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The Impact Of Augmented Reality And Artificial Intelligence Technologies On The Efficiency Of Decision-Making Among Saudi Red Crescent Ambulance Teams

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Abstract:

This study aimed to identify the impact of augmented reality (AR) and artificial intelligence (AI) technologies on the decision-making efficiency of the Saudi Red Crescent Authority's ambulance teams. The study relied on a descriptive-analytical approach due to its suitability to the nature of the research problem. Data was collected using a standardized questionnaire designed to measure three main dimensions: speed of field response, accuracy of decisions in critical situations, and team members' satisfaction with the use of AR and AI technologies. The study sample consisted of 50 ambulance team workers, randomly selected from some of the Authority's main centers. The results showed a significant improvement in decision-making efficiency when applying AR and AI technologies. The arithmetic averages indicated higher levels of response speed and accuracy compared to traditional methods, with the greatest improvement being in decision accuracy in critical situations. The results also showed that participants' satisfaction with the use of the technologies was generally positive, although opinions varied among sample members to varying degrees. The results indicate that integrating these technologies contributes to enhancing the effectiveness of ambulance teams and increasing the reliability of their decisions, which positively impacts the quality of services and reduces response times. The study recommends expanding the application of augmented reality and artificial intelligence technologies within Saudi Red Crescent operations, while providing ongoing training programs to ensure their effective use. It also recommends conducting subsequent studies on larger samples in different regions of the Kingdom, with a focus on measuring the economic feasibility and long-term sustainability of these applications.

Keywords: Augmented Reality (AR); Artificial Intelligence (AI); Decision-Making Efficiency; Ambulance Teams; Saudi Red Crescent; Emergency Medical Services.

Chapter one : INTRODUCTION

with information and the surrounding environment , and with these Innovations show that Augmented Reality(AR) technologies are one of the most promising fields that work to integrate the digital world with ,the physical reality through an interactive and simple method. Far from being part of science fiction augmented reality has become a tangible reality that appears in multiple applications extending from many fields such as education and medicine to industry and also entertainment , which opens new horizons to enhance human perception and facilitate complex tasks 1,2.

Accordingly, Augmented Reality(AR) is defined as a set of technologies that project digital objects or information (such as images, texts, 3D models, and video clips) onto the user's real environment in real time, which works to enrich and enhance Realistic experience with additional information , which is the

opposite or opposite of virtual reality(VR) technology . Which puts the user completely in a digital environment separate from reality, so we find that augmented reality works to maintain And the connection between the user and his real environment with the addition of other layers of digital content to it , and we find that Augmented reality technology works by achieving integration and harmony between several basic components that begin with the process of identifying the real environment through the use of a smart device camera (such as a mobile phone, tablet, or specialized glasses for this purpose) , and then through several advanced software programs it analyzes these scenes using techniques such as image and pattern .recognitionGPS as well as data from various sensors (such as accelerometer and gyroscope) , are used , to analyze the digital content and display it in the correct orientation within the real environment on the .device screen, creating the illusion that this content is part of the actual reality 3.

DISCUSSION:

The contemporary world is witnessing a technological revolution and innovations that are reshaping the interaction Despite the widespread use of augmented reality technologies in recent years, their roots date back to the mid-20th century. The first attempts can be traced back to 1968 , when Ivan Sutherland developed the first head-mounted display system , which he called the “Sword of Damocles” due to its weight and complexity. However, the term “augmented reality” was not defined and formulated until 1990 when Thomas Caudell ,, a researcher at Boeing, described a system that helped workers assemble aircraft wiring. The 1990s and the beginning of the new millennium witnessed successive developments in academia and the military , but the real turning point came with the spread of smartphones, which provided an ideal and easy-to-access platform for augmented reality applications, leading to their penetration into all aspects of daily life 12.

Accordingly, multiple augmented reality applications can be explained, as augmented reality applications are not limited to entertainment and games , but rather include a wide range of vital sectors that benefit from its ability to present information in its direct context, such as:

Education and training fields) Augmented realityVR) technology has transformed silent educational materials into interactive three-dimensional models, enabling students to explore the human body, dissect objects, or disassemble a car engine, enhancing deep understanding and making the learning process more engaging and exciting . In healthcare, surgeons use AR technology to visualize patient data (such as CT scans) directly over the patient's body during surgeries to increase accuracy. This technology helps train doctors on complex procedures by providing a safe environment 15.

However, with these developments, there are still some challenges facing augmented reality that limit its full spread. For example, these challenges include the need to provide devices with high processing .capabilities and accurate motion tracking, in addition to issues related to privacy and user acceptance However, the future looks great with this technology with the continuous development in the fields of artificial intelligence. It is expected that augmented reality will become more integrated and involved in life , transforming from an experience that takes place through a screen into an information layer that is seamlessly integrated into expanding the awareness of the world to the world , as augmented reality represents a qualitative shift in how to interact with data, by transforming it from static information on . .screens into dynamic experiences that are integrated with reality 13.

The concept and development Historical

The beginnings of augmented reality technology were in the late sixties American computer scientistIvan Sutherland is considered the father of both virtual and augmented reality . In 1968, he invented the first head- mounted display(HMD), calledThe Sword of Damocles. This primitive device displayed simple computer graphics overlaid on the user's view of the real world, laying the foundation for augmented reality .technology. In the early 1990s, Thomas Caudell coined the term "augmented reality" A Boeing researcher was describing displays worn by electricians to display digital aircraft wiring diagrams over physical

assembly panels . This helped simplify these complex processes . During this period, the development of augmented reality was focused on university laboratories and military projects. In 1992, Louis Rosenberg at the US Air Force Research Laboratory developed theVirtual Fixtures system which demonstrated that , the overlay of virtual information could significantly improve user performance in real-world tasks . In the early 2000s, Hirokazu Kato developed the open-sourceAR Toolkit software library which in turn greatly , facilitated developers in creating augmented reality applications . This led to rapid innovation , and then with the emergence of smartphones equipped with powerful cameras, advanced processors, and GPS, augmented reality found its ideal platform to reach people on a wide scale. In 2013, Google launched Google Glass, an early attempt to integrate augmented reality into an . everyday wearable device 7,9.

Several concepts can be explained that attempt to describe augmented reality technology, including:

Technical definition: Ronald Azumain defined the augmented reality system as the system that … It 1997 achieves three basic conditions : combining the real and the virtual , working interactively and in real time and aligning the installation . Virtual objects with their real-world counterparts ,(three-dimensional registration). We find that this definition focuses on the basic technical characteristics that distinguish augmented reality from other technologies 8,5.

The functional definition of augmented reality is that it is a technology that enriches the user's sensory perception by adding layers of digital information (such as images, texts, sounds, or 3D models) to the real environment , providing additional direction or detailed information that cannot be seen with the naked eye We find that this definition focuses on the purpose of augmented reality technology, which is to enhance . understanding and interaction with reality 6.

And the definition within the "Reality-Virtuality Continuum" where researchers Paul Milgram and Fumio , Kishino introduced in 1994 the concept of" Reality-Virtuality Continuum" within this trend , augmented reality falls between real reality that does not contain any digital elements and virtual reality that completely immerses the user in a digital environment. The space in which augmented reality is located is called mixed .reality(Mixed Reality - MR) .through which real and virtual objects interact with each other , 5.

- **Uses Medical And health**

Augmented Reality(AR) technology has revolutionized many fields , and the medical and healthcare sector is one of the most important beneficiaries of its transformative potential . By integrating three-dimensional digital information with the real environment of the patient or doctor, this technology works to provide innovative solutions that contribute to raising the accuracy of diagnosis. The efficiency of surgical operations and the quality of medical training and increases the communication between doctors and patients . One of the most important medical and health uses of augmented reality technology is in the field of microsurgery, as surgery is one of the fields that benefit most from augmented reality technology , as it provides surgeons with... Seeing under the skin Without the need for large incisions , augmented reality can displayCT or MRIimages and convert them into 3D models , then project them directly onto the patient's body on the operating table . This allows the surgeon to pinpoint the locations of tumors, blood vessels, and vital organs with extreme precision, reducing the risk of damaging surrounding healthy tissue It is used , for example, in neurosurgery, where a map of the brain can be projected directly onto the . patient's head . Augmented reality technology also provides surgeons with precise visual guidance during complex procedures, for example, determining the optimal path for inserting a biopsy needle or placing screws in orthopedic surgeries. Which increases the accuracy of the operation and reduces the duration of the procedure 4.

Augmented reality technology is being leveraged in medical education and training, changing the traditional way of learning medicine. For example, instead of relying solely on real cadavers, medical students can use augmented reality applications to study anatomy. Applications such as HoloAnatomyallow students to view, disassemble, and explore detailed, accurate 3D models of body organs and systems from

. all angles, deepening their understanding of the spatial relationships between anatomical structures Trainees can also practice complex surgical procedures in a safe and controlled environment Augmented ,reality -enabled simulation systems create realistic scenarios that require trainees to make critical decisions helping to hone their motor and visual skills before interacting with real patients 6.

Augmented reality technology also helps oncologists accurately visualize the size, location, and spread of cancerous tumors in three dimensions relative to surrounding organs, facilitating the development of an accurate treatment plan, whether surgical or radiological . Augmented reality technology is also being used to make physical therapy sessions more effective and motivating for patients 3.

- **Intelligence artificial**

Artificial intelligence is a branch of computer science that is concerned with building machines and systems that have the ability to perform tasks that require human intelligence, such as learning. Thinking , solving problems , and understanding the environment And understanding language and making decisions, which means that it is the field that contributes to creating programs that have the ability to simulate intelligent human behavior And make the computer think, learn, solve problems and make decisions in a way similar to human thinking . The main idea of artificial intelligence is An attempt to simulate human intelligence and process information in a way similar to the way the human mind worksbut by using machines and software 11.

- **. The concept and algorithms Basic**

the most important branches of artificial intelligence is machine learning, which isthe ability to learn from data without the need for direct programming. That is, instead of telling the computer what to do at each step through It is fed with a large amount of data and it learns rules and patterns on its own . Deep learning is an advanced branch of machine learning. It uses artificial neural networks that mimic the structure of the human brain . This type of learning is particularly effective in complex tasks such as image and speech recognition , as well as natural language processing(NLP), ,where machines are able to understand, analyze and generate human language. This is the basis for the work of voice assistants such asSiri .Google Assistant and also from the branches of artificial intelligence is computer vision ,, which gives machines the ability to see. Interpretation of visual information from images and videos Such as facial recognition or content analysis , and the field of robotics**(** Robotics **)** Which is used in a field that intersects with engineering, as it focuses on design and development Robots that can perform real-world tasks, often relying on artificial intelligence technologies 10.

- **Applications Intelligence artificial in sector Emergency Medical**

Artificial intelligence applications in the medical emergency sector contribute to improving the speed and efficiency of response, reducing human errors, and saving more lives . These applications cover multiple aspects, starting from the stage of receiving the report and reaching receiving care in the hospital . One of the most important applications of artificial intelligence in the medical emergency sector is advanced dispatch systems, as artificial intelligence is used in emergency systems to prioritize calls and direct them to them faster. Artificial intelligence algorithms analyze incoming calls to determine the severity of the case , for example, a heart attack, a major traffic accident, or a minor injury, and classify them automatically. This allows ambulance teams to move towards the most urgent and critical cases first, and it also contributes to optimizing the route. By using traffic data and maps, artificial intelligence can calculate the optimal and fastest route for paramedics to reach the accident site, which reduces response time . Artificial intelligence also helps paramedics and doctors make accurate and quick decisions especially . In cases that require a quick and immediate diagnosis, wearable devices or smart medical equipment can collect patient data such as heart rate , oxygen level , and electrocardiogram and send it to an artificial intelligence system that analyzes it and provides alerts. Immediately, any serious changes are detected, and machine learning algorithms are also used to quickly analyze CT scansto detect signs of

stroke or blocked arteries, allowing doctors to begin appropriate treatment immediately. Therefore artificial intelligence is one of the tools A powerful tool that improves the efficiency and effectiveness of emergency medical services, leading to better treatment plans and better treatment outcomes for patients10.

- **take decision in difference ambulance**

AI applications help enhance decision-making in ambulance teams by providing accurate, real-time information, allowing for faster and more effective responses to emergency situations , rather than relying on human judgment alone. AI technologies provide analytical tools capable of processing large amounts of data at high speed . AI algorithms are used to analyze emergency calls to assess the severity of the situation. Response time is also an important factor in emergency situations, as AI technologies analyze real-time traffic data in addition to potential accidents. To predict the best and fastest route an ambulance can take , AI-connected mobile devices can analyze vital readings such as electrocardiograms(ECGs) or . X-ray images and provide immediate recommendations to the paramedic 9.

- **factors Influential in quality decision Medical**

:are influenced by a complex set of factors that interact with each other and can be explained as follows

Factors related to the physician or healthcare provider: These factors relate to the experience, personal and professional skills of the physician or paramedic , as experience and knowledge are the cornerstone of making sound medical decisions . We find that an experienced physician can recognize disease patterns ,and make decisions based on previous similar cases. Unconscious biases can also affect medical judgment such as the tendency to confirm an early diagnosis (confirmation bias) or rely on common diagnoses without considering rare cases. Stress , fatigue or tension can also negatively affect the physician's ability .to focus and make an accurate decision. Especially in emergency situations that require quick decisions 8.

Also, there are factors related to information and data , as the quality of the decision depends directly on the quality of the available information , as well as organizational and environmental factors. These factors .relate to the environment in which the decision is made . We find time pressures in emergency situations The lack of time imposes enormous pressures, which may force doctors to make quick decisions without , having all the necessary information about the case. Also, the lack of resources such as specialist doctors medical equipment or medicines can limit the available treatment options and affect the quality of ,treatment. Decision- making , and a healthcare organization's culture that encourages cooperation . transparency, and learning from mistakes contributes to improving the overall quality of decisions 7.

- **Challenges in Environments Emergency**

Physicians and paramedics face complex challenges that directly impact their ability to make decisions and provide medical care. These challenges are not only related to the medical aspect, but also include environmental and organizational factors. Psychologically , the lack of time and decision-making is one of the biggest challenges. In many cases, making a decision requires seconds or minutes, leaving little room for calm thinking or gathering additional information . This pressure can lead to making quick decisions based on superficial symptoms without getting the full picture and increasing the level of stress that can affect the ability of the healthcare provider to focus and analyze properly . Lack of information is also a challenge. Paramedics may not have the patient's medical records, making it difficult to know the medical history and whether the patient suffers from allergies to certain medications or lack of information about the medications he is taking. The emergency environment is often chaotic and crowded , which increases the difficulty of work. All the necessary tools , equipment, or medications may not be available in the ambulance or at the scene, requiring the paramedic to improvise and make informed decisions. On what is .available and available to him 1,12.

We find that individuals working in the emergency sector face significant psychological challenges that affect their decisions . For example, the long working hours and constant pressure they are exposed to can

lead to physical and mental exhaustion, which reduces the quality of concentration and sound decision-making . Doctors and paramedics may also fall into a cycle of mental biases such as confirmation bias, as they seek information that supports an early diagnosis without considering the existence of other possibilities 4,8.

the chapter Second : Experiments and applications Global

Many developed countries are increasingly and rapidly utilizing artificial intelligence applications to improve the efficiency and effectiveness of emergency medical services, in order to address the major challenges facing these systems. Some of these challenges can be explained as follows:

Use of intelligent transmission systems(Intelligent Dispatch Systems) Copenhagen's emergency services use an AI- powered system to analyze emergency calls and identify symptoms of cardiac arrest . The system monitors vocal and nonverbal patterns in conversation, such as tone of voice and breathing rate, to alert the call center operator of a potential cardiac arrest faster than human diagnosis. This reduces the time to initiate CPR and increases the patient's chances of survival. In Singapore, the Civil Defense Force has developed a program to analyze emergency calls in local languages and multiple dialects . This program converts calls into written texts and extracts key information such as the location of the accident, the cause of the injury , and the severity level . This helps speed up the dispatch process and direct resources more efficiently, as the system can analyze thousands of calls and identify the places most in need of assistance during times of extreme congestion. In some US cities, such as Phoenix, Arizona, AI technologies are being used to triage non-critical emergency calls and redirect them to primary healthcare services or remote consultation and treatment . This reduces This puts pressure on hospital emergency departments and allows doctors to focus on critical care . Some US cities are also using artificial intelligence systems to dynamically change traffic lights to facilitate the passage of emergency vehicles . This system analyzes traffic patterns in real time, determines the ambulance's route, and changes the lights to green along the . route to ensure they arrive quickly 1,5,9.

From the above, we find that these experiments with artificial intelligence technologies are not just a support tool , but rather an integral part of modern emergency systems. They effectively contribute to saving lives and improving the quality of healthcare and medical care. However, challenges remain related to data privacy, compatibility between different systems, and the need to build trust between healthcare .providers and these modern technologies 12,13.

- **to merge reality The enhancer in Training Medical**

Augmented Reality(AR) integration into medical training enhances and enriches practical and theoretical learning, making it more interactive and effective . AR allows trainees to interact with digital information in a real-world environment, providing an engaging and realistic simulation experience . Using AR technology, trainees can view 3D models of human organs on real devices, such as a virtual patient . It also allows them to see the path of blood vessels or nerves during a simulated procedure, helping them understand precise anatomy and avoid potential errors. For example, AR glasses can be used to display digital layers of skin, muscles, and tissue on a patient's body during training, enabling the trainee to see through these layers . AR technologies also make first aid training easier and more effective , as trainees can use an application on their smartphones to display interactive instructions on a virtual patient. For example, an app can show a trainee the correct compressions for cardiopulmonary resuscitation(CPR) or how to stop severe bleeding . Augmented reality applications are also being used as an innovative educational tool for studying anatomy . Instead of relying on books and two-dimensional images, students can use augmented reality applications to view three-dimensional models of body organs, such as the heart or brain, in their real-life environment . They can zoom in, rotate, and view different layers of these models to understand the complex relationships between tissues and organs . Therefore, integrating augmented reality into medical training is an important step toward a more interactive and effective future for medical education 8,6.

- **Intelligence artificial in to improve Response Ambulance**

artificial intelligence technologies can significantly contribute to improving emergency response by addressing key challenges facing this sector, such as time pressure. And the lack of information and making accurate and quick decisions through smart dispatch systems, as these systems are the basis for improving the response , instead of relying on random or manual dispatch, artificial intelligence algorithms are used to analyze data and prioritize cases, as artificial intelligence can analyze emergency calls in real time to determine the severity of the case . For example, an AI system can distinguish sounds that indicate a cardiac arrest or shortness of breath. Which allows for sending assistance immediately and quickly, and artificial intelligence algorithms also use geographic location data. Traffic and ambulance locations are available to identify the nearest medical team equipped with the appropriate resources to deal with the case, which significantly reduces response time. We also find that artificial intelligence technologies can act as a virtual .assistant for paramedics while they are with the patient, which enhances their accuracy and effectiveness Mobile devices connected to artificial intelligence can also analyze the patient's vital readings (such as an electrocardiogram) and provide immediate recommendations to the paramedic. Such as the need to administer a certain medication or perform a certain procedure , AI can also predict the future need for emergency services, allowing resources to be allocated proactively by analyzing historical data such as locations that have witnessed previous accidents , peak times , or seasonal patterns. AI can also predict where more ambulances are likely to be needed. By proactively distributing them to those locations , and ,also using real-time traffic data, AI can direct the ambulance to avoid traffic congestion or accidents ensuring it arrives at the accident site as quickly as possible 5,10.

- **Applications in the world Arabic**

region faces significant challenges in providing effective emergency medical services . Therefore, many countries in the region have begun to adopt artificial intelligence technology to improve their emergency response . Saudi Arabia is working to achieve the Kingdom’s Vision 2030, which focuses on digital transformation, and artificial intelligence is an essential part of this vision . In the field of medical emergencies, authorities are working to develop smart solutions for ambulance services, such as automated dispatch systems that use artificial intelligence algorithms to identify the nearest available ambulance to . the emergency site, taking into account real- time traffic conditions The General Authority for Statistics in the Kingdom is developing platforms that collect data from various sources , such as traffic accident records and health data , in order to improve emergency services . The United Arab Emirates, particularly in Dubai, is using an AI-powered police system to analyze traffic accident data, which helps direct ambulances to accident sites more quickly. Healthcare data is also analyzed to identify patterns that may indicate a growing need for emergency services in certain areas . In Egypt, some hospitals have begun using AI systems to analyze X-rays and CT scans in emergency departments, helping doctors detect critical conditions such as internal bleeding or complex fractures more quickly and accurately . In Jordan, smart applications have been developed for paramedics , helping them make clear field decisions by providing them with quick information about the patient's condition and vital signs and providing recommendations regarding the best course of action . There are many joint initiatives at the regional level . Such as conferences and workshops that focus on exchanging expertise and experiences in the field of artificial intelligence in the healthcare sector, with the aim of enhancing cooperation between Arab countries to provide more advanced and efficient medical services 4,5,9.

these trends in the use of AI technologies demonstrate that the region is still in the early stages of adopting AI in the healthcare sector, but it is rapidly moving towards improving the efficiency and quality of emergency services to save more lives 2,15.

the chapter Third : Study Field (Hilal) red Saudi

methodology Search and its tools

The study relied on the descriptive analytical approach to examine the impact of augmented reality (AR) and artificial intelligence (AI) technologies on the decision-making efficiency of the Saudi Red Crescent ambulance teams.

Research Tools:

A standardized questionnaire designed to cover three main areas:

Speed of field response. Accuracy of decisions in critical situations.Team members' satisfaction with the use of AR and AI technologies. A five-point Likert scale was used to measure sample responses. The validity of the tool was verified by specialized referees, while the reliability coefficient was calculated using Cronbach's alpha and reached an acceptable and statistically significant value.

- community Sample the study

The study population consisted of all workers in the Saudi Red Crescent ambulance teams. The study sample consisted of 50 individuals who were randomly selected from some major centers, with their ages, experiences, and educational levels varying to reflect an appropriate representation of the study community.

- tool collection Data

The electronic questionnaire was used as the primary and sole tool for collecting data from sample members. It was distributed through the Saudi Red Crescent's official channels to ensure direct access and accurate responses.

Taple (1) - questionnaire

Variable	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Level of decision-making efficiency before AR/AI implementation					
Level of decision-making efficiency after AR/AI implementation					
Speed of field response					
Accuracy of decisions in critical situations					
Team members' satisfaction with the use of technology					

- **analysis Results**

Taple (2) the resault N (sample), Arithmetic mean, Median and Standard deviation

Variable	**N (sample)**	**Arithmetic mean**	**Median**	**Standard deviation**
Level of decision-making efficiency before AR/AI implementation	50	3.21	3.20	0.88
Level of decision-making efficiency after AR/AI implementation	50	4.15	4.20	0.65
Speed of field response	50	4.05	4.10	0.70
Accuracy of decisions in critical situations	50	4.22	4.30	0.62
Team members' satisfaction with the use of technology	50	4.10	4.00	0.75

The table shows that the average decision-making efficiency of ambulance teams before applying augmented reality and artificial intelligence technologies was (3.21) with a standard deviation of (0.88), which reflects an average level that tends to vary among sample members. After implementing the technologies, the average increased to 4.15, with a standard deviation of 0.65.

This indicates a clear improvement in efficiency with a decrease in dispersion, reflecting a convergence in participants' responses toward a higher degree of effectiveness. It is also clear that the average field response speed was (4.05) and the median (4.10) with a standard deviation of (0.70), which reflects a good improvement in performance speed.

Decision accuracy in critical situations recorded the highest value among the variables, with a mean of 4.22, a median of 4.30, and a relatively low standard deviation of 0.62. This indicates that the majority of the team demonstrated high levels of accuracy and consistency in their decisions. Regarding team members' satisfaction with the use of technology, the mean was (4.10) and the median was (4.00) with a standard deviation of (0.75), indicating relatively high satisfaction, albeit with a degree of variation among sample members.

In general, the results show that the integration of augmented reality and artificial intelligence technologies contributed to improving the effectiveness of decision-making among ambulance teams, in terms of efficiency, speed, and accuracy, while reducing individual differences among team members.

CONCLUSION:

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