International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-4, Issue-01, Jan 2019
ISSN: 2395-3470
www.ijseas.com

APPLICATIONS OF AUGMENTED REALITY AND FUTURE TRENDS

C.NANDHINI, Assistant Professor, Department of Computer Science, PSG College of Arts and Science, Coimbatore.

Abstract

Augmented reality is an emerging computer technology where the perception of the user is enhanced by the seamless blending between realistic environment and computer generated virtual objects co-existing in this same space. This paper gives the brief introduction of human computer interaction in recent applications and discussed about the technological developments in various fields. It describes work performed in different application domains and explains the exiting issues encountered when building augmented reality applications. Future directions and areas requiring further research are discussed.

Keywords: Augmented Reality, Virtual Environments, human-computer interaction

INTRODUCTION

Augmented reality (AR) is the term that describes a combination of technologies that enable real time mixing of computer-generated content with live video displays. This in other word means to integrate the artificially produced information into the real world. Running interactively and in real time, it combines real and virtual objects in a real environment and aligns both objects with each other. It is a real-time device-mediated perception of a real world environment that is closely or seamlessly integrated with computer generated sensory objects. The name, AR, was first coined in 1990 by a researcher named Tom Caudell at The Boeing Company and the major development in this technology occurred at the end of 90's when Hirokazu created AR ToolKit, a powerful library of tools for creating AR applications.

Its endless possibilities in different fields are one of the reasons of its growing popularity. And now there are already a handful of applications available on smart phones or portable devices. AR is related to all five senses of the human body i.e. sight, hearing, feeling, taste and smell and the one related to these are respectively called Visual AR, Audio AR, Haptic AR, Gustatory AR and Olfactory AR. Visual AR is a field of computer vision (CV) concerning of the techniques for projecting virtual contents in a scene with real objects creating the illusion of unique environment. In order to achieve an adequate level of realism in AR applications, it is important to have a real-time computation of the relative position between the user and the scene and previse collimation and registration between real and virtual objects.

The augmented scene is then projected back to the user by means of head mounted display. In other word AR is a visualization technology that allows the user to experience the virtual experience added over real world in real time Audio AR embeds the digital sound in the physical world where as Haptic AR allows the user to touch and feel AR objects placed into a real-world environment. AR adds graphics, sounds, hepatic feedback and smell to the natural world as it exists. Apart from other, Gustatory AR and Olfactory AR are only possible in principle as they are hard to implement. But the research in smell enhanced AR is being conducted at different labs. Sixth sense technology is a revolutionary way to augment the physical world directly without using dedicated electronic chips.

Sixth sense is a set of wearable devices that acts as a gestural interface and aggrandize the physical world around us with digital information and lets the users to use natural hand gestures to interact with the digital information through it. This technology gaining its popularity strength because of the usability, simplicity and ability to work independently in today's scenario.

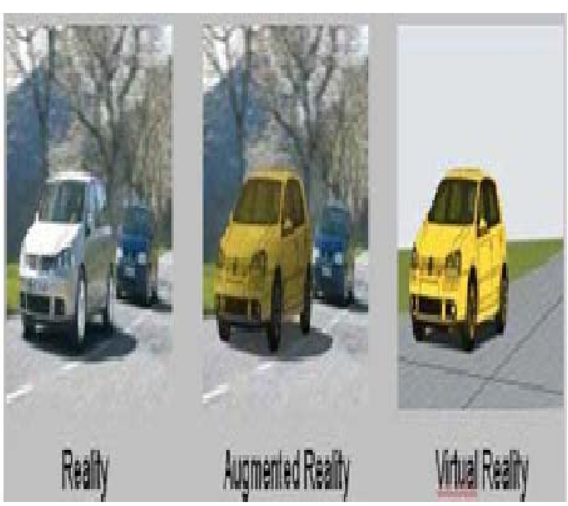
AUGMENTED REALITY AND VIRTUAL REALITY

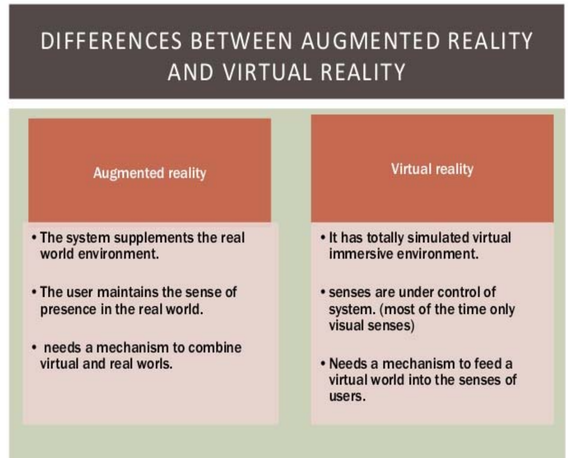
AR system have the following characteristics:

1) combines real and virtual
2) interactive in real time and
3) registered in 3-D.

Augmented reality really augments the real world with synthetic electronic data .it is a live direct or indirect view of a physical, real world environment whose elements are augmented (or supplemented) by computer generated sensory input such as sound, video, graphics or GPS data. The term virtual reality is commonly used by the popular media to describe imaginary worlds that only exist in computers and our minds. However, let us more precisely define the term.

According to virtual is defined to be being in essence or effect but not in fact. Reality is defined to be some-thing that constitutes a real or actual thing as distinguished from something that is merely apparent; something that exists independently of ideas conceiving it. the full-term virtual reality to be an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment. virtual reality is a computer-generated environment that can be interacted with as if that environment was real..A good virtual reality system will allow users to physically walk around objects and touch those objects as if they were real.





Ways to augment reality

There are three basic ways to augment reality - firstly, by augmenting the user. In this case the user physically carries a device with him which allows him to superimpose images on other objects or the same object. This includes technologies like VR helmets, goggles and data gloves. That is, whatever can be controlled by gestures of hand or other body parts to relay information which is processed by a computer having been pre-programmed to respond to different gestures in different ways. For example, a data glove to control slides during a presentation or the view of projected objects or a surgeon can feel patient's face and examine a 3-D reconstruction of bone data from a CAT scan that is superimposed on the patient's head. The second way is to augment the object. In this the physical object is changed by embedding input, output or computational devices on or within it.

This includes sensors, receptors, GPS and electronic paper. For example, toy cars can be made to sense the end of the path (visual) or respond to a large noise (audio) and perform required action like stopping or turning on/off light. The third way is to augment the environment. In this case, the information is collected by and displayed on other devices which do not require human contact. This includes video cameras, scanners, bar code readers, video projectors etc. This can be used to enhance human activities like moving animated objects on screen while presentations for visual impact or a simple game to allow speech to move computer-generated objects.

Mobile augmented reality

As computers increase in power and decrease in size, new mobile, wearable, and pervasive computing applications are rapidly becoming feasible, providing people access to online resources always and everywhere. This new flexibility makes possible new class of applications that exploit the per-son's surrounding context. Augmented reality already presents a particularly powerful user interface (UI) to context-aware computing environments. AR systems integrate virtual information into a person's physical environment so that he or she will perceive that information as existing in their surroundings. Mobile augmented reality systems provide this service without constraining the individual's whereabouts to a specially equipped area. Ideally, they work virtually adding a palpable layer of information to any environment whenever desired. By doing so, they hold the potential to revolutionize the way in which information is presented to people. Computer-presented material is directly integrated with the real world surrounding the freely roaming person, who can interact with it to display related information, to pose and re-solve queries, and to collaborate with other people. The world becomes the user interface. Hence, mobile AR relies on AR principles in truly mobile settings; that is, away from the carefully conditioned environments of research laboratories and special-purpose work areas. Quite a few technologies must be combined to make this possible: global tracking technologies, wireless communication, location-based computing (LBC) and services (LBS), and wearable computing.

APPLICATIONS OF AUGMENTED REALITY:

There are 12 distinct classes of AR application domains have been identified. These classes include well-established domains like medical, military, manufacturing, entertainment, visualization, and robotics. They also include original and new domains such as education, marketing, geospatial, navigation and path planning, tourism, urban planning and civil engineering. The following sub-sections describe recent research project that have been done in each field. While these do not exhaustively cover every application domain of AR technology, they do cover the areas explored so far.

Medical

Medical augmented reality takes its main motivation from the need of visualizing medical data and the patient within the same physical space. This would require real-time in-situ visualization of co-registered heterogeneous data, and was probably the goal of many medical augmented reality solutions in 1968, Sutherland suggested a tracked head-mounted display as a novel human-computer interface enabling viewpoint-dependent visualization of virtual objects. It was only two decades later when Roberts et al. implemented the first medical augmented reality system. Another application for augmented reality in the medical domain is in ultrasound imaging.

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-4, Issue-01, Jan 2019
ISSN: 2395-3470
www.ijseas.com

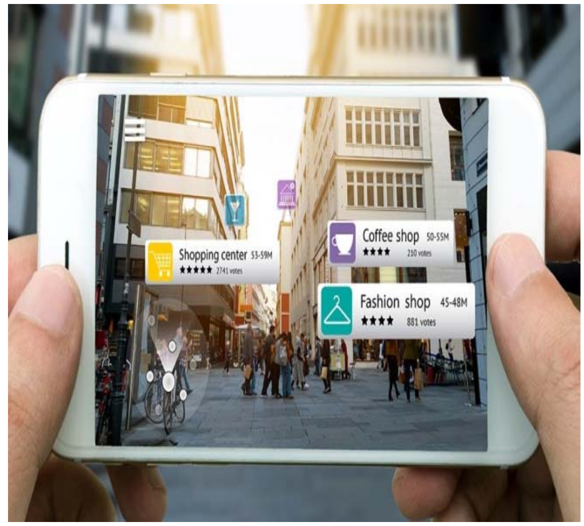
AR in medical applications

Using an optical see through display the ultrasound technician can view a volumetric rendered image of the fetus overlaid on the abdomen of the pregnant woman. The image appears as if it were inside of the abdomen and is correctly rendered as the user moves sielhorst2008. Moreover, Blum et al. describe the first steps towards a Superman-like X-ray vision where a brain-computer interface (BCI) device and a gaze tracker are used to allow the user controlling the AR visualization.

Visualization and navigation

AR is a useful visualization technique to overlay computer graphics on the real world. AR can combine visualization method to apply to many applications. A vision-based AR system was presented for visualization interaction. A device, Geoscope, was developed to support some applications such as city, landscape and architectural visualization.

AR visualization for laparoscopic surgery was approached. AR also enables visualization of invisible concepts or events by superimposing virtual objects or information onto physical objects or environments. AR systems could support learners in visualizing abstract science concepts or unobservable phenomena, such as airflow or magnetic fields, by using virtual objects including molecules, vectors, and symbols. For example, Augmented Chemistry allowed students to select chemical elements, compose into 3D molecular models, and rotate the models.



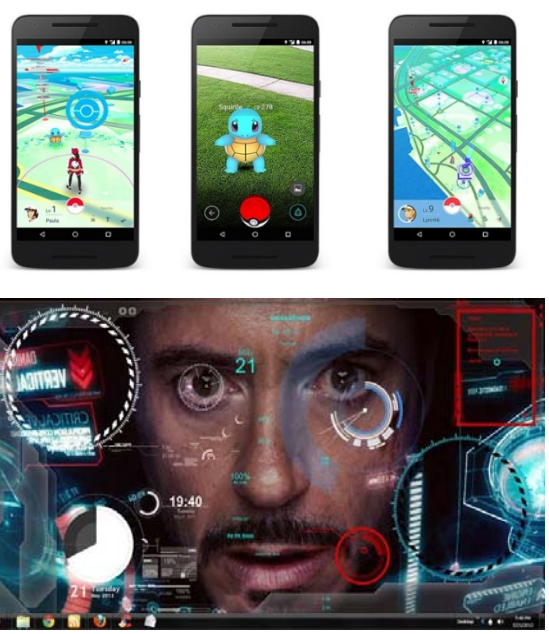
Clark et al. proposed an augmented paper-based coloring book with 3D content and provided children with a pop-up book experience of visualizing the book content. These augmented real objects create new visualizations that have potential to enhance the understanding of abstract and invisible concepts or phenomena. Modern mobile augmented-reality systems use one or more of the following 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. AR applications in smartphones generally include Global

Positioning System (GPS) to spot the user's location and its compass to detect device orientation.

Entertainment

Augmented reality has been applied in the entertainment industry to create games, but also to increase visibility of important game aspects in life sports broadcasting. In these cases where a large public is reached, AR can also serve advertisers to show virtual ads and product placements. Swimming pools, football fields, race tracks and other sports environments are well-known and easily prepared, which video see-through augmentation through tracked camera feeds easy. AR is also applied to annotate racing cars, snooker ball trajectories, life swimmer performances, etc. The most popular AR game till date is Pokémon Go which allows users to catch virtual Pokémon that are hidden throughout the map of the real world. It uses real locations to encourage players to far and wide in the real world to discover Pokemon. The game enables the players to search and catch more than a hundred species of Pokemon as they move in their surroundings. jarvis in ironman comic is designed based on AR



AR in gaming and entertainment

Military

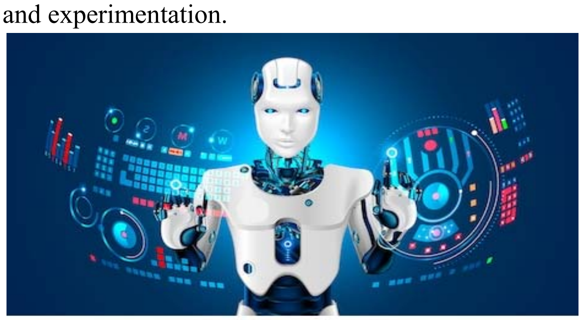
AR can be used to display the real battlefield scene and augment it with annotation information. Some HMD's were researched and built by company Liteye for military usage. In hybrid optical and inertial tracker miniature MEMS (micro electro-mechanical systems) sensors was developed for cockpit helmet tracking. it was described how to use AR technique for planning of military training in urban terrain. Using AR technique to display an animated terrain, which could be used for military intervention planning, was developed by company Arcane. The helicopter night vision system was developed by Canada's Institute for Aerospace Research (NRC-IAR) using AR to expand the operational envelope of rotor craft and enhance pilots' ability to navigate in degraded visual conditions. HMD was developed to a display that can be coupled with a portable information system in military. Extra benefits specific for military users may be training in large-scale combat scenarios and simulating real-time enemy action, as in the Battlefield Augmented Reality System (BARS) by Julier et al. The BARS system also provides tools to author the environment with new 3D information that other system users see in turn.

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-4, Issue-01, Jan 2019
ISSN: 2395-3470
www.ijseas.com

AR in military field

Robotics

AR is an ideal platform for human-robot collaboration. Medical robotics and image guided surgery are mainly based AR. Predictive displays for tele-robotics were designed based on AR. Remote manipulation of using AR for robot was researched. Robots can present complex information by using AR technique for communicating information to humans. AR technique was described for robot development and experimentation.



The way to combine AR technique with surgical robot system for head-surgery. An AR approach was proposed to visualizing robot input, output and state information. Using AR tools for the tele-operation of robotic systems was found. It was developed how to improve robotic operator performance using AR. It was explored for AR technique to improve immersive robot programming in unknown environments.3D AR display during robot assisted Laparoscopic Partial Nephrectomy (LPN) was studied in.

AR in robotics

Manufacturing

The challenge in the manufacturing field is to design and implement integrated AR manufacturing systems that could enhance manufacturing processes, as well as product and process development, leading to shorter lead-time, reduced cost and improved quality. The ultimate goal is to create a system that is as good as the real world, if not better and more efficient. AR can enhance a person’s perception of the surrounding world and understanding of the product assembly tasks to be carried out. Using an AR approach, graphical assembly instructions and animation sequences can be pre-coded at the design stage for typical procedures. These sequences can be transmitted upon request and virtually overlaid on the real products at the assembly lines as and when they are needed. The instructions and animations are conditional and can be automatically adjusted to actual conditions at the assembly lines. These instructions and animated sequences can be updated periodically with updated knowledge from the manufacturers. This approach can reduce the information overload and the training required for assembly operators. It can reduce product assembly time, thus reducing product lead-time. On comparing three instructional media in an assembly system a printed manual, computer assisted instruction (CAI) using a monitor-based display and

International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-4, Issue-01, Jan 2019
ISSN: 2395-3470
www.ijseas.com

CAI using a head-mounted display is present. They found that, by using overlaying instructions on actual components, the error rate for an assembly task was reduced by 82%.

Education

New possibilities for teaching and learning provided by AR have been increasingly recognized by educational researchers. The coexistence of virtual objects and real environments allows learners to visualize complex spatial relationships and abstract concepts, experience phenomena that is not possible in the real world, interact with two- and three-dimensional synthetic objects in the mixed reality, and develop important practices that cannot be developed and enacted in other technology-enhanced learning environments. These educational benefits have made AR one of the key emerging technologies for education over the next five years. Visually learning helps to understand better.

Urban Planning and Civil Engineering

AR is a decision support way of in architecture and interior design. A system was presented for constructing collaborative design applications based on distributed AR. This technique was developed to explore relationships between perceived architectural space and the structural systems. It was developed for using AR systems to improve methods for the construction, inspection, and renovation of architectural structures. An approach is using AR to visualize architecture designs in an outdoor environment. A prototype system was developed to use AR for an architectural application in facility management and maintenance. In calibration-free AR based affine representation was described for urban planning. It was approached for using a tangible interface and a projection-based AR tabletop interface to research urban simulation and the luminous planning table.

A System based on AR with a tangible interface was demonstrated for city planning. AR user interaction techniques were developed to support the capture and creation of 3D geometry of large outdoor construction structures. A co-operative AR design system, A4D, for AEC (architectural, engineering and construction) was approached. It was presented that a system with human computer interaction, AR visualization and building simulation can interact with buildings. AR as tool was approached to be used in architecture, building performance visualization, retrieving information of building equipment and construction management respectively. System based AR was designed to support complex design and planning decisions for architects. 3D animation of simulated construction operations-based AR was investigated. The research spatially AR design environment can be used in urban design. Technologies and theories of using AR in architecture were described.

Applications of AR in the field of ACE (Architecture, Construction and Engineering).

FUTURE TRENDS

Several possible future directions are speculated for further research. Many HMDs created specifically with AR in mind need to be developed. HMDs are still too clumsy and have limited field of vision, contrast and resolution. HMDs and other wearable equipment's, such as data-gloves and datasuits, is a limitation for the user. All wearable equipment's need be developed to be lighter, smaller and easier to work with the user. Also, the AR system researchers need consider other challenges such as response time delays, hardware or software failures from AR systems. One limitation of AR systems is registration error. Occlusion detection is an active area of study of AR systems. Analyzing various tracking methods, possible tracking research directions are identified that allow researchers to effectively capitalize on knowledge in video frames, or integrate vision-based methods with other sensors in a novel way. It is important to incorporate a recognition system to acquire a reference representation of the real world. Further research on this direction could provide promising results, but it is mostly a top-down process and hard to deal with object dynamics, and evaluation of different hypotheses. The challenge is to construct a pervasive middleware to support the AR system.

Augmented reality in 2020:

Screen-less future becomes a reality as wearables become ubiquitous; any flat surface doubles up as a screen.

3-D visualization and mapping capabilities in conjunction with AR technology help navigate places with updated situational awareness.

Example of futuristic augmented reality

Visualization of data becomes seamless as users can access centralized data on the go through wearable technologies; it finds application in law enforcement, emergency response and human services.

Gestural interfaces—ways for humans to use body language and actions to control technology—begin to redefine the human-technology relationship, ushering in a sort of omnipresent "sixth sense."

Haptic (tactile) technologies redefine training in key government mission areas including defense, law enforcement and health care.

CONCLUSION:

Augmented Reality is a technology that has changed the face of smart phone apps and gaming. AR adds digital images and data to amplify views of the real world, giving users more information about their environments. This step is beyond virtual reality, which attempts to simulate reality. AR apps are growing at a tremendous speed as they give businesses a different edge which attracts the customers.

The prototype system will make learning efficient and provide benefited information related to business products. Augmented reality is considered a competence that has been around for years. Augmented reality is still in its initial phases; and thus, the upcoming possible apps are endless. A lot of AR products have been presented in several kinds and spread around the world. The layering of information over 3D space creates completely new experiences of the world, and supports the broader transition of computing from the desktop to the mobile devices, and at the same time raising new outlook concerning reaching information and new chances for learning. In spite of the fact that AR is utilized broadly in the customers sector, for example it is used in social engagement, entertainment and marketing, new forms of usage appear every day.

REFERENCES

[1] S. Kahn, H. Wuest, D. Stricker, and D. W. Fellner. 3D discrepancy check via augmented reality. In IEEE International Symposium on Mixed and Augmented Reality (ISMAR), pages 241–242. IEEE, 2010.

[2] C. Kerl, J. Sturm, and D. Cremers. Robust odometry estimation for RGB-D cameras. In IEEE International Conference on Robotics and Automation (ICRA), pages 3748–3754. IEEE, 2013.

[3] J. Kopf, M. F. Cohen, D. Lischinski, and M. Uyttendaele. Joint bilat-eral upsampling. ACM Transactions on Graphics (TOG), 2007.

R. Maier, J. Stuckler,¨ and D. Cremers. Super-resolution keyframe fusion for 3D modeling with high-quality textures. In International Conference on 3D Vision (3DV), pages 536–544. IEEE, 2015.

[4] F. C. Wu and A. Dellinger. Gpu-based discrepancy check for 3D fab-rication. In International Conference on Computer Graphics, Visual-ization and Computer Vision (WSCG), 2014.

[5] K. Museth. VDB: High-resolution sparse volumes with dynamic topology. ACM Transactions on Graphics (TOG), 32(3):27, 2013.

[6] R. A. Newcombe, D. Fox, and S. M. Seitz. DynamicFusion: Recon-struction and tracking of non-rigid scenes in real-time. In IEEE Con-ference on Computer Vision and Pattern Recognition (CVPR), 2015.

[7] R. A. Newcombe, S. Izadi, O. Hilliges, D. Molyneaux, D. Kim, A. J. Davison, P. Kohi, J. Shotton, S. Hodges, and A. Fitzgibbon. Kinectfu-sion: Real-time dense surface mapping and tracking. In IEEE Interna-tional Symposium on Mixed and Augmented Reality (ISMAR), 2011.

[8] O. Wasenmuller,¨ M. Meyer, and D. Stricker. CoRBS: Comprehensive RGB-D benchmark for slam using kinect v2. In IEEE Winter Confer-ence on Applications of Computer Vision (WACV). IEEE, 2016.

[9] Abrar Omar Alkhamisi, Muhammad Mostafa Monowar, Rise of Augmented Reality: Current and Future Application Areas, International Journal of Internet and Distributed Systems, 2013, 1, 25-34, October 12, 2013

[10] S. Webel, M. Becker, D. Stricker, and H. Wuest. Identifying differ-ences between CAD and physical mock-ups using AR. In IEEE In-ternational Symposium on Mixed and Augmented Reality (ISMAR), pages 1–2. IEEE, 2007.

[11] T. Whelan, M. Kaess, M. Fallon, H. Johannsson, J. Leonard, and J. McDonald. Kintinuous: Spatially extended KinectFusion. In RSS Workshop on RGB-D: Advanced Reasoning with Depth Cameras, Sydney, Australia, Jul 2012.