult to show to all the information within the limited space and also most of the AR apps require tracking of user location because of which privacy issues arises.

AR require high computation power in order to display the static content and if we want to display the dynamic content then tracking the device and user location is biggest challenge.

Augmented reality as an emerging technology has limited acceptance level in the field of education, this is because of people have not utilized this technology or haven't heard about this technology.

Majority of AR apps are developed by the programmer without the pedagogical point of view which leads to ignore the potential benefit of the technology in the education sectors.

There are multiple sdk developed by different platform holder

D. Platform holder Augmented reality supports different framework and SDK, but there are few SDK available which provide end to end solutions, choosing the appropriate framework is depend upon the type of the application and business requirement.

Different types of SDK and platform supported [7].

Product	Company	License	Supported Platforms
ARPA SDKs	Arpa Solutions	Commercial*	Android, iOS (ARPA SDKs), Google Glass (ARPA GLASS SDK), Android, iOS, Windows PC (ARPA Unity Plugin)
ARLab SDKs	ARLab	Commercial	Android, iOS
DroidAR	–	Free and Commercial	Android
Metaio SDK	Metaio	Free and Commercial	Android, iOS, Windows PC, Google Glass, Epson Moverio BT-200, Vuzix M-100, Unity
Vuforia SDK	Qualcomm	Free and Commercial	Android, iOS, Unity
Wikitude SDK	Wikitude GmbH	Commercial*	Android, iOS, Google Glass, Epson Moverio, Vuzix M-100, Optinvent ORA1, PhoneGap, Titanium, Xamarin

Augmented reality SDK consist of multiple component within AR application: AR tracking, AR recognition, AR content rendering. The recognition component is brain of AR apps. Tracking component is known as eye of AR experience. Content rendering is hypothetical virtual object and scene of real word information, AR SDK provides an array of tools to the developer for recognition, rendering and tracking of an AR application.

ARPA SDKs

ARPA SDK offers features such as image detection, tracking and user interaction through 3-D objects for building the iOS and android AR apps.

ARPA SDK also provides the geolocation based AR functionality: which allow you to define your own POIs, when detected allow user to select them and provide more information about them and also allow to perform action on them.

AR Lab SDKs

This SDK allow the adding and removing of the POIs independently from pictures in real time, AR Lab allow you to create your own local matching pool with lots of images and can be used to match the images without the connection of the internet. Also provides the supports for the QR code and barcode recognition.

2. DroidAR:

An open source platform that adds geo-based location functionality to android apps. Gesture detection, animated 3D object as well as provides the support for the static content through which user can interact. DroidAR also provides the support for marker detection.

3. Different apps available:

Augmented Reality apps used for education [8]

AR Flashcards – Alphabet (Free): App to help students learn the alphabet

AR Flashcards – Shapes & Colors (Free): App to help students learn colors and shapes.

Chromville (Free): Educational app using the eight multiple intelligences. Students color their characters and then they come to life with the Visual Arts app.

Barcy (Free): From the creators of Chromville comes Barcy, an AR app that explores water life and the water use.

Elements 4D (Free): AR Chemistry app that brings the elements to life. It includes lesson plans for all levels: elementary, intermediate, and high school.

Anatomy 4D (Free): Bring the human body to life with this AR app. Have students learn about the different systems and human anatomy with this app.

Arloon Geometry ($2.99): An amazing way to learn geometry! This app features 3D models with AR for most geometric shapes. By directly interacting with the figures, your students will improve their spatial visualization.

Arloon Mental Math ($2.99): Fun way for students to practice addition and subtraction without using paper

CONCLUSION

The currently available technique of Education System uses textual and graphical image. But as the AR is growing in the field of Education, Soon it will completely change the ecosystem of Education. It helps every student to impart knowledge in a better way. Teacher would be finding it easy and interesting to teach. The Existing difficulties is lack of ecosystem, where all the Scholars from different field would come together and work as a team As the Augmented Reality is the combination of real world and virtual world object. There has to be some form partnership between academics and technology, there is need for the government to step-in and set some policy which will benefits AR. Government should take initiative to clearly define policies that will differentiate the virtual and real IP. We need environment where the developer's, Designer's and Teacher's would come together to build some really great product. As looking at the current Condition the augment reality is the THING

REFERENCES

[1] https://www.3pillarglobal.com

[2] Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk. (2014). Augmented Reality Trends in Education: A Systematic Review of Research and Applications. Educational Technology & Society, 17 (4), 133–149.

[3] http://mashable.com/2012/09/24/augmented-reality.

[4] Teleoperators and Virtual Environments 6, 4 (August 1997), 355-385.

[5] T. Jeong, D.-W. Lee, G.-S. Heo, and C.-H. Lee, "Live Book: A mixed reality book using a projection system," in Consumer Electronics (ICCE), 2012 IEEE International Conference on, pp. 680–681, 2012

[6] Drivers and bottlenecks in adoption of AR Héctor Martínez[1], Danai Skournetou[2], Jenni Hyppölä[2], Seppo Laukkanen[1] and Antti Heikkilä[2][1]SenseTrix. PL 20, 00101,2014.

[7] https://www.developereconomics.com/top-5-tools-for-augmented-reality-in-mobile-apps/

[8] http://www.emergingedtech.com/2015/11/augmented-reality-apps-teaching-learning-classroom/

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