AUGMENTED REALITY ASSITANCE IN THE TECHNICAL FIELD

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Abstract. *The given paper is exploring the applications of Augmented Reality (AR) in Engineering and Technology by discussing its main aspects and providing common use cases. The numerous applications of AR require specific software and hardware. Unlike Virtual Reality, which creates a totally artificial environment, AR users experience a real-world environment with generated perceptual information overlaid on top of it. Identifying the possibilities and various benefits that the technology can offer in the workplace, we can provide a comprehensive overview of AR's integration into this field, aiming to contribute to the growing attention that this sector is receiving and inspire further exploration of its potential.*

Keywords: *AR simulations, projection, algorithm, virtual reality, visualization.*

Introduction

The slow pace of project development, updating, and review can be a significant issue in the technical field, causing delays and inefficiencies. However, Augmented Reality technology offers a solution to this problem by enabling the creation of an adaptive system that updates and displays information in real-time without the need for team meetings and paperwork. The use of AR technology also reduces the risk of errors and miscommunications that can arise and can be calculated to provide a useful cut in overall work cost, its implementation being proven to significantly improve general yield and efficiency.

Common uses of Augmented Reality

Augmented Reality has been a staple buzzword in the futuristic science department for the past 50 years, ever since its initial conception in the early 1990s, but what are the real applications of the technology? Starting with the Virtual Fixtures developed by the U.S Air Force for pilot flight training, the technology has quickly gained traction in commercial fields such as communications, entertainment, education and healthcare [1].

Distinction between Augmented Reality and Virtual Reality

Often compared to Virtual Reality (VR), the Augmented Reality technology has a few key differences. Namely: it alters the user's perception of reality while still keeping elements of the real vision as opposed to VR, which completely replaces the user's environment [2], a method that in turn makes the use of VR specific to limited hardware such as VR glasses or entire setups, a restriction which will provide little perspective in the work field. Augmented Reality, as a more flexible option than Virtual Reality, can be used to optimize safety, efficiency and accuracy in the industry, with the advantage of running with little impediments even on devices such as the user's phone, tablet, glasses or smart watches, boasting cheaper integration and cost.

The technology supporting Augmented Reality

Before going over the applications of Augmented Reality in the work field, we must cover the hardware and software that drives the AR devices.

The main hardware components of an AR device are: a processor, display, sensors and input devices. You might not recognize it, but most of our phones are suitable AR platforms [3], given the

abundancy of cameras, sensors and computing power. The more important aspect to discuss here is the various technologies used for displaying the information:

- Display – it can be one of many various technologies, such as: a monitor, handheld, head-mounted display or optical projection system. A head-mounted display (such as the well-known Oculus devices for VR) is a piece worn on the head, covering one or both eyes and displaying desired information through the use of screens in the eye-piece. These devices vary, with some being transparent, wireless or self-powered and allowing more freedom than others;
- Eyeglasses – AR displays that render on eyeglasses-like devices, allowing focus on both on-screen information and real-life scenery;
- HUD – a precursor to AR, first developed for pilots, considered archaic as it is a "heads-up" dashboard, with none of the expected Augmented Reality real-time updates;
- Contact lenses – while still in development, companies claim that development is coming to a close product, with some even using their CEOs as test subjects [4];

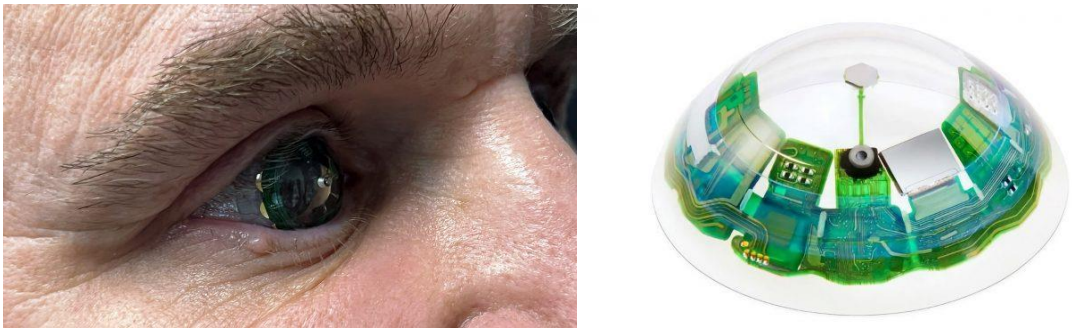

Figure 1. Mojo Vision CEO wearing AR contact lens [4]

- Virtual retinal display – on retinal implants that are research-backed proven high potential solution for patients affected by partial loss of vision, providing high resolution, contrast and brightness. This technology directly scans data onto the retina of the user, with the viewer seeing what would be a conventional display floating in space. Considered safe as per USA regulations.

There are many other niche attempts at displaying the AR information, some, on one hand more useful, such as projection mapping, but on the other hand either too resource demanding or unsuitable to the technological compartment that we are discussing.
When it comes to software, AR is based on algorithms trained to recognize and analyze the environment, relying heavily on the immersion of the user while still facilitating the experience.

Practical applications of Augmented Reality

The AR technology has been trialed in many different ways: work, entertainment, business, healthcare and gaming. For an engineer, AR can become an instrument on his tool belt. We will cover a few use cases, but the practical uses of Augmented Reality are limited only by the imagination of the user.

Among the more useful workplace integrations can be included:

- **Urban design and planning** – as a collaborative tool between paper, pen and CAD-like applications, AR could take its right place in Architecture and Design. The technology can provide real time rendering of building projects, capable of being laid over current building, if for example you needed a remodeling, or even show building plans such as piping, wiring, floor plans, room layouts, furniture fitments and anything the user might need [5].

Figure 2. Simulating furniture and house planning sheets [6]

- **Archaeology** would benefit greatly from the implementation of Augmented Reality as it yields multiple advantages. AR can be used to display models of constructions that have been long since dilapidated by the passage of time and elements, with furthermore monetization in entertainment [7]. A hands-on tool for archaeologists would be using AR in order to run simulations of dig sites being affected by time and weather in order to raise the chance of finding useful relics during excavation or searches, as it would give the scientists a better understanding of the field they work on. It could also integrate maps of underground pipe networks so as to not risk the possible damage during excavations.
- **The automotive industry** has a recent increasing demand for Augmented Reality systems, options that would aid the driver in the process of using the automobile, with functions such as danger highlight, be it through sound or light-up indicators on the windshield. The systems would be built to redirect the driver's attention to the road and decrease the risk of accidents while raising comfort.

Figure 3. On windshield display with driving information [8]

- **Robotics** is a newer field of engineering that would benefit greatly from wide-use Augmented Reality. Remote operation of a robot would be extremely convenient if the user would be able to have a detailed guide of the scenery that the robot is traversing. Using simulations, the operator could decide whether the action he takes will have the outcome that is expected, therefore knowing the result of an action before even taking it. In addition, using Robotics and Augmented Reality could be a turning point in healthcare. AR could be used to virtually overlay guides for medical practitioners, or to be employed in remote surgical operations using surgery robots, whether due to no available surgeons at the time or the operation requiring urgency.
- Large companies in the R&D department are starting to open their eyes toward Augmented Reality. Building cars, planes or houses is costly, therefore companies that run the technology find the edge in the industry by running AR simulations instead of building real life models, gaining a large financial advantage, as they can run as many simulations as they want at the maximum cost of electricity and computing power, instead of having to build said products

or even worse, risk lives. The technology has been used to visualize the structure of said products in different environments, be it crashes, natural disasters or weather conditions. AR has been successfully used to find differences between a computer model and real-life models in order to fix and address build issues [9].

Factors to bear in mind

AR presents itself with lots of benefits, but the constraints should not be easily dismissed. Here are some of the more obvious shortcomings:

1. Implementation of AR on large scales requires specialized hardware, software and training, thus incurring a considerable upfront investment.
2. Augmented Reality relies heavily on collecting and processing data, which raises immediate privacy and security concerns.
3. Human error and overreliance on technology. AR can become a double-edged sword, with advantageous applications but notable drawbacks too, such as reduced emphasis on human problems solving skills, critical thinking and expertise.

Conclusions

To summarize, Augmented Reality is a technological breakthrough with pros (easy to use, enhanced experience, supporting business activities) and cons (unaffordable, privacy or security concerns, addiction, more health issues). It has subsequently evolved into a valuable tool for many sectors. AR has become an everyday occurrence, and the future appears to have no boundaries.

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