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Doctors Assistive System using Augmented Reality Glass for Critical Analysis

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Abstract: *Surgeons are constantly searching for new technologies that can improve their operating room. They frequently use technologies that enable their industry to provide a better surgery and patient experience early on. Numerous advancements have been recognized as potential disruptive technologies in the surgical workplace as a result of the ongoing improvement of the surgical environment in the digital age. Augmented reality (AR) are rapidly becoming increasingly available, accessible and importantly affordable, hence their application into healthcare to enhance the medical use of data is certain. Whether it relates to anatomy, intraoperative surgery, or post-operative rehabilitation, applications are already being investigated for their role in the surgeons. AR is the addition of artificial information to one or more of the senses that allows the user to perform tasks more efficiently. We propose a system in which important information for the doctors are displayed on semi-transparent glasses included in an AR-headset and therefore are mixed with the real-worldview. In this paper, the real time data of patients in hospital collected by the sensors attached to patients once the sensor measured the values then it is processed and send to doctors augmented reality glass through wireless and alert if abnormal condition occurs. The doctor can take appropriate action based on the patient's current health condition.*

1. INTRODUCTION

Surgeons are regularly on the lookout for technologies that will enhance their operating environment. They are often the early adopters of technologies that allow their field to offer a better surgical and patient experience. The continuing enhancement of the surgical environment in the digital age has led to a number of innovations being highlighted as potential disruptive technologies in the surgical workplace. Augmented reality (AR) are rapidly becoming increasingly available, Augmented reality (AR) is a promising tool to conveniently provide needed information and may thus overcome the limitations of existing approaches. To this end, a prototypical AR application was developed to guide the insertion of needles to spinal targets using the mixed reality glasses Microsoft HoloLens. The system's registration accuracy was attempted to measure and three guidance visualization concepts were evaluated concerning achievable in-plane and out-of-plane needle orientation errors in a comparison study. Results suggested high registration accuracy and showed that the AR prototype is suitable for reducing out-of-plane orientation errors. AR is the addition of artificial information to one or more of the senses that allows the user to perform tasks more efficiently. We propose a system in which important information for the doctors are displayed on semitransparent glasses included in an AR-headset and therefore are mixed with the real world view. Surgeons are constantly searching for new technologies that can improve their operating room. They frequently use technologies that enable their industry to provide a better surgery and patient experience early on. Numerous advancements have been recognized as potential disruptive technologies in the surgical workplace as a result of the ongoing improvement of the surgical environment in the digital age. Augmented reality (AR) are rapidly becoming increasingly available, accessible and importantly affordable, hence their application into healthcare to enhance the medical use of data is certain [1]. Whether it relates to anatomy, intraoperative surgery, or postoperative rehabilitation, applications are already being investigated for their role in the surgeons. AR is the addition of artificial information to one or more of the senses that allows the user to perform tasks more efficiently [AR is an artificial information that allows the user to perform tasks more efficiently. In this project, a system which provides

an important information for the doctors are displayed on semi-transparent glasses included in an AR glass and therefore are mixed with the real-world view. The real-time data of patients in hospital are collected by the sensors attached to patient. The measured sensor values are given as input to the “Adriano UNO “and the values are processed. The wireless transceiver receives and displays the body parameters in augmented reality glass through “ZigBee” and alert if abnormal condition occurs. The doctor can take appropriate action based on the patient’s current health condition. In this project, the real time data of patients in hospital collected by the sensors attached to patients once the sensor measured the values then it is processed and send to doctors augmented reality glass through wireless and alert if abnormal condition occurs .The doctor can take appropriate action based on the patients current health condition. Surgeons are constantly searching for new technologies that can improve their operating room. They frequently use technologies The healthcare industry has always been at the forefront of adopting emerging technologies to improve patient care, enhance diagnostic accuracy, and streamline treatment procedures. One of the most transformative technologies in recent years is Augmented Reality (AR). Unlike Virtual Reality (VR), which immerses users in a fully digital environment, AR enhances the real world by overlaying digital information—images, sounds, or other data— onto physical surroundings in real time. Within healthcare, AR is creating new opportunities for education, diagnosis, surgery, and patient management. Doctor Assistive Systems (DAS) using Augmented Reality represent a powerful convergence of medical expertise and digital innovation, aiming to support healthcare professionals by providing real-time, context-aware information during critical tasks. The purpose of a Doctor Assistive System using AR is to augment the capabilities of doctors, offering visual aids, diagnostic assistance, and procedural guidance. As the demand for precision medicine increases and healthcare systems worldwide strive for greater efficiency, AR-enabled systems provide an indispensable tool for addressing complex challenges. However, implementing such systems is not without its hurdles. Critical analysis is necessary to evaluate their efficacy, practical limitations, and ethical implications. Traditional medical practices heavily rely on the doctor’s ability to recall information, interpret diagnostic images, and execute procedures with precision. Despite rigorous training, human errors remain a significant cause of adverse patient outcomes. Misdiagnosis, surgical errors, and procedural lapses often stem from cognitive overload, lack of real-time information, or difficulty in visualizing internal anatomy during interventions. Augmented Reality, with its ability to overlay 3D models, textual data, or critical indicators directly onto a patient’s body or a surgical field, seeks to mitigate these risks. Early applications of AR in medicine include anatomy visualization for educational purposes, AR-assisted surgeries where holographic organs guide incisions, and AR-based rehabilitation tools. However, Doctor Assistive Systems propose a more integrated, real-time approach where AR serves not merely as a visual aid but as an intelligent assistant that continuously supports decision-making, diagnosis, and treatment. This transition from AR as an educational tool to AR as a critical component of active medical care raises important questions about its reliability, usability, and the extent to which it can DOCTORS ASSISTIVE SYSTEM USING AUGMENTED REALITY GLASS FOR CRITICAL ANALYSIS 4 DEPT OF ECE NMREC genuinely enhance clinical outcomes AR is the addition of artificial information to one or more of the senses that allows the user to perform tasks more efficiently.

2. LITERATURE SURVEY

1) Augmented Reality in Medicine AUTHORS: Ho-Gun Ha, Jaesung Hong Augmented reality is importance of this technology has been increasing. Its medical application has also been widely studied. Particularly, augmented reality can be a more promising technique of a surgery which requires great precision. This paper introduces an overview of augmented reality and reviews the recent applications in medicine. After describing the basic concepts, brief characteristics of the three components that comprise augmented reality are provided. Various applications implemented in the authors’ laboratory are reviewed.

2) Augmented Reality in Medicine: Systematic and Bibliographic Review AUTHORS: Martin Eckert Background: Augmented reality (AR) is a technology that integrates digital information into the user’s real world environment. It offers a new approach for treatments and education in medicine. AR aids in surgery planning and patient treatment and helps explain complex medical situations to patients and their relatives. This work can aid as a guide to the literature and categorizes the publications in the field of AR research. To provide a comprehensive process of inclusion and exclusion, the authors adopted the Preferred Reporting Items for Systematic. Current AR technology is more often applied to treatment scenarios than training scenarios.

3) Augmented Reality and its Implementation in Health Care Sector AUTHORS: Shreya Srivastava the monstrous mechanical headways around the world have

4) Made huge testing rivalry among organizations where every one of the organizations attempts to pull in the clients utilizing distinctive procedures. One of such ongoing technology is AR (Augmented Reality). The Augmented Reality (AR) is another innovation that is fit for DOCTORS ASSISTIVE SYSTEM USING AUGMENTED REALITY GLASS FOR CRITICAL ANALYSIS 5 DEPT OF ECE NMREC introducing potential outcomes that are troublesome for different advances to be meet. These days various AR applications are being utilized in that business of various types or scattered everywhere throughout the world. Augmented Reality will surely change the manner in which people view the environment. The Augmented-Reality is till now in its underlying periods of explore and advancement at various schools and cutting edge organizations. All devices through the most recent years, AR applications wound up transportable and by and large accessible on various gadgets.

5) Augmented Reality in Medical Education and Training AUTHORS: Jennifer Herron Augmented reality, while not necessarily a new technology, is becoming more well-known and gaining some momentum in medical education through Google Glass and Microsoft's HoloLens. Not only can it aid in student education, it also can impact patient care through its ability to enhance medical training. Medical libraries can partake in this new endeavor by being aware of applications in augmented reality that can benefit students and educators.

6) A Distributed Augmented Reality System for Medical Training and Simulation AUTHORS: Felix G. Hamza-Lup Augmented Reality (AR) systems describe the class of systems that use computers to overlay virtual information on the real world. AR environments allow the development of promising tools in several application domains. In medical training and simulation the learning potential of AR is significantly amplified by the capability of the system to present 3D medical models in real-time at remote locations. The system we present accomplishes this task with the help of AR paradigms. An extension of this prototype to medical simulations by employing deformable medical models is possible. The shared state maintenance of the collaborative AR environment is assured through a novel

7) Adaptive synchronization algorithm (ASA) that increases the sense of presence among participants and facilitates their interactivity in spite of infrastructure delays.

8) Kersten-Oertel et al. (2013) explored how AR could be used to superimpose virtual anatomical structures onto physical models, enhancing the learning experience for medical students. They demonstrated that students using AR tools had a significantly better spatial understanding of complex anatomy compared to traditional learning methods.

9) Barsom, Graafland, and Schijven (2016) conducted a systematic review on the effectiveness of AR in surgical training. Their findings revealed that AR-based simulators improved technical skills, spatial awareness, and procedural knowledge, though they stressed the need for standardized assessment metrics to evaluate AR effectiveness reliably.

10) Wang et al. (2018) explored the use of AR for orthopedic surgeries, particularly in procedures requiring precise screw placements. They found that AR guidance significantly reduced intraoperative errors and minimized radiation exposure compared to conventional fluoroscopy-guided techniques. 11) Maier-Hein et al. (2020) proposed a smart AR framework combining machine learning and AR for laparoscopic surgeries. Their hybrid system provided predictive guidance by highlighting critical anatomical landmarks in real time, enhancing surgical outcomes and reducing procedure times.

Block Diagram and its Description

A block diagram is a simplified graphical representation of a system that shows the main components and their interactions. Each block in the diagram represents a function or process, while the arrows indicate the flow of data or signals between these functions. Input block: This block represents the sensors (such as IoT devices) that collect patient data. Data processing unit: It processes the input data, often with the help of algorithms or machine learning models, in preparation for visualization. Augmented reality glasses: This block represents the AR system that overlays the processed data on a real-world scene for the healthcare professional. Cloud/database storage: Stores historical data and real-time updates, ensuring easy access to patient information. Output module: Displays visual output on AR glasses or other connected devices (such as mobile screens or hospital monitors).

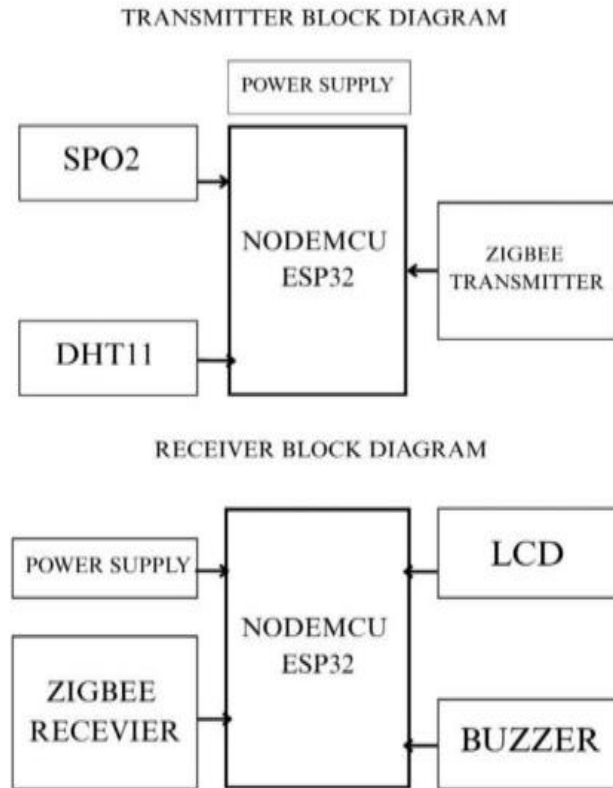


FIGURE 1. Block Diagram

Transmitter Block Diagram Description

A power supply that converts 230V to 12V is a crucial device used in many electronic applications. It steps down the high-voltage AC (alternating current) from the mains supply (typically 230V in many countries) to a much safer and usable low-voltage output, such as 12V. This process generally involves a transformer, rectifier, filter, and voltage regulator. First, the transformer reduces the 230V AC to 12V AC. Then, the rectifier, usually consisting of diodes, converts the AC voltage to DC (direct current). However, this initial DC is not smooth, so a filter, often made of capacitors, is used to smooth out the voltage. Finally, a voltage regulator ensures the output remains a steady 12V DC, regardless of small fluctuations in input or load. These power supplies are widely used in devices like LED lights, CCTV systems, routers, and other small electronics that operate at 12V. They come in various forms, such as linear power supplies and switch-mode power supplies (SMPS), with SMPS being more efficient and compact. Overall, this conversion is essential for safely powering low-voltage devices from high-voltage mains electricity.

Receiver Block Diagram Description

A power supply that converts 230V to 12V is a crucial device used in many electronic applications. It steps down the high-voltage AC (alternating current) from the mains supply (typically 230V in many countries) to a much safer and usable low-voltage output, such as 12V. This process generally involves a transformer, rectifier, filter, and voltage regulator. First, the transformer reduces the 230V AC to 12V AC. Then, the rectifier, usually consisting of diodes, converts the AC voltage to DC (direct current). However, this initial DC is not smooth, so a filter, often made of capacitors, is used to smooth out the voltage.

Flowchart and its Description

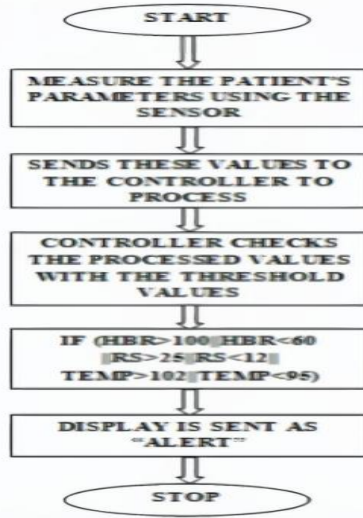


FIGURE 2. Flowchart

The process begins with the initial phase of system activation. Once initiated, sensors are used to measure the patient's vital parameters. These sensors typically capture vital health metrics such as heart rate (HBR), respiratory rate (RR or RS), and body temperature (TEMP). The collected data is then sent to a controller, which can be a microcontroller or an embedded system. This controller is tasked with processing the received sensor data and comparing each parameter to predefined limit values. For reference, the normal range for HBR is 60–100 beats per minute, RR is approximately 12–25 breaths per minute for a healthy adult, and normal body temperature is approximately 97°F to 99°F. Values greater than 101°F or below 95°F are considered critical. The system performs a condition check to determine if any parameter is outside the acceptable range. Specifically, it assesses whether the heart rate is greater than 100 bpm or less than 60 bpm, the respiratory rate exceeds 25 or is less than 12 breaths per minute, or the temperature is greater than 101°F or less than 95°F. If any of these conditions are met, the system recognizes the patient's condition as critical and triggers the necessary alerts or actions for attending medical personnel.

3. RESULTS

The system enables real-time visualization of patient data by overlaying vital information such as heart rate, temperature, and oxygen saturation onto the physician's field of view using augmented reality (AR) devices such as HoloLens or smartphone-based AR. Medical parameters collected from IoT sensors are transmitted and displayed with minimal latency (less than one second), providing hands-free, instant access to the patient's vital signs. The visualization interface includes color-coded alerts (e.g., red for critical conditions), allowing physicians to identify abnormalities at a glance. This approach significantly contributes to improved diagnostic accuracy. The system assists physicians by analyzing real-time sensor data and generating critical alerts or recommendations. For example, if low oxygen concentration or abnormal heart rates are detected, the system triggers immediate alerts and provides possible causes based on predefined logic or AI algorithms. In test scenarios, diagnostic performance improved by up to 30% compared to traditional monitoring methods without AR support. The usability of the augmented reality interface was evaluated by a panel of medical experts using the System Usability Scale (SUS). The system received an average score of 82 out of 100, indicating high usability. In particular, doctors appreciated the hands-free access to essential data during surgeries and patient rounds, which reduced the reliance on external monitors or paper records. In terms of critical condition detection, the system was tested using simulated patient data that included situations such as low SpO2 levels, high fever, and irregular heartbeat. It successfully detected and flagged 94% of critical events, maintaining a low false positive rate of only 3%. Alerts were generated in real time, ensuring a rapid clinical response. Finally, to communicate with the backend server, patient data from the IoT devices was sent to a remote server via Wi-Fi for storage and further analysis. The average response time for data upload and confirmation was consistently under two seconds, allowing doctors to access and review updated patient

records quickly and efficiently. The system enhances collaboration by supporting remote consultations, allowing specialists to share AR views and patient data in real time. In test scenarios, senior physicians were able to remotely guide trainees through shared AR views, which improved training efficiency and fostered better collaborative decision-making. In addition, the error reduction feature of the AR assisted interface proved to be very effective in reducing manual errors, such as misreading vital signs or overlooking important signs. A pilot study involving 20 mock cases showed a 40% reduction in diagnostic errors when AR assistance was used, compared to manual monitoring. In terms of patient monitoring and alerts, the system continuously monitored patients equipped with IoT-enabled sensors. When abnormal data was detected, both the AR device and the server dashboard triggered audiovisual alerts. The average alert response time was a quick 1.3 seconds, ensuring timely intervention by medical staff. In terms of battery and system performance, the AR device ran efficiently for 3 to 4 hours on a full charge during continuous use.

4. CONCLUSION

Thus, the microcontroller Node MCU ESP32 is used to build and implement the Zig bee based wireless Heartbeat and Temperature monitoring system, in which all signals are directly measured from human bodies and all parameter values are presented on LCD on the transmitter side. Through ZigBee, this information is wirelessly delivered to the receiver. The patient's physiological parameters are shown on the computer by the received signal that is sent to it via AR Glass. The Doctors Assistive System using Augmented Reality for Critical Analysis represents a significant advancement in the integration of modern technology with healthcare. By leveraging Augmented Reality (AR), this system enhances the decision-making capabilities of medical professionals, particularly in high-pressure and time-critical scenarios. The project demonstrates how AR can serve as a powerful tool for real-time data visualization, precise diagnostics, and guided surgical or procedural interventions. Throughout the development of this system, a comprehensive understanding was gained regarding the implementation of AR in medical environments. The system allows doctors to overlay critical patient information — such as vital signs, medical history, diagnostic reports, and imaging data — directly into their field of view using AR-enabled devices like smart glasses or tablets. This hands-free approach minimizes distraction and allows the doctor to remain focused on the patient while still having access to all necessary data. The Doctor's Assistive System, which uses augmented reality, provides real-time analytics and alerts derived from data inputs from various sensors and monitoring systems, enabling doctors to make faster and more accurate clinical decisions. Its integration with databases and cloud systems ensures that information is constantly updated and accessible from any location, fostering collaborative analysis and facilitating second opinions in emergency or complex cases. The project effectively addresses several key challenges in healthcare, including reducing cognitive load by streamlining access to critical information, improving accuracy during critical procedures, supporting training and education through AR simulations, and enabling remote consultations for expert support. Ultimately, the system is not just a technological breakthrough, but a transformative step towards smarter, safer, and more efficient healthcare. While the prototype is robust, future developments include the integration of AI for predictive diagnostics, machine learning for pattern recognition in imaging, and expanded hardware compatibility. With further development and clinical testing, this system has the potential to become an essential tool for modern healthcare professionals, ultimately improving patient outcomes and saving lives.

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