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Collecting Vital Information Using Virtual Healthcare Robot with the Help of IoT

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ABSTRACT—

Our thinking focuses on the capabilities of a convenient virtual expert robot, a user-friendly automated healthcare device that leverages the network of things and highlights the intelligent customer interface for therapeutic purposes (IoT). Check/Test Self-Screen, a virtual healthcare device, instantly checks body temperature, blood weight and heart rate. In critical cases, a specialist will be contacted online via video call and depending on the patient's condition, the specialist can contact to book an ambulance (depending on conditions). In nonemergency situations, the setting will dispense more medication based on health issues. Therefore, experts believe that this strategy can be applied in places where there is no immediate access to health services. Adopting this strategy in these regions not only contributes to health emergencies, epidemics, and pandemics like COVID, but also increases survival rates. Our whole system is controlled and monitored by microcontrollers and by Internet of Things.

Keywords –IoT, Healthcare, Robot, transparency

Introduction

In the era of new technologies healthcare sector has also evolved with new tech and machines making the whole ecosystem digital and easy to use and has also helped the Medicare system to work even faster in extreme conditions. The IoT platform gave this project a new path for the ecosystem and made all the facility smart.

These robots, also known as telemedicine robots, are designed to provide remote medical assistance to patients, especially in areas where access to healthcare facilities is limited. The virtual doctor robot is an innovative solution that combines the power of technology and healthcare, providing a convenient and efficient way for patients to receive medical care. This paper will discuss the concept of virtual doctor robots, their applications, benefits, and potential challenges.

Fig.1 Basic Virtual Healthcare Robot

Healthcare robots are fascinating innovations with the potential to revolutionize medical care in numerous ways. These robots can assist healthcare professionals in various tasks, ranging from patient care to administrative duties.

Fig.2 Modern day look of Virtual Healthcare Robot

2. Background Work

2.1 IoT in Healthcare system:

Current IoT application works on healthcare systems, contactless approach.

2.2 Virtual Robot Basics:

Giving introduction to this robot as it contains different sensors and other contactless methods to diagnose the patient.

2.3 Existing Integrations of IoT and Blockchain:

The first healthcare robot was used in surgery by using a robotic arm to cure patients but with increase in technology has now made robots to perform much better actions in this sector.

As we delve into the integration of IoT and healthcare bots this paper will give you a detail analysis about the working and the functions of healthcare robots with detail analysis that how the bot works, how it is useful and beneficial for the people.

3. Methodology

3.1 System Architecture

The proposed system mainly aims to make a virtual healthcare system which can work in any extreme condition without being in the contact with the patient.

IoT Device Integration:

The system will mainly use different sensors like temperature sensor, blood pressure sensor etc. to diagnose the patient. It will be connected to the application of the robot which will present real time data to both the patient and the doctor.

Fig.3 Working of Virtual healthcare Robot

Identity Management:

A proper identity management system is used to keep all the records separately i.e. each person is going to have their own set of data.

3.2 Data Security and Privacy

Security and user privacy are critical aspects of the proposed methodology. As patients' information are vital hence it is important to secure the data.

Secured Mechanism:

A secured mechanism will be developed, allowing patients to control the sharing of their data to whom so doctor or person they want.

User Identification for Security:

User identification will be used to ensure the data safety as each user will have their own UID hence the chances of data leak will be bare minimum.

3.3 Transfer of Data

Virtual healthcare robot will be able to transfer the data to anywhere the patient wants.

Smart Data Transfer:

Smart data transfer is used as it will collect all the data and other vital information of the patient and directly transfer it to the patient's application as well as the doctors.

Data Verification:

A mechanism will be integrated into it to verify the data of the patient so that the data shred is correct. The patient will first see the data then while uploading it the verification process is performed.

Integration with Cloud and IoT:

All the data shared and transferred will be stored in the cloud storage of the patient. The device will be integrated with the IoT which will help the sharing and storing of the data transfer easy.

3.4 Performance Monitoring

Real-time Monitoring:

A real-time monitoring system will track the performance of the healthcare robot to check whether the robot is functioning right or not. Real-time monitoring system is required as the data collected by the system is a vital information.

Scalability:

The scalability of the proposed system will be done based on the usage of the devices and the data collected through healthcare robots.

User Feedback and Improvement:

Each user will be allowed to give feedback as it will help the developers to know the review of the devices and to do the required changes.

Literature Review

IoT in Healthcare Systems:

The IoT in healthcare system has offered different number of benefits such as patient remote monitoring or improving the outcomes of the treatment.

Remote Patient Monitoring:

IoT has now evolved as a major source of collecting vital signs of the patient remotely. All the basic detailed information of the patient like blood pressure, temperature, heart rate and glucose levels can be measured remotely.

Health and Wellness Monitoring:

Smart healthcare devices allow the patient to check their basic health at their homes. This provides them feature to check or monitor their health on daily basis which give them proper feedback about their health.

Smart Hospital at Remote Areas:

This healthcare robot will provide hospitals to work in a smart way as all the monitoring will be done by the robots and it is also useful at remote areas because it only needs simple knowledge to learn, and patient can share their reports to doctors who are even far to them.

Implementation: Case Study

IoT Devices:

The implementation of healthcare robot is done based on the devices used in the system. All the devices are integrated together so that they can perform all the to ensure constant connectivity, the IoT devices were equipped with Wi-Fi module and high-speed communication modules such as GSM, which facilitated instant data transmission to the system.

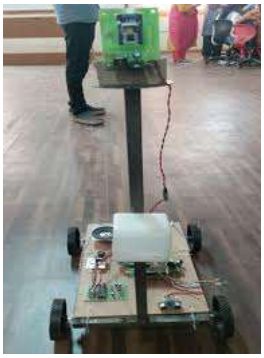

Fig.4 IoT devices implemented in healthcare system.

A) *ESP32*

The ESP32 is a powerful microcontroller and system-on-chip (SoC) commonly used in IoT (Internet of Things) projects due to its versatility, low cost, and extensive features. Developed by Espressif Systems, the ESP32 builds upon the success of its predecessor, the ESP8266, offering improved performance, more GPIO pins, integrated Bluetooth, and dual-core processing capabilities.

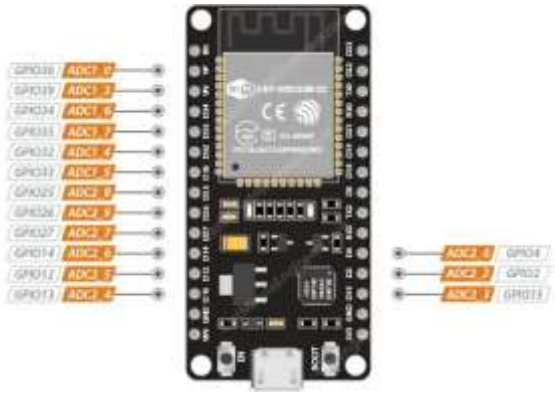

Fig.5 ESP32

B) *MAX30100*

MAX30100 is a pulse oximetry and heart rate monitor sensor. Developed by Maxim Integrated, the MAX30100 is designed to accurately measure heart rate and blood oxygen saturation (SpO2) levels using photoplethysmography (PPG) principles. MAX30100 is a versatile sensor module that enables accurate and reliable measurement of heart rate and blood oxygen saturation levels in a wide range of applications, from consumer wearables to medical devices. Its integration simplicity, low power consumption, and motion artifact rejection make it a popular choice among developers and manufacturers alike.

Fig.6 MAX30100

C) *AD8232*

AD8232 is an integrated single-lead heart rate monitor front end. Developed by Analog Devices, it is specifically designed to measure electrocardiogram (ECG) signals from the human body. AD8232 offers high performance, low power consumption, and ease of integration, making it an ideal solution for developers and manufacturers designing wearable health monitoring devices and portable ECG systems. Its ability to accurately capture ECG signals from the human body makes it a valuable tool for both consumer and medical applications.

Fig.7 AD8232

D) *Temperature Sensor*

Temperature sensors are electronic devices that measure temperature variations and convert them into electrical signals. They are widely used in various applications, from environmental monitoring to industrial processes and consumer electronics. The choice of temperature sensor depends on factors such as measurement accuracy, temperature range, response time, cost, and application requirements. Each type of sensor has its advantages and limitations, and selecting the right sensor for a specific application is crucial to achieving accurate and reliable temperature measurements.

Fig.8 Temperature Sensor

E) *16x2 LCD Display*

A 16x2 LCD display is a liquid crystal display with 16 characters displayed on 2 lines, commonly used in electronic devices for text output. It consists of a grid of 16 columns and 2 rows, allowing the display of alphanumeric characters, symbols, and basic graphics. These displays are controlled by a microcontroller or dedicated driver circuit, communicating through protocols like I2C or SPI. They offer simplicity, low power consumption, and clear visibility with backlight options. Popular in embedded systems, they serve various purposes like displaying sensor data, menus, and messages in electronic projects and consumer devices.

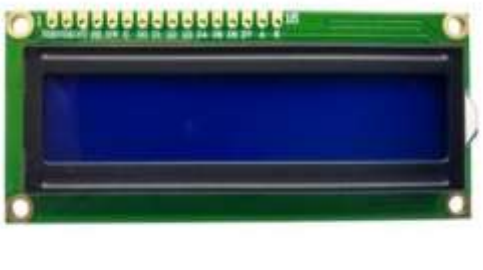

Fig.9 16x2 LCD Display

F) *Breadboard*

A breadboard is a tool used in electronics prototyping and experimentation. It provides a platform for quickly and easily building and testing electronic circuits without the requirement for soldering. Breadboards are essential tools for electronics enthusiasts, students, and professionals. They provide a convenient and flexible platform for designing, testing, and iterating electronic circuits.

Fig.10 Breadboard

G) *Four Wheel Chassis*

A four-wheel chassis, also known as a four-wheeled platform or base, is a foundational structure used in robotics, particularly in wheeled robot designs. It provides support for mounting various components such as motors, wheels, sensors, and controllers, allowing the robot to move and perform tasks.

Fig.11 Four Wheel Chassis

H) *Jumper Wires*

Jumper wires are essential components in electronics and prototyping. These flexible wires, often with pins or clips on each end, allow for easy connections between electronic components on breadboards, PCBs, or other platforms. They come in various lengths, colours, and gauges to accommodate different needs. Jumper wires facilitate quick and temporary connections, aiding in circuit testing, debugging, and experimentation without the need for soldering. Their versatility makes them indispensable in hobbyist projects, educational settings, and professional prototyping environments. Overall, jumper wires streamline the process of building and testing electronic circuits, enabling efficient and flexible wiring configurations.

Fig.12 Jumper Wires

Platform:

A platform is chosen where all the data is transferred and will be shown. IoT Arduino cloud has been used to show the data and to store the data. Integrating Arduino with cloud services enables IoT devices to securely send data to the cloud for storage, processing, and analysis, as well as receive commands or updates from the cloud. Arduino libraries and third-party integrations make it relatively straightforward to connect Arduino boards to popular cloud platforms. Commands or instructions can be sent from the cloud back to the Arduino device to control actuators (e.g., motors, relays) or trigger actions based on predefined conditions.

Challenges Encountered:

Despite the success of the implemented system, several challenges were encountered during the implementation phase:

Interoperability: Healthcare robots often need to interact with other medical devices, systems, and electronic health records (EHRs). Ensuring interoperability and seamless integration with existing healthcare IT infrastructure is crucial for maintaining data integrity across different platforms.

Scalability: Ensuring scalability became a priority as the system expanded to monitor more patients. Optimizing IoT infrastructure to handle increased transaction volumes without compromising performance presented a notable challenge.

User Acceptance: Educating and gaining acceptance from users, including both doctor and patient and drivers, proved challenging. Clear communication about the benefits of the virtual healthcare system and addressing concerns about data privacy and security were essential for user adoption.

Result discussion

Data integrity:

Data integrity is quite a concern in healthcare sector especially when it comes to robot. Accuracy, security, interoperability are few of the important aspects of the healthcare robot as it collects sensitive data of the patients these key points are necessary for data integration as well as data safety.

Authentication Results:

IoT devices are now using various methods of authentication and are improved. Two Factor authentication is one of the main and highly secured authentications.

Discussion:

Smart healthcare robot can go through vast amount of data and can follow a similar pattern if any which can help in diagnosing the patients easily.

Authorization Results:

User experience is highly enhanced, the user can easily use the virtual healthcare system without any doctors or supporting staff. This has made the virtual healthcare robot a user-friendly device.

Conclusion

This paper highlights the integration of IoT and healthcare system together. Virtual Doctors are disinfections and can transfer data easily and can also manage the data very quickly and easily. healthcare robots represent a promising and transformative advancement in the medical field, offering numerous benefits such as improved efficiency, enhanced patient care, and increased accessibility to healthcare services. These robots can assist healthcare professionals in various tasks, ranging from patient care to administrative duties, and they have the potential to revolutionize healthcare delivery.

Future Scope

The system is getting only few parameters as input. In future more sensors can be added to get more parameters to increase the accuracy. Other diseases can also be predicted by using different data sets. This system can be made more compact and user friendly. Healthcare robots holds immense promise for revolutionizing healthcare delivery, improving patient outcomes, and enhancing the overall quality of care. Continued research, innovation, and collaboration across disciplines will be essential to unlock the full potential of these transformative technologies. Healthcare robots become more integrated into medical practice, it will be essential to address ethical and social considerations, such as privacy, autonomy, accountability, and the impact on human-human interactions. Clear guidelines and regulations will need to be established to ensure that robots are used responsibly and ethically in healthcare settings.

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