AUGMENTED REALITY FOR REAL-WORLD ENVIRONMENT PROBLEMS

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Abstract— Augmented reality (AR) refers to computer displays that add virtual information to a user's sensory perceptions. Most AR research focuses on see-through devices, usually worn on the head that overlay graphics and text on the user's view of his or her surroundings. In general, it superimposes graphics over a real world environment in real time. Getting the right information at the right time and the right place is key in all these applications. What makes augmented reality different is how the information is presented: not on a separate display but integrated with the user's perceptions. This kind of interface minimizes the extra mental effort that a user has to spend when switching his or her attention back and forth between real-world tasks and a computer screen. In augmented reality, the user's view of the world and the computer interface literally become one. Between the extremes of real life and Virtual Reality lies the spectrum of Mixed Reality, in which views of the real world are combined in some proportion with views of a virtual environment. Combining direct view, stereoscopic video, and stereoscopic graphics, Augmented Reality describes that class of displays that consists primarily of a real environment, with graphic enhancements or augmentations. In Augmented Virtuality, real objects are added to a virtual environment. In Augmented reality, virtual objects are added to real world.

Key words: Augmented Reality, integrated with user’s perception, Mixed reality, Superimposition, Virtual environment, Virtual reality.

1. INTRODUCTION

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real-world are "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities,
including visual, auditory, haptic, somatosensory,
and olfactory. The overlaid sensory information can be constructive (i.e. additive to the natural environment) or destructive (i.e. masking of the natural environment) and is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, augmented reality alters one's ongoing perception of a real world environment, whereas virtual reality completely replaces the user's real world environment with a simulated one. Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality.

The primary value of augmented reality is that it brings components of the digital world into a person's perception of the real world, and does so not as a simple display of data, but through the integration of immersive sensations that are perceived as natural parts of an environment. Now other industries are also getting interested about AR's possibilities for example in knowledge sharing, educating, managing the information flood and organizing distant meetings. Augmented reality is also transforming the world of education, where content may be accessed by scanning or viewing an image with a mobile device or by bringing immersive, markerless AR experiences to the classroom. Another example is an AR helmet for construction workers which display information about the construction sites.

Augmented Reality (AR) is used to enhance natural environments or situations and offer perceptually enriched experiences. With the help of advanced AR technologies (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive. Information about the environment and its objects is overlaid on the real world. This information can be virtual or real, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space. Augmented reality also has a lot of potential in the gathering and sharing of tacit knowledge. Augmentation techniques are typically performed in real time and in semantic context with environmental elements. Immersive perceptual information is sometimes combined with supplemental information like scores over a live video feed of a sporting event. This combines the benefits of both augmented reality technology and heads up display technology (HUD).

2. TECHONOLOGY

2.1 Hardware

Hardware components for augmented reality are: processor, display, sensors and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements which often include a camera and MEMS sensors such as accelerometer, GPS, and solid state compass, making them suitable AR platforms.

2.1.1 Display

Various technologies are used in augmented reality rendering, including optical projection systems, monitors, handheld devices, and display systems worn on the human body.A head-mounted display (HMD) is a display device worn on the forehead, such as a harness or helmet. HMDs place images of both the physical world and virtual objects over the user's field of view. Modern HMDs often employ sensors for six degrees of freedom monitoring that allow the system to align virtual information to the physical world and adjust accordingly with the user's head movements. HMDs can provide VR users with mobile and collaborative experiences. Specific providers, such as uSens and Gestigon, include gesture controls for full virtual immersion.

2.1.2 Eyeglasses

AR displays can be rendered on devices resembling eyeglasses. Versions include eyewear that employs cameras to intercept the real world view and re-display its augmented view through the eyepieces and devices in which the AR imagery is projected through or reflected off the surfaces of the eyewear's lens pieces.

2.1.3 HUD

A head-up display (HUD) is a transparent display that presents data without requiring users to look away from their usual viewpoints. A precursor technology to augmented reality, heads-up displays were first developed for pilots in the 1950s, projecting simple flight data into their line of sight, thereby enabling them to keep their "heads up" and not look down at the instruments. Near-eye augmented reality devices can be used as portable head-up displays as they can show data, information, and images while the user views the real world. Many definitions of augmented reality only define it as overlaying the information. This is basically what a head-up display does; however, practically speaking, augmented reality is expected to include registration and tracking between the superimposed perceptions, sensations, information, data, and images and some portion of the real world.

CrowdOptic, an existing app for smartphones, applies algorithms and triangulation techniques to photo metadata including GPS position, compass heading, and a time stamp to arrive at a relative significance value for photo objects. CrowdOptic technology can be used by Google Glass users to learn where to look at a given point in time.

A number of smart glasses have been launched for augmented reality. Due to encumbered control, smart glasses are primarily designed for micro-interaction like reading a text message but still far from more well-rounded applications of augmented reality. First impressions were generally that such a device might be more useful than a small off to the side display like Google Glass offered with packaged productivity oriented applications.

2.1.4 Contact lenses

Contact lenses that display AR imaging are in development. These bionic contact lenses might contain the elements for display embedded into the lens including integrated circuitry, LEDs and an antenna for wireless communication. Another version of contact lenses, in development for the U.S. military, is designed to function with AR spectacles, allowing soldiers to focus on close-to-the-eye AR images on the spectacles and distant real world objects at the same time.

Many scientists have been working on contact lenses capable of many different technological feats. The company Samsung has been working on a contact lens as well. This lens, when finished, is meant to have a built-in camera on the lens itself. The design is intended to have you blink to control its interface for recording purposes. It is also intended to be linked with your smartphone to review footage, and control it separately. When successful, the lens would feature a camera, or sensor inside of it. It is said that it could be anything from a light sensor, to a temperature sensor.

In Augmented Reality, the distinction is made between two distinct modes of tracking, known as marker and markerless. Marker are visual cues which trigger the display of the virtual information. A piece of paper with some distinct geometries can be used. The camera recognizes the geometries by identifying specific points in the drawing. Markerless also called instant tracking does not use marker. Instead the user positions the object in the camera view preferably in a horizontal plane. It uses sensors in mobile devices to accurately detect the real-world environment, such as the locations of walls and points of intersection.

2.1.5 EyeTap

The EyeTap (also known as Generation-2 Glass) captures rays of light that would otherwise pass through the centre of the lens of the eye of the wearer, and substitutes synthetic computer-controlled light for each ray of real light.

The Generation-4 Glass (Laser EyeTap) is similar to the VRD (i.e. it uses a computer-controlled laser light source) except that it also has infinite depth of focus and causes the eye itself to, in effect, function as both a camera and a display by way of exact alignment with the eye and resynthesize (in laser light) of rays of light entering the eye.

2.1.6 Handheld

A Handheld display employs a small display that fits in a user's hand. All handheld AR solutions to date opt for video see-through. Initially handheld AR employed fiducial markers, and later GPS units and MEMS sensors such as digital compasses and six degrees of freedom accelerometer–gyroscope. Today SLAM markerless trackers such as PTAM are starting to come into use. Handheld display AR promises to be the first commercial success for AR technologies. The two main advantages of handheld AR are the portable nature of handheld devices and the ubiquitous nature of camera phones. The disadvantages are the physical constraints of the user having to hold the handheld device out in front of them at all times, as well as the distorting effect of classically wide-angled mobile phone cameras when compared to the real world as viewed through the eye. The issues arising from the user having to hold the handheld device (manipulability) and perceiving the visualisation correctly (comprehensibility) have been summarised into the HARUS usability questionnaire.

Games such as Pokémon Go and Ingress utilize an Image Linked Map (ILM) interface, where approved geotagged locations appear on a stylized map for the user to interact with.

2.1.7 Spatial

Spatial augmented reality (SAR) augments real-world objects and scenes without the use of special displays such as monitors, head-mounted displays or hand-held devices. SAR makes use of digital projectors to display graphical information onto physical objects. The key difference in SAR is that the display is separated from the users of the system. Because the displays are not associated with each user, SAR scales naturally up to groups of users, thus allowing for collocated collaboration between users.

Examples include shader lamps, mobile projectors, virtual tables, and smart projectors. Shader lamps mimic and augment reality by projecting imagery onto neutral objects, providing the opportunity to enhance the object's appearance with materials of a simple unit - a projector, camera, and sensor.

Other applications include table and wall projections. One innovation, the Extended Virtual Table, separates the virtual from the real by including beam-splitter mirrors attached to the ceiling at an adjustable angle. Virtual showcases, which employ beam-splitter mirrors together with multiple graphics displays, provide an interactive means of simultaneously engaging with the virtual and the real. Many more implementations and configurations make spatial augmented reality display an increasingly attractive interactive alternative.

An SAR system can display on any number of surfaces of an indoor setting at once. SAR supports both a graphical visualization and passive haptic sensation for the end users. Users are able to touch physical objects in a process that provides passive haptic sensation.

2.1.8 Tracking

Modern mobile augmented-reality systems use one or more of the following motion tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, RFID. These technologies offer varying levels of accuracy and precision. The most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique.

2.1.9 Networking

Mobile augmented reality applications are gaining popularity due to the wide adoption of mobile and especially wearable devices. However, they often rely on computationally intensive computer vision algorithms with extreme latency requirements. To compensate for the lack of computing power, offloading data processing to a distant machine is often desired. Computation offloading introduces new constraints in applications, especially in terms of latency and bandwidth. Although there is a plethora of real-time multimedia transport protocols, there is a need for support from network infrastructure as well.

2.1.10 Input devices

Techniques include speech recognition systems that translate a user's spoken words into computer instructions, and gesture recognition systems that interpret a user's body movements by visual detection or from sensors embedded in a peripheral device such as a wand, stylus, pointer, glove or other body wear. Products which are trying to serve as a controller of AR headsets include Wave by Seebright Inc. and Nimble by Intugine Technologies.

2.1.11 Computer

The computer analyses the sensed visual and other data to synthesize and position augmentations. Computers are responsible for the graphics that go with augmented reality. Augmented reality uses a computer-generated image and it has a striking effect on the way the real world is shown. With the improvement of technology and computers, augmented reality is going to have a drastic change on our perspective of the real world. According to Time Magazine, in about 15–20 years it is predicted that Augmented reality and virtual reality are going to become the primary use for computer interactions. Computers are improving at a very fast rate, which means that we are figuring out new ways to improve other technology. The more that computers progress, augmented reality will become more flexible and more common in our society. Computers are the core of augmented reality.

The Computer receives data from the sensors which determine the relative position of objects surface. This translates to an input to the computer which then outputs to the users by adding something that would otherwise not be there. The computer comprises memory and a processor. The computer takes the scanned environment then generates images or a video and puts it on the receiver for the observer to see. The fixed marks on an objects surface are stored in the memory of a computer. The computer also withdrawals from its memory to present images realistically to the onlooker. The best example of this is of the Pepsi Max AR Bus Shelter.

2.2 Software and algorithms

A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent from the camera, from camera images. That process is called image registration, and uses different methods of computer vision, mostly related to video tracking. Many computer vision methods of augmented reality are inherited from visual odometry.

Usually those methods consist of two parts. The first stage is to detect interest points, fiducial markers or optical flow in the camera images. This step can use feature detection methods like corner detection, blob detection, edge detection or thresholding, and other image processing methods. The second stage restores a real world coordinate system from the data obtained in the first stage. Some methods assume objects with known geometry (or fiducial markers) are present in the scene. In some of those cases the scene 3D structure should be precalculated beforehand. If part of the scene is unknown simultaneous localization and mapping (SLAM) can map relative positions. If no information about scene geometry is available, structure from motion methods like bundle adjustment are used. Mathematical methods used in the second stage include projective (epipolar) geometry, geometric algebra, rotation representation with exponential map, kalman and particle filters, nonlinear optimization, robust statistics.

Augmented Reality Markup Language (ARML) is a data standard developed within the Open Geospatial Consortium (OGC), which consists of XML grammar to describe the location and appearance of virtual objects in the scene, as well as ECMAScript bindings to allow dynamic access to properties of virtual objects.

To enable rapid development of augmented reality applications, some software development kits (SDKs) have emerged. A few SDKs such as CloudRidAR leverage cloud computing for performance improvement. AR SDKs are offered by Vuforia, ARToolKit, Catchoom CraftAR Mobinett AR, Wikitude, Blippar Layar, Meta. and ARLab.

2.3 Development

The implementation of Augmented Reality in consumer products requires considering the design of the applications and the related constraints of the technology platform. Since AR system rely heavily on the immersion of the user and the interaction between the user and the system, design can facilitate the adoption of virtuality. For most Augmented Reality systems, a similar design guideline can be followed. The following lists some considerations for designing Augmented Reality applications:

2.3.1 Environmental/context design

Context Design focuses on the end-user's physical surrounding, spatial space, and accessibility that may play a role when using the AR system. Designers should be aware of the possible physical scenarios the end-user may be in such as:

- Public, in which the users use their whole body to interact with the software
- Personal, in which the user uses a smartphone in a public space
- Intimate, in which the user is sitting with a desktop and is not really in movement
- Private, in which the user has on a wearable.

By evaluating each physical scenario, potential safety hazard can be avoided and changes can be made to greater improve the end-user's immersion. UX designers will have to define user journeys for the relevant physical scenarios and define how the interface will react to each.

Especially in AR systems, it is vital to also consider the spatial space and the surrounding elements that change the effectiveness of the AR technology. Environmental elements such as lighting, and sound can prevent the sensor of AR devices from detecting necessary data and ruin the immersion of the end-user.

Another aspect of context design involves the design of the system's functionality and its ability to accommodate for user preferences. While accessibility tools are common in basic application design, some consideration should be made when designing time-limited prompts (to prevent unintentional operations), audio cues and overall engagement time. It is important to note that in some situations, the application's functionality may hinder the user's ability. For example, applications that is used for driving should reduce the amount of user interaction and user audio cues instead.

2.3.2 Interaction design

Interaction design in augmented reality technology centres on the user's engagement with the end product to improve the overall user experience and enjoyment. The purpose of Interaction Design is to avoid alienating or confusing the user by organising the information presented. Since user interaction relies on the user's input, designers must make system controls easier to understand and accessible. A common technique to improve usability for augmented reality applications is by discovering the frequently accessed areas in the device's touch display and design the application to match those areas of control. It is also important to structure the user journey maps and the flow of information presented which reduce the system's overall cognitive load and greatly improves the learning curve of the application.

In interaction design, it is important for developers to utilize augmented reality technology that complement the system's function or purpose. For instance, the utilization of exciting AR filters and the design of the unique sharing platform in Snapchat enables users to better the user's social interactions. In other applications that require users to understand the focus and intent, designers can employ a reticle or raycast from the device. Moreover, augmented reality developers may find it appropriate to have digital elements scale or react to the direction of the camera and the context of objects that can are detected.

The most exciting factor of augmented reality technology is the ability to utilize the introduction of 3D space. This means that a user can potentially access multiple copies of 2D interfaces within a single AR application. AR applications are collaborative, a user can also connect to another's device and view or manipulate virtual objects in the other person's context.

2.3.3 Visual design

In general, visual design is the appearance of the developing application that engages the user. To improve the graphic interface elements and user interaction, developers may use visual cues to inform user what elements of UI are designed to interact with and how to interact with them. Since navigating in AR application may appear difficult and seem frustrating, visual cues design can make interactions seem more natural.

In some augmented reality applications that uses a 2D device as an interactive surface, the 2D control environment does not translate well in 3D space making users hesitant to explore their surroundings. To solve this issue, designers should apply visual cues to assist and encourage users to explore their surroundings.

It is important to note the two main objects in AR when developing VR applications: 3D volumetric objects that are manipulatable and realistically interact with light and shadow; and animated media imagery such as images and videos which are mostly traditional 2D media rendered in a new context for augmented reality. When virtual objects are projected onto a real environment, it is challenging for augmented reality application designers to ensure a perfectly seamless integration relative to the real world environment, especially with 2D objects. As such, designers can add weight to objects, use depths maps, and choose different material properties that highlight the object's presence in the real world. Another visual design that can be applied is using different lighting techniques or casting shadows to improve overall depth judgment. For instance, a common lighting technique is simply placing a light source overhead at the 12 o'clock position, to create shadows upon virtual objects.

3. TYPES OF AR

3.1 Marker Based Augmented Reality

Marker-based augmented reality (also called Image Recognition) uses a camera and some type of visual marker, such as a QR/2D code, to produce a result only when the marker is sensed by a reader. Marker based applications use a camera on the device to distinguish a marker from any other real world object. Distinct, but simple patterns (such as a QR code) are used as the markers, because they can be easily recognized and do not require a lot of processing power to read. The position and orientation is also calculated, in which some type of content and/or information is then overlaid the marker.

Figure 1:Marker based AR

3.2 Markerless Based Augmented Reality

As one of the most widely implemented applications of augmented reality, markerless (also called location-based, position-based, or GPS) augmented reality, uses a GPS, digital compass, velocity meter, or accelerometer which is embedded in the device to provide data based on your location. A strong force behind markerless augmented reality technology is the wide availability of smartphones and location detection features they provide. It is most commonly used for mapping directions, finding nearby businesses, and other location-centric mobile applications.

Figure 2:Markerless based AR

3.3 Projection Based Augmented Reality

Projection based augmented reality works by projecting artificial light onto real world surfaces. Projection based augmented reality applications allow for human interaction by sending light onto a real world surface and then sensing the human interaction (i.e. touch) of that projected light. Detecting the user's interaction is done by differentiating between an expected (or known) projection and the altered projection (caused by the user's interaction). Another interesting application of projection based augmented reality utilizes laser plasma technology to project a hologram into mid-air.

Figure 3:Projection based AR

3.4 Superimposition Based Augmented Reality

Superimposition based augmented reality either partially or fully replaces the original view of an object with a newly augmented view of that same object. In superimposition based augmented reality, object recognition plays a vital role because the application cannot replace the original view with an augmented one if it cannot determine what the object is. A strong consumer-facing example of superimposition based augmented reality could be found in the Ikea augmented reality furniture catalogue. By downloading an app and scanning selected pages in their printed or digital catalogue, users can place virtual ikea furniture in their own home with the help of augmented reality.

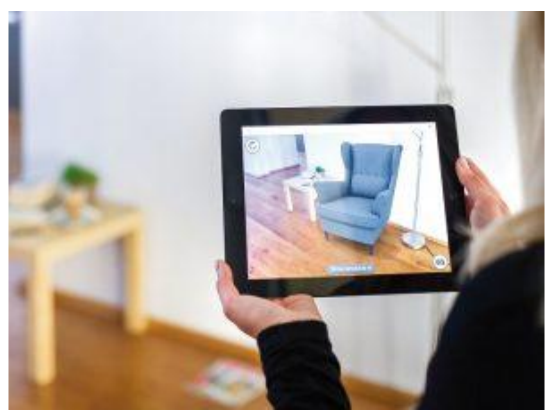

Figure 4:Superimposition based AR

4. APPLICATION

Augmented reality has been explored for many applications, from gaming and entertainment to medicine, education and business. Example application areas described below include Archaeology, Architecture, Commerce and Education. Some of the earliest cited examples include Augmented Reality used to support surgery by providing virtual overlays to guide medical practitioners to AR content for astronomy and welding.

4.1 Literature

An example of an AR code containing a QR code.The first description of AR as it is known today was in Virtual Light, the 1994 novel by William Gibson. In 2011, AR was blended with poetry by ni ka from Sekai Camera in Tokyo, Japan. The prose of these AR poems come from Paul Celan, "Die Niemandsrose", expressing the aftermath of the 2011 Tōhoku earthquake and tsunami.

4.2 Archaeology

AR has been used to aid archaeological research. By augmenting archaeological features onto the modern landscape, AR allows archaeologists to formulate possible site configurations from extant structures. Computer generated models of ruins, buildings, landscapes or even ancient people have been recycled into early archaeological AR applications. For example, implementing a system like, "VITA (Visual Interaction Tool for Archaeology)" will allow users to imagine and investigate instant excavation results without leaving their home. Each user can collaborate by mutually "navigating, searching, and viewing data." Hrvoje Benko, a researcher for the computer science department at Colombia University, points out that these particular systems and others like it can provide "3D panoramic images and 3D models of the site itself at different excavation stages" all the while organizing much of the data in a collaborative way that is easy to use. Collaborative AR systems supply multimodal interactions that combine the real world with virtual images of both environments. AR has been recently adopted also in the underwater archaeology field to efficiently support and facilitate the manipulation of archaeological artefacts.

4.3 Architecture

AR can aid in visualizing building projects. Computer-generated images of a structure can be superimposed into a real life local view of a property before the physical building is constructed there; this was demonstrated publicly by Trimble Navigation in 2004. AR can also be employed within an architect's workspace, rendering animated 3D visualizations of their 2D drawings. Architecture sight-seeing can be enhanced with AR applications, allowing users viewing a building's exterior to virtually see through its walls, viewing its interior objects and layout.

With the continual improvements to GPS accuracy, businesses are able to use augmented reality to visualize georeferenced models of construction sites, underground structures, cables and pipes using mobile devices. Augmented reality is applied to present new projects, to solve on-site construction challenges, and to enhance promotional materials. Examples include the Daqri Smart Helmet, an Android-powered hard hat used to create augmented reality for the industrial worker, including visual instructions, real-time alerts, and 3D mapping.

Following the Christchurch earthquake, the University of Canterbury released CityViewAR, which enabled city planners and engineers to visualize buildings that had been destroyed. Not only did this provide planners with tools to reference the previous cityscape, but it also served as a reminder to the magnitude of the devastation caused, as entire buildings had been demolished.

4.4 Visual art

AR applied in the visual arts allows objects or places to trigger artistic multidimensional experiences and interpretations of reality.

Augmented Reality can aid in the progression of visual art in museums by allowing museum visitors to view artwork in galleries in a multidimensional way through their phone screens. The Museum of Modern Art in New York has created an exhibit in their art museum showcasing Augmented Reality features that viewers can see using an app on their smartphone. The museum has developed their personal app, called MoMAR Gallery, that museum guests can download and use in the Augmented Reality specialized gallery in order to view the museum's paintings in a different way. This allows individuals to see hidden aspects and information about the paintings, and to be able to have an interactive technological experience with the artwork as well.

AR technology aided the development of eye tracking technology to translate a disabled person's eye movements into drawings on a screen.

4.5 Commerce

The AR-Icon can be used as a marker on print as well as on online media. It signals the viewer that digital content is behind it. The content can be viewed with a smartphone or tablet.

AR is used to integrate print and video marketing. Printed marketing material can be designed with certain "trigger" images that, when scanned by an AR-enabled device using image recognition, activate a video version of the promotional material. A major difference between augmented reality and straightforward image recognition is that one can overlay multiple media at the same time in the view screen, such as social media share buttons, the inpage video even audio and 3D objects. Traditional print-only publications are using augmented reality to connect many different types of media.

AR can enhance product previews such as allowing a customer to view what's inside a product's packaging without opening it. AR can also be used as an aid in selecting products from a catalogue or through a kiosk. Scanned images of products can activate views of additional content such as customization options and additional images of the product in its use.

By 2010, virtual dressing rooms had been developed for e-commerce.In 2012, a mint used AR techniques to market a commemorative coin for Aruba. The coin itself was used as an AR trigger, and when held in front of an AR-enabled device it revealed additional objects and layers of information that were not visible without the device.In 2013, L'Oreal Paris used CrowdOptic technology to create an augmented reality experience at the seventh annual Luminato Festival in Toronto, Canada.In 2014, L'Oreal brought the AR experience to a personal level with their "Makeup Genius" app. It allowed users to try out make-up and beauty styles via a mobile device.

In 2015, the Bulgarian startup iGreet developed its own AR technology and used it to make the first premade "live" greeting card. A traditional paper card was augmented with digital content which was revealed by using the iGreet app.

4.6 Education

In educational settings, AR has been used to complement a standard curriculum. Text, graphics, video, and audio may be superimposed into a student's real-time environment. Textbooks, flashcards and other educational reading material may contain embedded "markers" or triggers that, when scanned by an AR device, produced supplementary information to the student rendered in a multimedia format. This makes AR a good alternative method for presenting information and Multimedia Learning Theory can be applied.

As AR evolved, students can participate interactively and interact with knowledge more authentically. Instead of remaining passive recipients, students can become active learners, able to interact with their learning environment. Computer-generated simulations of historical events allow students to explore and learning details of each significant area of the event site.

In higher education, Construct3D, a Studiers tube system, allows students to learn mechanical engineering concepts, math or geometry. Chemistry AR apps allow students to visualize and interact with the spatial structure of a molecule using a marker object held in the hand. Others have used HP Reveal, a free app, to create AR notecards for studying organic chemistry mechanisms or to create virtual demonstrations of how to use laboratory instrumentation. Anatomy students can visualize different systems of the human body in three dimensions.

5. DANGERS OF AR

5.1 Reality modifications

There is a danger that AR will make individuals overconfident and put their life at risk because of it. Pokémon GO with a couple of deaths and many injuries is the perfect example of it. "Death by Pokémon GO" , by a pair of researchers from Purdue University's Krannert School of Management, says the game caused “a disproportionate increase in vehicular crashes and associated vehicular damage, personal injuries, and fatalities in the vicinity of locations, called PokéStops, where users can play the game while driving.”. The paper extrapolated what that might mean nationwide and concluded “the increase in crashes attributable to the introduction of Pokémon GO is 145,632 with an associated increase in the number of injuries of 29,370 and an associated increase in the number of fatalities of 256 over the period of July 6, 2016, through November 30, 2016.” The authors valued those crashes and fatalities at between $2bn and $7.3 billion for the same period.

Furthermore, more than one in three surveyed advanced internet users would like to edit out disturbing elements around them, such as garbage or graffiti. They would like to even modify their surroundings by erasing street signs, billboard ads, and uninteresting shopping windows. So it seems that AR is a threat to companies as it is an opportunity. Although this could be a nightmare to numerous brands that do not manage to capture consumer imaginations it also creates the risk that the wearers of augmented reality glasses may become unaware of surrounding dangers. Consumers want to use augmented reality glasses to change their surroundings into something that reflects their own personal opinions. Around two in five want to change the way their surroundings look and even how people appear to them.

Next, to the possible privacy issues that are described below, overload and over-reliance issues is the biggest danger of AR. For the development of new AR related products, this implies that the user-interface should follow certain guidelines as not to overload the user with information while also preventing the user to overly rely on the AR system such that important cues from the environment are missed. This is called the virtually-augmented key. Once the key is not taken into account people might not need the real word anymore.

5.2 Privacy concerns

The concept of modern augmented reality depends on the ability of the device to record and analyse the environment in real time. Because of this, there are potential legal concerns over privacy. While the First Amendment to the United States Constitution allows for such recording in the name of public interest, the constant recording of an AR device makes it difficult to do so without also recording outside of the public domain. Legal complications would be found in areas where a right to a certain amount of privacy is expected or where copyrighted media are displayed.

In terms of individual privacy, there exists the ease of access to information that one should not readily possess about a given person. This is accomplished through facial recognition technology. Assuming that AR automatically passes information about persons that the user sees, there could be anything seen from social media, criminal record, and marital status. Privacy-compliant image capture solutions can be deployed to temper the impact of constant filming on individual privacy.

6. CONCLUSION

Most tech experts are considering AR to be the future of design. When it comes to augmented reality app development**,** it is obvious that AR is providing excellent opportunities to effectively augment user experiences even beyond measure. Everyone already knows the importance of mobile phones in the society today. These devices have risen to become such an integral part of people's lives that they might as well become extensions of their bodies. Even without being intrusive, there is every possibility that technology can even be further integrated into human lives.

There is no gainsaying, the introduction and inclusion of AR will almost certainly bring about much more advances in the larger-than-life but little seen, Internet of Things. It's high time UX designers begin to seriously take the questions of how to improve traditional experiences through AR especially through application development India. No doubts, there are lots of advantages to benefit through this.

As a major challenge of the twenty-first century UX profession, it's not enough to enhance a device's ability to use computer enhancements. It needs to do more to improve user activity and even affect the way they interact with their devices. When the quality of the output or task efficiency of an experience is improved for the user, there is no doubt that the future will belong to AR.

In conclusion, augmented reality (AR) has evolved from pipe dream (dreams of tech enthusiasts) to a substantial reality in just within a century. Until developers and UX designers begin to think about how AR can be integrated with daily life to improve the quality, efficiency, and productivity of experiences, then will we see the rapidity of the concept and its untoward effectiveness on a universal scale.

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