Automatic Medical Dispatcher with Dynamic Telemonitoring System Using IoT in Rural Areas

Mrs.G.Praveena Reddy, Assistant professor, Dept of ECE,
Guru Nanak Institute of Technology, Hyderabad,
praveena.ecegnit@gniindia.org

Vanga Nagaprasad, Dept of ECE,
Guru Nanak Institute of Technology, Hyderabad
vanganagaprasad007@gmail.com

M.Bhanu Teja, Dept of ECE,
Guru Nanak Institute of Technology, Hyderabad
tdhanush200218@gmail.com

Masuna Shivaprasad, Dept of ECE,
Guru Nanak Institute of Technology, Hyderabad
masunashivaprasad@gmail.com

Abstract: - Accessing quality healthcare in rural areas can be challenging, often requiring individuals to travel long distances to nearby towns or cities. To address this issue, the Anytime Medical Machine (AMM) project was developed, leveraging Internet of Things (IoT) technology to provide on-the-spot medical consultations. AMM, a part of the Internet of Medical Things (IoMT), is designed for primary deployment in rural areas. Through AMM, individuals can receive consultations from qualified doctors without the need to travel. Doctors can prescribe medications and provide treatment recommendations, reducing both time and expenses associated with travel. The system collects patient data using sensors for temperature, heart rate, and blood oxygen saturation (SPO2), transmitting this information to doctors via a Wi-Fi module. The doctor-patient interaction is facilitated through secure video conferencing, requiring a unique username and password for each user to prevent misuse. After analyzing the patient's health parameters, the doctor prescribes appropriate medication, which is then dispensed through AMM. Patient information is securely uploaded to a cloud server for future reference, and the system is maintained by an administrator who refills medications as needed.

Keywords- Rural Healthcare, Remote Consultation, IoT Healthcare, Medical IoT, Telemedicine, Remote Monitoring, Cloud-Based Healthcare, Healthcare Accessibility

I. INTRODUCTION

Access to experienced medical consultation can significantly benefit rural populations, where such expertise is often concentrated in urban areas. While online platforms offer a means to connect with doctors remotely, they may not always ensure appropriate treatment. To address this gap, our project utilizes a microcontroller to collect patient data from sensors measuring temperature, heartbeat, and blood oxygen saturation (SPO2). This data is then securely stored in the cloud and shared with doctors when a patient seeks consultation. Real-time video conferencing facilitates direct interaction between patients and doctors, enabling patients to describe their symptoms effectively. Subsequently, medication prescribed by the doctor is dispatched from the Anytime Medical Machine (AMM). In emergency situations, the stored data can be accessed for quick patient analysis. Cloud storage, a ubiquitous technology, offers various deployment options such as hybrid, private, and public cloud. For security reasons, we opt for a private cloud to store patient information, ensuring confidentiality and compliance with privacy regulations.

II. EXISTING SYSTEM

Urban residents have easy access to doctors, clinics, and pharmacies, allowing for convenient consultation, tests, and prescription fulfillment. In contrast, rural residents face significant challenges, including long travel distances and associated time, effort, and expenses. Recent efforts have introduced new medical devices like MEDIBOX, designed to assist patients in adhering to their medication schedules. However, MEDIBOX lacks features such as doctor consultation and cloud-based data storage. Existing medical systems lack standardized frameworks, leading to inconsistencies and inefficiencies.

The current healthcare system presents significant challenges for rural residents, who often lack easy access to medical facilities. Unlike their urban counterparts, who benefit from nearby doctors, clinics, and pharmacies, rural residents face the arduous task of traveling long distances for consultations, tests, and prescription fulfillment. This process is not only time-consuming but also unreliable, as patients must visit hospitals for consultations, undergo tests, and obtain prescriptions before traveling to medical shops to purchase medications. This fragmented approach to healthcare delivery results in inefficiencies and increased burdens on patients, who must navigate queues and delays at every step of the process.

III. PROPOSED SYSTEM

The proposed system leverages IoT technologies to enhance healthcare delivery, benefiting not only the elderly and disabled but also anyone needing daily support. Temperature, SPO2, and Heartbeat sensors collect patient data, aiding the doctor in assessing health conditions. Video conferencing enables seamless doctor-patient interaction. Post-examination, the doctor prescribes medication dispatched from the AMM. Patient information is securely stored in the cloud for future reference. If the initial prescription is ineffective, stored data can reveal additional health conditions. The system aims for a user-friendly design, enabling patients to consult doctors via video call. Components include a sensor network for consultations and a dispatching unit for medication. The model adheres to standards, emphasizing consultation and medication dispatch. Data collection begins with sensors, transmitting to the doctor's end via Wi-Fi. The system uses an ESP8266 controller with MAX30100 and DHT11 sensors, and a second ESP8266 controller with L298 motor drivers for medicine dispatch. The data cloud stores consultation and medication details. Powered from the mains, the system ensures reliable healthcare delivery.

IV. METHODOLOGY

The methodology for implementing the proposed system involves a systematic approach to designing, integrating, and testing various components to ensure its effectiveness and reliability. Initially, thorough research and requirement analysis are conducted to understand the specific healthcare needs in rural areas and the potential of IoT technologies to address these needs. Based on this analysis, the system architecture is designed, encompassing the sensor network, medicine dispatcher, Wi-Fi module, data cloud, and power supply. The next step involves integrating temperature, SPO2, and Heartbeat sensors into the system to collect patient data accurately. The Wi-Fi module is then set up with the Blynk server to facilitate communication between the sensor network, doctor's end, and data cloud. The medicine dispatcher circuit is implemented using the ESP8266 controller and L298 motor drivers to ensure accurate dispensing of medication based on the doctor's prescription. The data cloud is set up to securely store patient information, including consultation details and medication history.

V. FLOW CHART

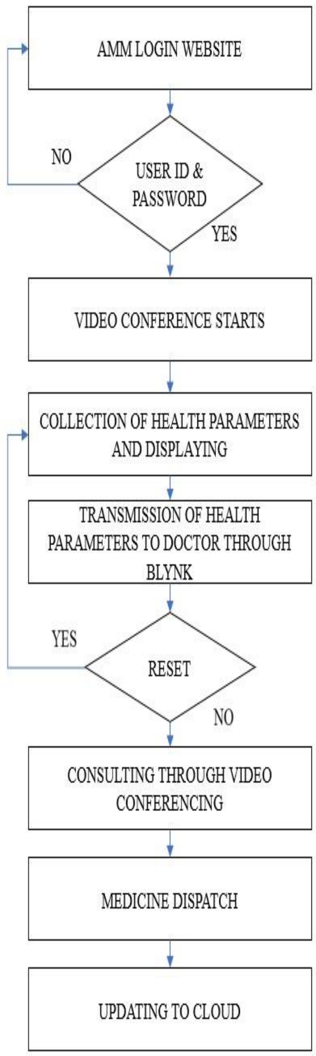

Figure 1. Flowchart of Working

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VI. BLOCK DIAGRAM

we have utilized two ESP8266 controllers, each serving a specific function. The first ESP8266 controller is connected to both the temperature and heartbeat sensors. Its primary role is to collect data from these sensors and display it on an LCD display. Additionally, this controller forwards the collected data to the Blynk interface for further processing and analysis. The second ESP8266 controller is interfaced with two motor drivers, which are further connected to four DC motors (two motors per motor driver). These motors are responsible for controlling the opening and closing of the medicine container lids in the dispatching unit. The second controller communicates with the Blynk platform to receive instructions for controlling the motors based on the doctor's prescription.

Blynk serves as the software platform for both controllers, providing a user-friendly interface for displaying, controlling, and accessing the patient's data. It allows for the visualization of health parameters over various time periods and enables the plotting of graphs for easy analysis of the data.

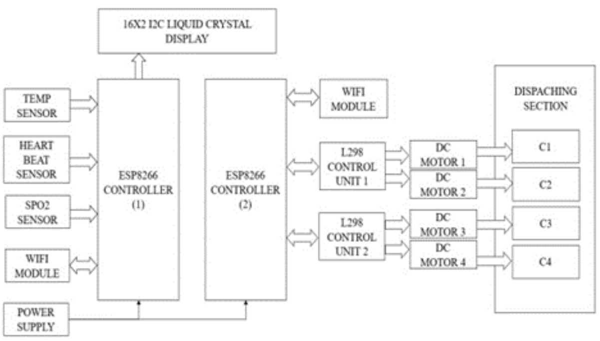

Figure 2. Block Diagram of AMM (Hardware implementation).

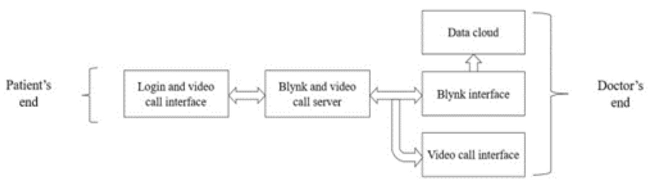

Figure 3. Block diagram of AMM (Software implementation).

APPLICATIONS

- Remote Consultations
- Medication Dispatching
- Real time monitoring
- Data Analysis
- Emergency Response

VII. HARDWARE DETAILS

The system requires specific hardware components, including the Arduino ESP8266, two L298 motor drivers, a DHT11 temperature sensor, and the MAX30100 sensor. The ESP8266 is a compact Wi-Fi module that enables wireless internet connectivity for microcontrollers, making it ideal for IoT applications. It includes built-in features like antenna switches, power amplifiers, and low-noise receive amplifiers, which are beneficial for mobile and wearable electronics. The L298 motor driver is a dual full-bridge driver capable of handling high voltages and currents, making it suitable for driving motors and other inductive loads. It can be controlled independently using standard TTL logic levels. The DHT11 temperature sensor is a digital sensor that provides accurate temperature and humidity measurements. It offers reliability and long-term stability and is designed to be connected to a microcontroller for data acquisition. Finally, the MAX30100 sensor is a comprehensive solution for monitoring pulse oximetry and heart rate. It features LEDs, a photodetector, and advanced optics, along with low-noise analog signal processing, ensuring effective detection of vital signs.

With an operational range of 1.8V to 3.3V, the MAX30100 sensor can be conveniently powered down using software, consuming minimal standby current and enabling the power supply to remain connected continuously. Its SpO2 subsystem is equipped with ambient light cancellation (ALC), a 16-bit sigma-delta ADC, and a unique discrete-time filter. The SpO2 ADC is a continuous-time oversampling sigma-delta converter offering up to 16-bit resolution. Users can program the ADC output data rate from 50Hz to 1kHz. Moreover, the MAX30100 includes a distinctive discrete-time filter that effectively eliminates 50Hz/60Hz interference and reduces low-frequency residual ambient noise.

VIII. DESCRIPTION OF SOFTWARE

For the software aspect of this project, we require several tools and technologies to develop and manage the system. This integrated development environment (IDE) is crucial for programming Arduino-compatible boards.The MAX30100 supports programming languages such as C and C++. It offers a software library derived from the Wiring project, which facilitates common input and output operations.Blynk is an open-source application for iOS and Android that allows for the control of processor boards like Arduino and Raspberry Pi. It enables the creation of graphic interfaces and dashboards for project control and is easy to use, requiring only a Wi-Fi or Ethernet connection to function. A login page is implemented in our project to allow patients to access their registered accounts. This page requires entering a registered ID and password, with an option for password recovery if needed. HTML is a markup language used for building the basic framework of web pages. It allows for the addition of text, graphics, tables, forms, and other features, essential for creating the web interface of our system. Cascading Style Sheets (CSS) is used for styling web pages, controlling aspects such as text color, font style, spacing, layout designs, and more. It enhances the visual appeal and presentation of the web interface. PHP is a scripting language commonly used for server-side programming to create dynamic web pages. It is widely used and provides powerful capabilities for web development. Google Cloud Platform (GCP) offers a suite of cloud computing services for hosting and managing applications. It provides services for computing, data storage, analytics, and machine learning, making it ideal for storing patient information and details about dispatched medicine.

IX. SIMULATION RESULT

This project demonstrate the successful achievement of our objectives. We have developed a user-friendly medical platform, the Anytime Medical Machine (AMM), which integrates video conferencing and medicine dispatching systems. This platform aims to provide rural communities with access to quality medical care. One of the key contributions of our project is the establishment of a standard framework for designing IoT-based medical applications. This framework addresses the lack of standards in existing IoT projects, providing a basis for future developments in this field. The login page serves as the entry point for patients to access the AMM. Upon entering their correct username and password, patients can use the AMM to consult with doctors via video conferencing. The website's background can be customized by modifying the HTML and CSS source codes.

X. SCHEMATIC DIAGRAM

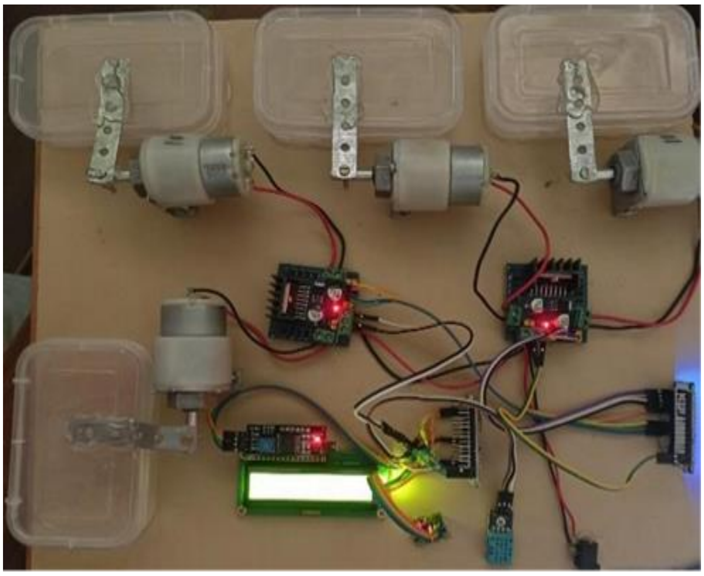

Figure 4. Hardware

CONCLUSION

In conclusion, this project has successfully developed an Anytime Medical Machine (AMM) with a dynamic telemonitoring system based entirely on IoT. This system includes features such as video conferencing, temperature, heartbeat, and SPO2 sensors, as well as a medicine dispatching unit. The application was developed using Windows operating system, Arduino programming, and Arduino cloud. Through rigorous testing, we have confirmed that our project performs efficiently, with a performance rating of up to 90%. This demonstrates the potential for the AMM application to serve as an effective telemedicine tool, particularly benefiting people in rural areas. It can replace unreliable online platforms and provide better healthcare and consultation services to those in need. Data confidentiality is a top priority, and we have implemented measures to ensure that patient data is protected from unauthorized access. By utilizing cloud storage, we have established a secure and organized method for maintaining patient records. Overall, our project has the potential to significantly improve healthcare access and delivery in rural areas.

Acknowledgment

I would like to express my sincere gratitude to the Raspberry Pi Foundation for providing the Raspberry Pi Pico, which has been instrumental in the development of the "Automatic Medical Dispatcher with Dynamic Telemonitoring System Using IoT in Rural Areas" project. The Raspberry Pi Pico serves as a key component in the implementation of this innovative healthcare solution. I also want to acknowledge the developers of MicroPython for their contribution to enabling versatile programming capabilities on the Raspberry Pi Pico platform. Their work has been invaluable in creating the software infrastructure necessary for the functionality of our project. Additionally, I extend my appreciation to the researchers and engineers in the fields of healthcare and IoT, whose insights and advancements have inspired and informed the development of our project. Their dedication to improving healthcare access and delivery has been a driving force behind our work.

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