AUGMENTED REALITY

Adam Vidlička

Faculty of Mechanical Engineering, Brno University of Technology
Institute of Automation and Computer Science
Technicka 2896/2, Brno 616 69, Czech Republic
191930@vutbr.cz

Abstract: *This seminar paper discuss about augmented reality - its brief history, what it is, its applications.*

Keywords: *augmented reality, history of AR, visualization of AR, applications of AR*

1 Introduction

Augmented reality (AR) is widely emerging in almost every field, whether it is entertainment (gaming), the field of visual art, photography, cinema, interactive digital media, healthcare or industry. Implementation of AR has a great potential in the fourth industrial revolution (renowned as Industry 4.0) to improve the productiveness and to enhance the user experience.[1, 2]

2 Augmented Reality

2.1 History

The history of AR dates back to the 1960s, when Ivan Sutherland introduced the head mounted display. In the 1970s, Myron Krueger created a room, that allowed users to interact with virtual objects. In the early 1990s was coined the phrase Augmented Reality. Later was created AR system called Virtual Fixtures by L.B. Rosenberg to benefit human performance. In the year 2000 was AR implemented to the sports aerial camera. Bruce Thomas developed outdoor mobile AR game ARQuake. In the year 2009 the ARToolkit was made available in Adobe Flash. In the mid 2010s were introduced Google Glass (by Google) and HoloLens (by Microsoft). [3, 4, 5, 6]

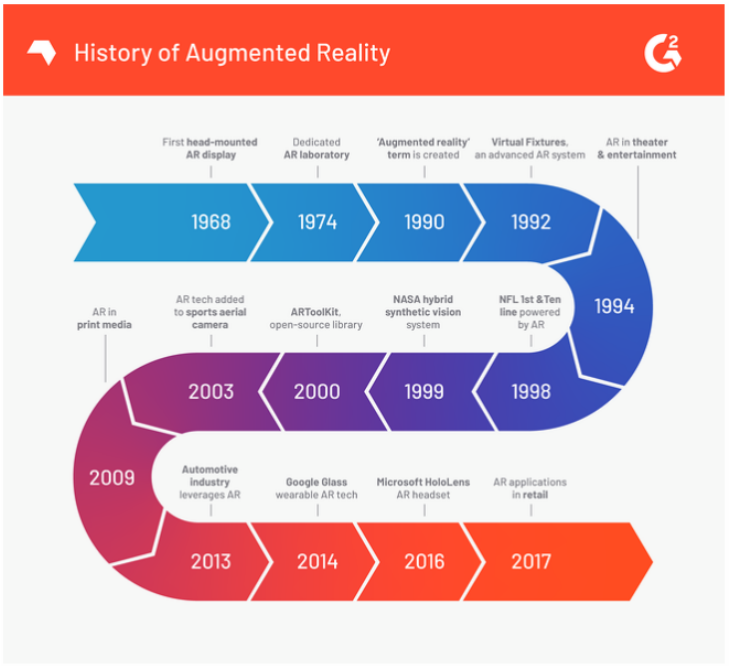


Figure 1: History of AR [5]

2.2 What is augmented reality

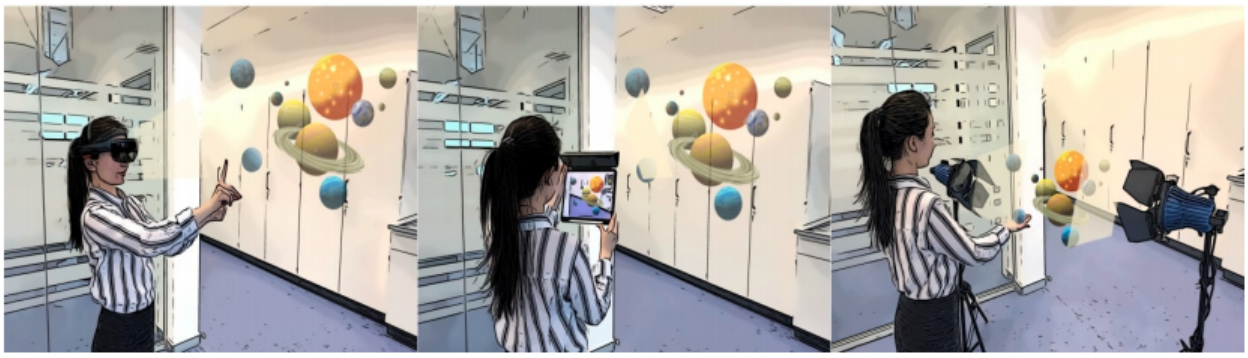
AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. Therefore, AR supplements reality, rather than completely replacing it. Ideally, it would appear to the user that the virtual and real objects coexisted in the same space. [7, 8]

2.3 Augmented reality vs virtual reality

AR is a variation of virtual environment (VE), or also commonly called virtual reality (VR). VR technologies completely immerse a user inside a synthetic environment, where the user cannot see the real world around him in contrast of AR (viz chapter 2.1).[7, 8]

2.4 Visualization of augmented reality

AR can be experienced through different sets of technology including mobile displays (tablets and smartphone screens), computer monitors, Head-Mounted Displays (HMDs), and projecting systems called Spatial Augmented Reality (SAR). [3, 9]



HMDs mobile display SAR

Figure 2: Visualization of AR [3]

3 Application of augmented reality

3.1 Medical

Doctors could use AR as a visualization and training aid for surgery. It may be possible to collect 3D datasets of a patient in real time, using noninvasive sensors like magnetic resonance imaging (MRI), computed tomography scans (CT), or ultrasound imaging. These datasets could then be rendered and combined in real time with a view of the real patient. In effect, this would give a doctor "X-ray vision" inside a patient. [3, 4, 7]

Figure 3: X-ray using AR [4]

AR might also be helpful for general medical visualization tasks in the surgical room. Surgeons can detect some features with the naked eye that they cannot see in MRI or CT scans, and vice versa. AR would give surgeons access to both types of data simultaneously. This information might also guide precision tasks, such

as displaying where to drill a hole into the skull for brain surgery or where to perform a needle biopsy of a tiny tumor. The information from the noninvasive sensors would be directly displayed on the patient, showing exactly where to perform the operation.

Another use of AR could be for training purposes. Virtual instructions could remind a novice surgeon of the required steps, without the need to look away from a patient to consult a manual. Virtual objects could also identify organs and specify locations to avoid disturbing the patient. [3, 4, 7]

3.2 Manufacturing and maintenance

Another category of AR applications is the assembly, maintenance, and repair of complex machinery. Instructions might be easier to understand if they were available, not as manuals with text and pictures, but rather as 3D drawings superimposed upon the actual equipment, showing step-by-step the tasks that need to be done and how to do them. These superimposed 3D drawings can be animated, making the directions even more explicit. [7, 10]

Figure 4: Maintenance instructions [10]

3.3 Robot path planning

There are demands for flexible and intuitive ways of programming industrial robots that allow the user to focus on the task and not on the complexity of the robotic system. Instead of using a real robot, the user plans and specifies the robot's actions by manipulating the virtual version, in real time. The results are directly displayed on the real world. [3, 7, 11]

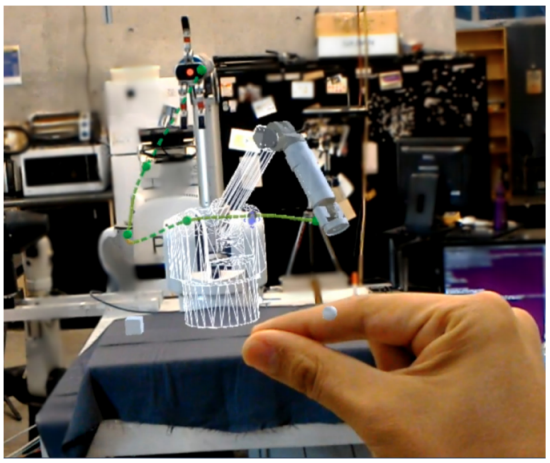


Figure 5: Robot path planning [11]

3.4 Entertainment

Entertainment and education applications for example include cultural and gaming apps and sports. In cultural application, there exists a few systems that uses AR for virtually reconstructing ancient ruins. In cultural application, there exist a few systems, that use AR for virtually reconstructing ancient ruins or for museum guidance. In gaming application, there is for example game Pokémon GO, which superimposes virtual characters upon open world. There is also wide use of AR in sports for example telemetry information. [4]

3.5 Advertising and commercial

AR is mostly used by marketers to promote new products online. Most techniques use markers that the users present in front of their webcam either on special software or simply on the advertising company's website. Another example could be furnishing of a room using AR (for example app IKEA Place). [4]

Figure 6: Mini advertisement [4]

4 Conclusion

Augmented reality has its place in Industry 4.0. With its real-time usage in real world, it offers improvement in productivity and better user experience. It can be used with just a smartphone and installed app. This makes it a cheaper solution in comparison to VR. But same as VR, it can be used in wide variety of applications from the industry to the medicine or even the entertainment.

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