

# Revolutionizing Healthcare Through Augmented Reality

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## Abstract:

When you think of augmented reality the first thing that comes to mind is games like Pokémon GO and many other games. Nevertheless, in this term paper we will look at how augmented reality helps in developing healthcare. We will try to understand the utility of Augmented Reality in healthcare, mainly in surgical training in regards to cardiovascular care. Through this paper we will understand the quality and impact of this technology. The aim of this paper is to understand; what AR is and its working, what fields of healthcare do we need and make things easier by introducing AR? What are the benefits of this technology when compared to traditional methods? Then we will look at AR in cardiovascular care in depth. We will also discuss if AR is the future of the healthcare industry. Lastly, we will conclude this paper by concluding if the AR technology is worthy and could possibly enhance the efficiency of the healthcare industry and also look at its future compatibility with the current generation. <sup>[1]</sup>

**Keywords** —Augmented reality, AR, healthcare, imaging, Cardiovascular care.

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## I. INTRODUCTION

Augmented reality (AR) is technology where we combine the real world with computer-generated content. By combining both we create an interactive experience between the user and the computer. The user interacts with virtual objects placed in the human world. Basically, AR is a digital layer which is superimposed on the real world and mixes the real world with the virtual world to enhance user experience. <sup>[2]</sup>

The first AR technology was invented and developed in 1968 at Harvard when Ivan Sutherland (known as the father of computer graphics) created an AR head-mounted display system. In the following years many companies further came up with advanced AR technology. AR is a highly challenging and impressive technology which provides us with additional information to the

existing real world. This helps a person to work efficiently and cure people easily. AR could be put into role with the help of specially designed glasses or with the help of any advanced devices. We can say that AR is an advanced version of virtual reality. AR offers a new platform to help doctors better visualise complex medical data, especially before and during medical procedures. The new standalone AR device aims to provide an immersive AR experience where surgeons can interactively explore data in three dimensions (3D).

AR based training and simulation improve surgical skills, reduce errors and increase surgical efficiency. AR can help guide treatment and ultimately improve patient care. Doctors can now use AR to view cardiac MR information without touching in a sterile environment. By projecting these images on a glass screen worn like a mask over the surgeon's face, AR allows surgeons to interact with medical

information, maintaining a sterile environment and reducing the risk of infection. [3]

## **II. HOW DOES AUGMENTED REALITY WORK**

AR works by using a device such as a smartphone or smart glasses, to overlay computer generated images onto the user's view of the physical world.

The device uses its camera to capture the user's surroundings and then analyses the image to identify features and signs, such as colours or patterns, that serve as reference points for digital content. The device then projects the digital content in those reference points making the digital content part of the real world. [4]

Algorithm for the working of AR:

1. A physical object is recognized by an AR-enabled device by analyzing the video stream and recognizing its shape.
2. Data from business systems and outside sources can be integrated with data coming from sensors on physical objects as it streams to the twin.
3. Through a touchscreen that requires touchscreen-enabled headsets or smart glasses, the user communicates with the items by sending commands to the cloud.
4. The digital twin of the object, which is a 3-D digital replica stored in the cloud, is then connected to AR. [5]
5. The AR device superimposes the information on the user's perspective after the program obtains it from the twin, such as performance information about the object or interaction instructions.
6. The cloud receives control instructions, like halt, and sends them to the object. [6]

The "digital twin" of the object, a 3D cloud-based digital model, serves as a link between smart objects and augmented reality. Either computer-aided design, which is frequently used during

product creation, or technology that digitizes real-world things are used to generate this model. [7]

## **III. AREAS OF APPLICATION IN HEALTHCARE**

The use of artificial intelligence (AI) in the medical profession has several advantages. Some of the main benefits are as follows:

1. **Medical education and training:** AR can be used to teach students more effectively by creating an environment where they can experience how it is going to be in reality.
2. **Surgery and procedural support:** During surgery AR provides the surgeons with real time information and guidance which help them to target and locate areas of the body very easily.
3. **Patient education and engagement:** AR can help patients understand their conditions and treatment options. This helps increase the engagement of the patient in his/her treatment plans.

Incorporating AR technology into healthcare has the potential to significantly alter a number of areas, including patient care, medical education, and therapy. This might alter how medical treatment is provided and received. [8]

## **IV. AR Vs. TRADITIONAL METHODS**

Following the benefits of AR over traditional methods:

1. **Improved visualization:** AR allows users to visualize complex data in a more intuitive and interactive way, making it easier to understand and analyze.
2. **Real-time interaction:** AR provides real-time interaction with digital content, making it easier to manipulate and control than traditional methods.

3. **Hands-free use:** AR devices can be used in hands-free mode, which can be especially useful in medical or industrial settings where hands-free operation is important for safety.
  4. **Cost-effective:** AR can be more cost-effective than traditional methods, such as building physical models or conducting real-time training.
  5. **Remote Collaboration:** AR enables remote collaboration, allowing people to collaborate in real time regardless of their physical location.
  6. **Better learning:** AR can improve learning by providing a more immersive and immersive experience that can improve retention and understanding.
  7. **Personalization:** AR can be tailored to the specific needs of the user, enabling a personalized user experience that can be tailored to their unique needs.<sup>[9]</sup>
2. **Data Security and Privacy:** As with any new technology, employing AR raises questions regarding data security and privacy. The ability of the technology to gather and communicate data about people and their surroundings raises concerns about how that data will be used and safeguarded.
  3. **Ethical Considerations:** When employing AR in healthcare, there are additional ethical issues to consider, such as the risk of patients being unduly dependent on technology and the possibility of bias in algorithms and data sets.
  4. **Regulatory Issues:** while implementing AR technology in healthcare, there are regulatory considerations to take into account. For instance, there can be specific rules regarding data privacy and security, and the technology might need to be certified by regulatory organizations before it can be utilized in certain medical applications.
  5. **Development and implementation cost:** The cost at which we can buy and access the AR resources is very high and only the privileged hospitals can be benefited by it.
  6. **Scope of adaptation:** AR experiences are so heavily reliant on the particular setting and context in which they are used, that the scope of adaptation becomes a problem.

AR offers many advantages over traditional methods, making it a powerful tool in many fields.

## V. CURRENT ISSUES IN AUGMENTED REALITY

Following the current issues of AR:

1. **Hardware and software limitations:** One of the primary problems with AR technology is that the available hardware can be pricey, big, and heavy, which limits its appeal to a wide audience. The user experience may be negatively impacted by the devices' low resolution, short battery life, and other technological flaws. Because AR software is still in its infancy, there are some restrictions on its potential, accuracy, and interoperability across many platforms and devices.

Therefore, although there is a lot of potential for augmented reality technology in the healthcare and other sectors, there are still some obstacles that must be overcome.

## VI. AUGMENTED REALITY IN CARDIOVASCULAR CARE

Cardiovascular anatomy is very complex and difficult which requires long term education to achieve high quality standards in its care for diagnostics and therapeutic approaches. AR is an

innovation tool to enhance the diagnostics of cardiovascular care, for healthcare providers and patients. AR has the potential to revolutionize cardiovascular care by providing doctors with a new way to visualize and interact with patient data in real time.<sup>[10]</sup>

One example of the use of AR in cardiovascular care is the use of AR glasses or headsets that can display important patient data such as heart rate, blood pressure and oxygen levels right in the doctor's field of view. This allows doctors to monitor the patient's health indicators without having to take the patient's eyes off, which can improve the quality and efficiency of treatment. AR can also be used in medical education to provide interactive 3D models of the heart and cardiovascular system. This can help healthcare professionals better understand the complex anatomy and physiology of the heart and cardiovascular system. Another application of AR is through the use of VR training simulators. This allows doctors to practice complex cardiovascular procedures in a safe, simulated environment. AR can also be used in medical education to provide interactive 3D models of the heart and cardiovascular system that can be manipulated and explored in real time. It can help medical students and healthcare professionals better understand the complex anatomy and physiology of the heart and cardiovascular system.

AR has the potential to transform cardiovascular care by providing physicians with new tools to visualize and interact with patient data, improve medical education, and improve physician practice.<sup>[11]</sup>

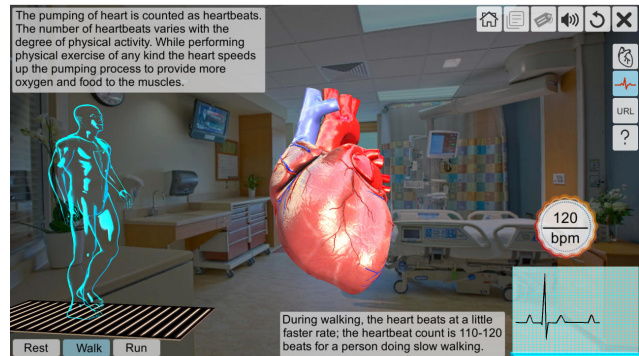
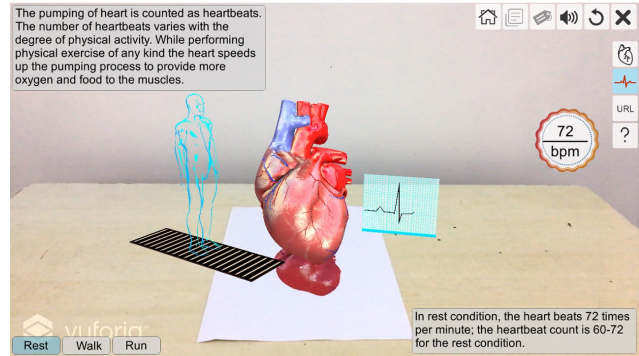
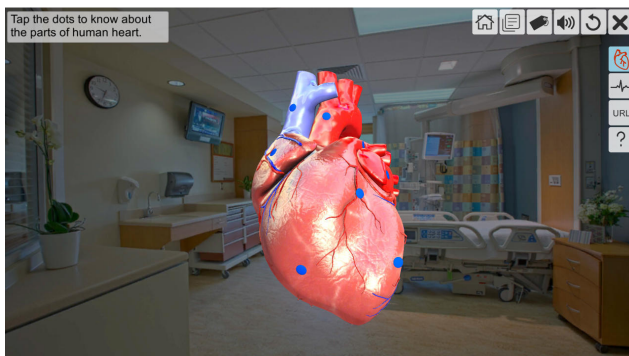


Image source: AR Human heart – A glimpse, by MT Concepts, 2019.

Through the above images you get to visualize a heart through a headset or any other suitable hardware.

## VII. ADVANTAGES OF AR IN CARDIOVASCULAR CARE

1. **Hands-free use:** AR glasses or headsets can be used in hands-free mode, allowing doctors to focus on the patient and avoid distractions while processing patient data.
2. **Enhanced Education and Training:** AR can be used to provide interactive 3D models of the heart and cardiovascular system that can be used to educate physicians and healthcare professionals and improve their understanding of complex cardiovascular anatomy and procedures.
3. **Better patient outcomes:** By giving doctors a better understanding of patient data and

anatomy, AR can improve patient outcomes and improve the overall quality of care.

4. **Reduced radiation exposure:** AR can be used to guide minimally invasive cardiovascular procedures, which can reduce the need for radiation exposure during procedures and improve patient safety.
5. **Reduced risk and Complications:** By giving medical professionals a more accurate and thorough image of the patient's anatomy, augmented reality technology can help to lessen the risks and complications connected with invasive operations.

AR has several advantages in cardiovascular care, making it easier for doctors to use AR more efficiently.<sup>[12]</sup>

#### **VIII. ALGORITHM FOR THE USE OF AR TECHNOLOGY IN CARDIOVASCULAR CARE**

1. **Choose the appropriate AR hardware and software:** Select the appropriate technology, be it a headset or any other proper technology based on the use care.
2. **Scan the patient's anatomy:** The patient's cardiovascular anatomy should be captured in detail using a 3D scanner or imaging technology. The heart, blood vessels, and other interesting structures can be included in this.
3. **Create an AR visualisation:** Use the scanned information to generate a 3D depiction of the patient's anatomy that can be shown in real time with augmented reality technology. This can make it easier for medical professionals to comprehend the anatomy of the patient and spot any anomalies or disorders.
4. **Integrate with other medical devices and systems:** In order to give a patient a more

complete picture of their cardiovascular health, AR technology can be combined with other medical equipment or systems, such as imaging technology or electronic health records.

5. **Use AR for diagnosis and treatment planning:** Using the AR visualization, healthcare professionals may identify cardiovascular disorders and create a customized treatment plan for each patient.
6. **Monitor post-operative recovery:** Track changes in cardiovascular health over time and track the patient's recovery following surgery using augmented reality (AR) technology.<sup>[13]</sup>

For a complete and efficient patient care solution, employing AR technology in cardiovascular care necessitates a combination of hardware, software, and medical knowledge.<sup>[14]</sup>

#### **IX. FUTURE SCOPE OF AUGMENTED REALITY**

Augmented reality is certainly going to be the future. The healthcare sector is prepared to use augmented reality (AR) technology more and more. The efficiency of healthcare delivery could be greatly improved, and patient outcomes could be dramatically improved, even if it might not totally replace conventional ways of care.

From patient care and treatment to medical education and training, AR technology can be employed in a variety of healthcare applications. It can give medical professionals a more thorough and interactive image of the patient's anatomy, aid in the more accurate diagnosis and treatment of diseases, and support surgical procedures and post-operative monitoring. In addition, AR technology can be used to improve patient engagement and education, allowing patients to better understand their condition and treatment options, and ultimately improve adherence to treatment plans.

Although there are still a few issues to be resolved, including the need for improved software and hardware as well as legal and ethical issues,

augmented reality technology has a lot of potential for the future of the healthcare sector.

In conclusion, AR technology is likely to play a bigger role in the healthcare sector going forward, offering creative and practical ways to enhance patient care and outcomes.<sup>[15]</sup>

## X. CONCLUSION

In conclusion, through this research paper we have a deeper overview about augmented reality in healthcare. We looked at augmented reality in a general and more specific way. Generally, we looked at the working of augmented reality, the concerns relating to augmented reality, the fields in which augmented reality can be used to make things easier. Specifically, we looked at augmented reality in cardiovascular care. We looked at how AR helps patients with heart problems.

The application of augmented reality (AR) technology in cardiovascular care has tremendous promise for enhancing patient outcomes and care delivery. AR technology aids in the diagnosis and treatment of cardiovascular disorders and ailments by giving medical professionals a more thorough and interactive image of the patient's anatomy. Additionally, it can be utilized to improve medical education and training, enabling medical professionals to advance their expertise in cardiovascular care.

Additionally, AR technology can enhance patient education and engagement, helping patients better grasp their diseases and available treatments. In the end, this may result in greater adherence to treatment plans and improved patient outcomes.

Although there are still certain obstacles that need to be resolved, including restrictions on hardware and software, data privacy and security, ethical dilemmas, and regulatory concerns, augmented reality technology has a bright future in cardiovascular care. We can contribute to improve the delivery of care and patient outcomes in cardiovascular health by continuing to progress the field and address these problems.

This research has emphasized the potential advantages of augmented reality (AR) technology in cardiovascular care and has offered insightful information about how to use this technology to enhance patient care and outcomes. Our objective is that this research will stimulate additional study and development of augmented reality (AR) technology in cardiovascular care, resulting in more effective and efficient care delivery in this crucial area. Lastly, we looked at the future scope of augmented reality.

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