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Applications of Augmented Reality

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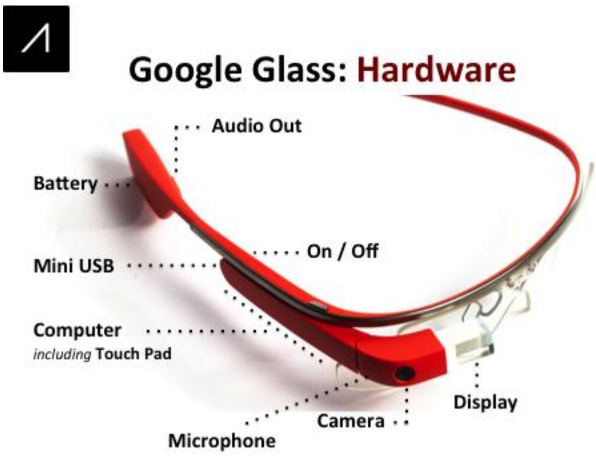
Abstract: We are on the verge of accepting Augmented Reality Technologies to enhance our current perception and feel our environment in better enriched way. AR is researched by many researchers due to its applicability in different mechanical fields. This is enabled by continuous improvement in computer hardware and software. This paper provides basic definition, development history and technical as well as non-technical applications. In spite of its vast utility, AR still remains a challenge due to its complex algorithms.

Keywords: *AR (Augmented Reality), Applications, Virtual, Direct, Indirect, Display*

I. INTRODUCTION

Due to release of Google glasses, Augmented Reality has gained a sudden importance.AR is a technology that works on vision based algorithms augment various parameters on real world object using various technical devices. It is very interactive way for virtual elements to be the part of real world.

AR, in which virtual content is seamlessly integrated with displays of real world scenes, is growing area of interactive design[2]. AR displays superimposed views and can take you into a new world where real and virtual worlds are coupled tightly[1]. Dsplays of AR are not limited to any regular output devices like desktop or television but can be experienced through wearable devices. Google glass is the best example.

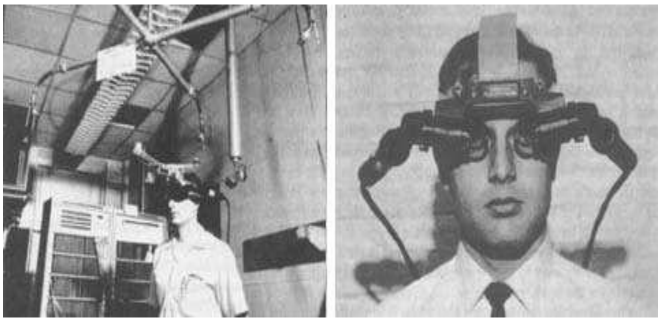


II. BEGINNING

A. Development of the concept

From 1957, a gentleman Morton Helig began building a machine called the Sensorama. It was designed as a cinematic experience to take in all your senses and, shaped, it blew wind at you, vibrated the seat you sat on, played sounds to your eyes and projected a form of a stereoscopic 3D environment to the front and sides of your head. It was supposed to be impressive with its demo film of a cycle ride through the streets of Brooklyn but it never sold commercially and was very expensive to make films for largely because it involved the camera man having three cameras strapped to him at all times, and while it was really more an adventure in full virtual reality, there are clearly elements of AR involved with both the devices in place between the user and the environment and that fact that the environment itself was, itself, the real world viewed in a real time situation - even if recorded.

In 1966 Professor Ivan Sutherland of Electrical Engineering at Harvard University invented the first model of one of devices used in both AR and VR today - the head-mounted display.The device made by him was very bulky, hence too heavy for human head. This was the very first successful step in making AR a usable possibility.



B. Invention of AR

Augmented Reality is supposed to have been coined by Professor Tom Caudell while working in Boeing's Computer Services' Adaptive Neural Systems Research and Development project in Seattle. In a search to find an easier way to help the aviation company's manufacturing and engineering process he began to apply VR technology and eventually came up with some complex software that could overlay the positions of where certain cables in the building process were supposed to go. It means the mechanics didn't have to ask or tries to translate from what they found described in abstract diagrams in manuals.

At the same time, in 1992, LB Rosenberg creates what's widely recognized as the first functioning AR system for the US Air Force known as VIRTUAL FIXTURES where fixtures were what he described as cues to help guide the user in their task and did so in very big letters.

A second group, also fond of capping things up, made up of Steven Feiner, Blair MacIntyre and DoreeSeligmann-submitted a paper on a prototype system they called KARMA (Knowledge-based Augmented Reality for Maintenance Assistance). The team from Columbia University built an HMD with Logitech-made trackers attached to it .The project was then to develop 3D graphics of a ghost image to show people how to load and service the machine without having to refer to instructions. The paper went down rather well and was widely cited within the science community [3].

III. BASIC DEFINITION

A. Reality-Virtuality Continuum

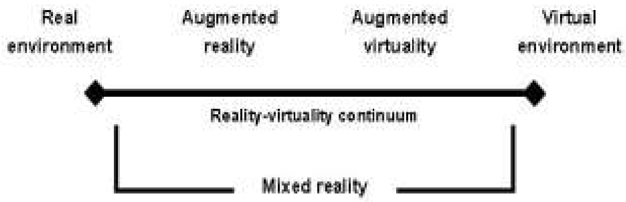


Figure 1: The reality-virtuality continuum by Milgram and Ki

shino [1] (Fig. 1), AR is part of the general area of mixed reality. AR provides local virtuality[1]. An AR system:

- combines real and virtual objects in a real environment;
- registers (aligns) real and virtual objects with each other; and
- runs interactively, in three dimensions, and in real time.

B. Technical Definition

Augmented reality (AR) is a direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. . It is related to a more general concept called mediatedreality, in which a view of reality is modified by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one.

Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable. Artificial information about the environment and its objects can be overlaid on the real world.

IV. APPLICATION

A. Industrial Applications

With the use of AR, designers can experience a product's design and operation before completion. Volkswagen has started using AR for comparing calculated and actual crash test imagery. AR can be used to visualize and modify a car body structure and engine layout. AR is also used to compare digital mock-ups with physical mock-ups for finding discrepancies between them[4][5].

1. Design:

With the use of AR, worker can very accurately imagine any intricate component. AR also has its application in crash tests done on car. Volkswagen, ford and few other companies have adopted this technology in their manufacturing. AR proves to be very useful in repairing damaged cars; as it gives a virtual view of repaired car and helps the worker to understand the damages easily.

Fiorentino[1] introduced the SpaceDesign MR Workspace that allows for instance visualisation and modification of car body curvature and engine layout.

2. Assembly:

Since BMW experimented with AR to improve welding processes on their cars [6], Volkswagen uses AR in construction to analyse interfering edges, plan production lines and workshops, compare variance and verify parts. Assisting the production process at Boeing, Mizell [8] uses AR to overlay schematic diagrams and accompanying documentation directly onto wooden boards on which electrical wires are routed, bundled, and sleeved. Curtis et al. [9] verified the AR and found that workers who use AR create wire bundles and also created conventional approaches, even though tracking and display technologies were limited at the time [1].

Major benefit of using AR in assembly is that big projects can be monitored and scheduled individually and properly.

3 Combat /Simulation:

Satellite navigation, heads-up displays for pilots, and also Research related to AR conducted in universities and corporations are done with the help of military funding. Companies likeInformation in Place have contracts with the Army, Air Forceand Coast Guard, as use of AR mayoverlap in for instance navigational support, communications enhancement, repair and maintenance and emergency medical care.

Other advantages specifically for military users may be trainingin large-scale combat scenarios and simulating real-timeenemy action, as in the Battlefield Augmented Reality System(BARS). Not to overload the user with too much informationmay prove to be critical and is being studied by Julier et al. . TheBARS system also provides tools to modify the environmentwith new 3D information that other system users see in turn.Azuma et al.is studying the projection of reconnaissance data from unmannedaeroplanes for land warriors [1].

B. Navigation

AR augments the effectiveness of navigation devices. Direction maps can be displayed on an automobile's windshield indicating destination directions and distance, weather, terrain, road conditions and traffic information. Also AR can detect alerts to potential hazards in their path. In marine navigation systems, AR plays a vital role. AR can allow bridge watch-standers to continuously monitor ship's heading and speed while moving throughout the bridge or performing other tasks [10].

Navigation in prepared environments has been tried and tested. Rekimoto launched a Navi Cam for indoor use that augmented a video stream from a hand held camera using fiducial markers for position tracking. Starner studied applications and limitations of AR for wearable devices, including problems like finger tracking and facial recognition. Narzt et al. discuss navigation paradigms for (outdoor) pedestrians and cars that overlay routes as well as highway exits, follow-me cars, dangers, fuel prices, etc. They prototyped video see-through PDAs and envision eventual use in car wind shield heads-up displays. Tönnis investigate the success of using AR to warn a car driver and drive his attention towards danger . Kim et al suggested how a 2D travel guidance service can be made 3D using GIS data for AR in navigation. Results showed that the use of augmented reality displays result in a considerable decrease in navigation errors and issues related to diversion of attention when compared to using regular displays. Nokia's project31 known as MAR Are searches deployment of AR on general, current mobile phone technology.

C. Medical

Similar to maintenance personnel, roaming nurses anddoctors could benefit from important information beingdelivered directly to their glasses. Surgeons howeverrequire very precise registration while AR system mobility isless of an issue. An early optical see-through augmentation ispresented by Fuchs et al. for laparoscopic surgery36where the overlaid view of the laparoscopes inserted throughsmall incisions is simulated. Pietrza confirm that the use of 3D imagery in laparoscopic surgerystill has to be proven, but the opportunities are well documented.

D. AR for Entertainment

Like VR, AR can be applied in the entertainment industry to create AR 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.

V. FUTURE OF AUGMENTED REALITY

[1] A car can be virtually designed and tested for the requires specifications.

[2] Any route can easily be visualized, thus eliminating use of sign boards.

[3] Any medical complication can be identified beforehand and a remedy can be found out.

[4] Any sport can be made more interesting using augmented reality.

[5] Whatever imagined can actually be visualized.

CONCLUSION

AR, overlaying of computer graphics onto the real worldview, can provide necessary means for a human robotic system to fulfil these requirement for collaboration. Even though AR has vast utility in most of the fields its use is quite limited due to some limitations like portability, outdoor use, over-reliance and auto caliberation. The company called *Information in place* estimated that by 2014, 30% of workers will be using augmented reality [1].

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