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Rural IOT: IOT HEALTHCARE SYSTEM FOR SMART HOME

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Abstract:

The IoT-based healthcare monitoring system is an innovative solution designed to improve patient care by enabling continuous, real-time tracking of vital health parameters like body temperature and pulse rate, particularly for elderly individuals or those requiring regular monitoring. Utilizing biomedical sensors interfaced with a microcontroller, the system processes and displays data on a compact OLED screen for local observation while transmitting it via Wi-Fi to cloud platforms or remote monitoring stations, ensuring caregivers or healthcare professionals can access real-time information from anywhere. To enhance safety, a GSM module sends SMS alerts to designated contacts, such as family members or emergency responders, during critical situations with abnormal readings, complemented by a local buzzer for immediate audible alerts. This system's integration of real-time monitoring, wireless data transmission, and emergency alert mechanisms offers a cost-effective, user-friendly, and scalable approach, particularly beneficial for home-based care, reducing response times, improving patient outcomes, and contributing to smarter, connected healthcare environments.

Introduction:

The Internet of Things (IoT) is revolutionizing the healthcare industry by seamlessly integrating advanced technology into daily life, offering smarter and more efficient solutions for health

monitoring. IoT healthcare systems for smart homes represent a transformative approach to personalized care, enabling continuous and real-time monitoring of vital health parameters from the comfort of one's residence. Designed to cater to the growing demand for proactive health management, these systems utilize interconnected devices and sensors to track essential metrics such as heart rate, body temperature, blood pressure, and oxygen levels, transmitting data to cloud-based platforms for analysis and remote access by caregivers or medical professionals.

In a smart home environment, IoT healthcare systems enhance convenience, safety, and responsiveness, particularly for elderly individuals, patients with chronic illnesses, or those recovering from surgery. By integrating features such as real-time alerts, automated emergency notifications, and data visualization tools, these systems empower users and their families to stay informed and take timely actions in critical situations. Moreover, the scalability and user-friendly nature of IoT technology make it adaptable to various healthcare needs, reducing the burden on traditional medical infrastructure.

Scope of the Project:

The scope of the project "IoT Healthcare System for Smart Home" focuses on creating an intelligent, real-time health monitoring and alert system designed for home-based care. By utilizing IoT-enabled biomedical sensors, the system will continuously track vital health parameters such as heart rate, body temperature, blood pressure, and oxygen saturation. Data will be displayed locally on a compact screen for immediate observation and transmitted to cloud platforms or remote devices, enabling caregivers and healthcare professionals to access the information from anywhere.

In addition to monitoring, the system incorporates emergency alert mechanisms that automatically notify designated contacts—such as family members, doctors, or emergency responders—via SMS or app-based notifications when critical conditions are detected. A local audible alarm ensures immediate attention within the household. Designed with scalability and user-friendliness in mind, the system can integrate seamlessly into a smart home ecosystem, offering a cost-effective and reliable healthcare solution. This project aims to enhance safety, improve health outcomes, and promote proactive healthcare management, especially for elderly individuals and patients with chronic or critical health conditions.

Proposed System:

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The proposed IoT-based healthcare system for smart homes provides an easy-to-use solution for real-time health monitoring. It uses sensors to measure vital signs like heart rate and body temperature, displaying the data locally and transmitting it to a cloud platform for remote access by doctors or caregivers. In case of emergencies, the system sends SMS alerts via a GSM module and activates a local buzzer for immediate attention.

An integrated application allows patients to communicate with doctors through voice or chat for consultations. The system also supports medication reminders and is designed to work seamlessly in a smart home setup, making it ideal for elderly individuals or patients needing regular care. This solution simplifies health management at home, ensuring timely medical assistance and improving overall healthcare accessibility.

Block Diagram:

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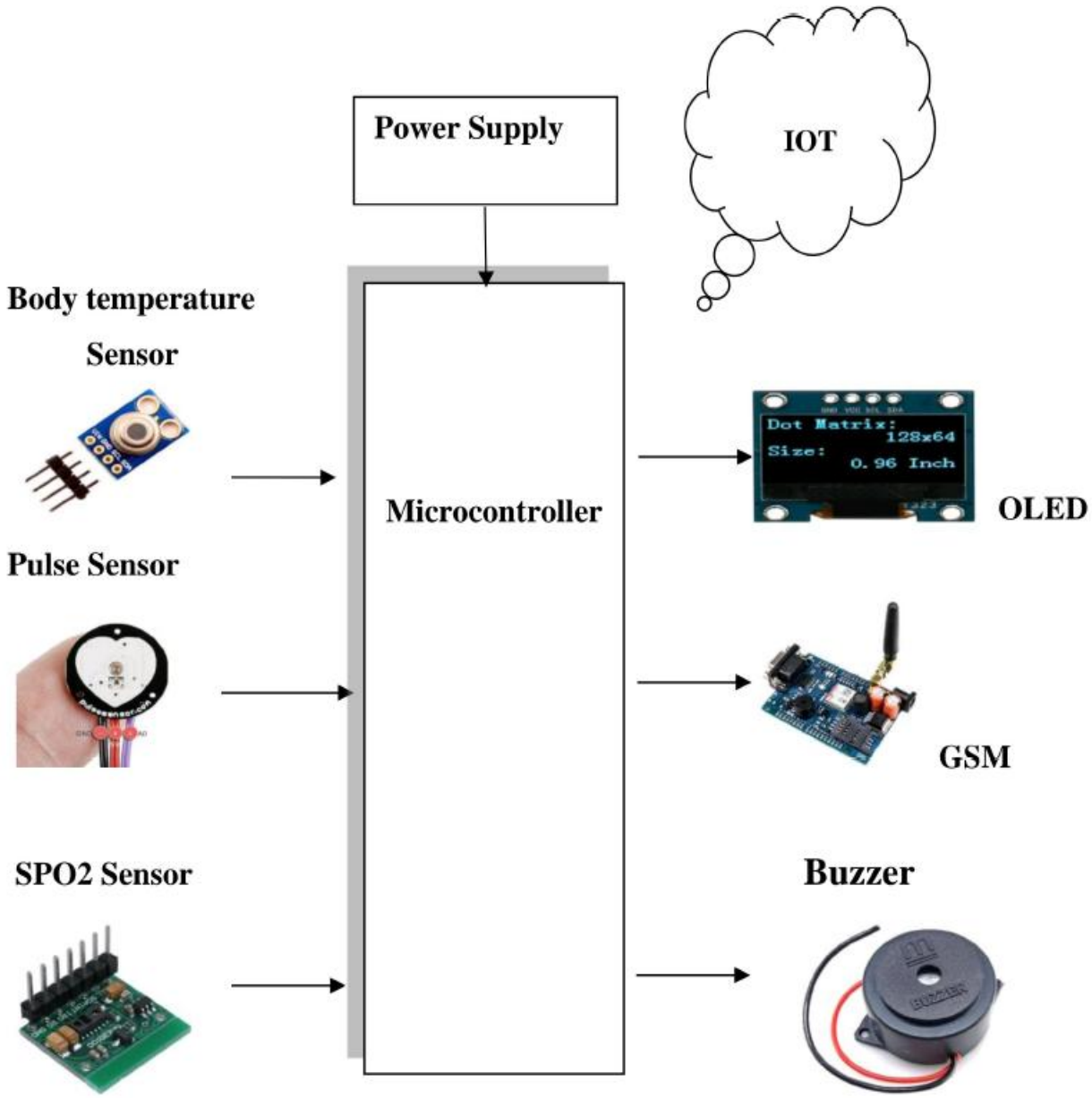

Fig: Block diagram of IOT Healthcare System for Smart Home

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HARDWARE TOOLS:

Power Supply:

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

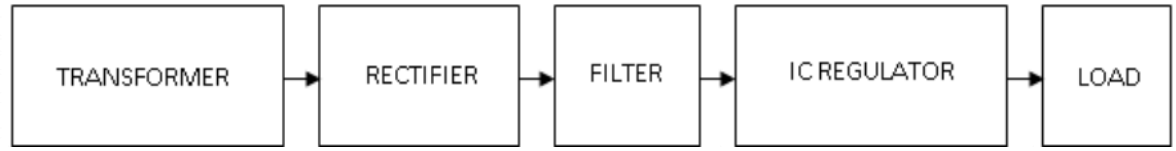

Fig: Block Diagram Of Power Supply

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RASPBERRY PI PICO W:

Fig: Raspberry Pi Pico W

Raspberry Pi Pico W is **Raspberry Pi**'s first wireless microcontroller board, designed especially for physical computing. It is the successor of the popular **Raspberry Pi Pico** board. Similar to the Pico board, which we discussed earlier, the **Pico W** board is also built around the **Raspberry Foundation** in-house ARM chip RP2040. The main improvement is the addition .of Wi-Fi and Bluetooth functionality. **Raspberry Pi Pico W** incorporates an Infineon **CYW43439** wireless chip that supports IEEE 802.11 b/g/n wireless LAN, and Bluetooth 5.2. The main difference between the **Pico** and **Pico W** is the inclusion of Infineon's CYW43439 2.4-GHz Wi-Fi chip, which is responsible for Wi-Fi and Bluetooth. Another major change is with the power section. The new Pico W uses the **RT6154A** from **Richtek** as the power regulator instead of the **RT6150B** in the original Pico design. The debug port also moved near the SoC to make space for the Wi-Fi antenna.

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Buzzer:

A buzzer or beeper is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows.

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise). Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker.

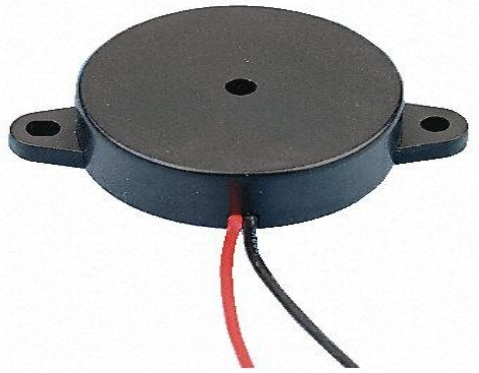

Fig: Buzzer

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HEART RATE USING PULSE SENSOR:

The Pulse Sensor is a well-designed low-power plug-and-play heart-rate sensor for the Arduino. Anyone who wants to incorporate real-time heart-rate data into their work—students, artists, athletes, makers, and game and mobile developers—can benefit from it.The best part is that this sensor plugs right into Arduino and easily clips onto a fingertip or earlobe. It is also super small (button-shaped) and has holes for sewing into fabric.

Fig: Heart Rate Pulse Sensor

TEMPERATURE SENSOR - MLX90614 :

The MLX90614 is a **Contactless Infrared (IR) Digital Temperature Sensor** that can be used to measure the temperature of a particular object ranging from -70° C to 382.2°C. The sensor uses IR rays to measure the temperature of the object without any physical contact and communicates to the microcontroller using the I2C protocol.

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Fig: Temperature Sensor - MLX90614

Result:

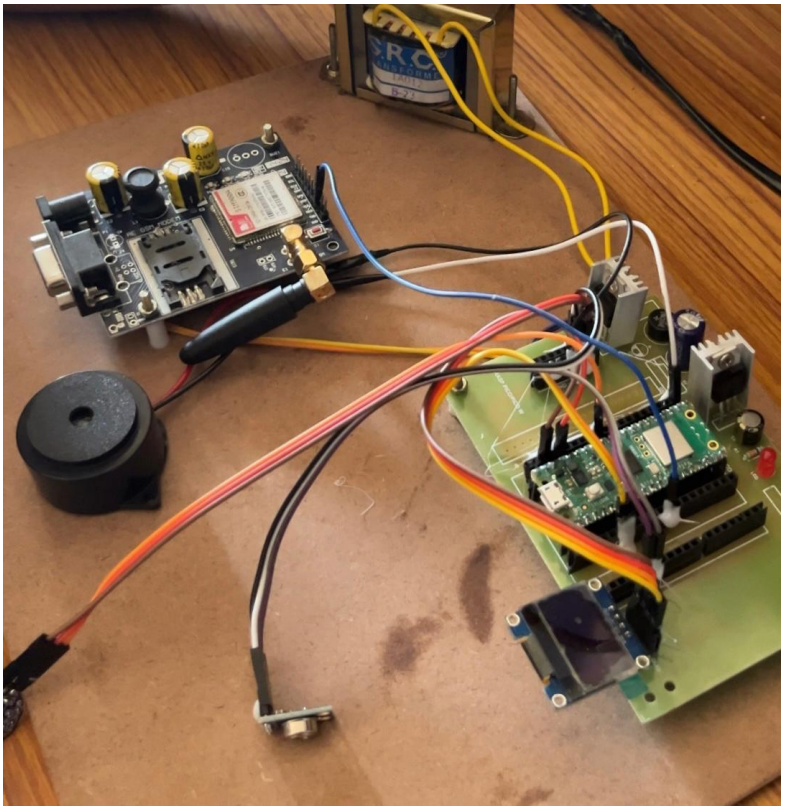

Fig: System under off condition

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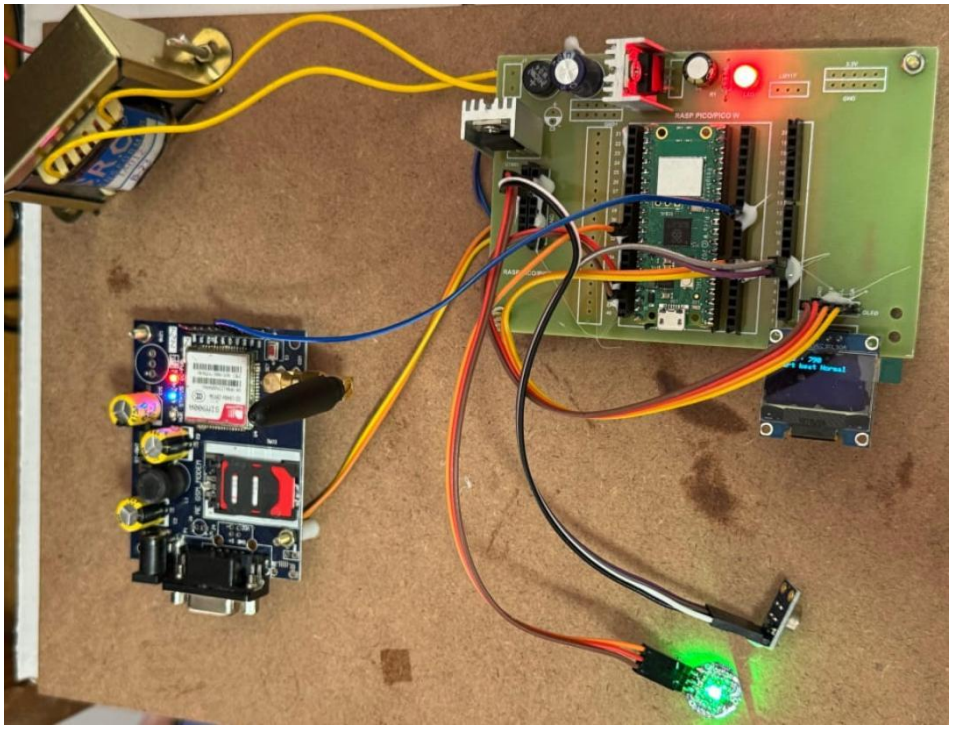

Fig: System under on condition

Result:

The implementation of the IoT-based healthcare system for smart homes effectively enabled real-time monitoring of vital health parameters such as heart rate, body temperature, and oxygen levels, using IoT-enabled sensors. The system successfully transmitted data to remote caregivers and healthcare professionals via cloud platforms, ensuring timely intervention. In emergencies, the integrated alert mechanism promptly notified designated contacts via SMS and activated local alarms, ensuring rapid responses. The communication feature allowed seamless remote consultations with doctors, enhancing accessibility to medical guidance. This cost-effective and user-friendly system demonstrated its potential to improve patient care, safety, and convenience within a smart home environment.

Conclusion:

The IoT-based healthcare system for smart homes is a practical and efficient solution for modern healthcare needs, allowing real-time monitoring of vital health parameters from the comfort

of home. It ensures timely care by providing remote access to health data, sending emergency alerts, and enabling communication with doctors. This system is particularly beneficial for individuals with limited access to traditional healthcare, such as the elderly or those in remote areas. By making healthcare more accessible, responsive, and personalized, the system contributes to a smarter, more connected healthcare approach that improves overall well-being.

Future scope:

The future scope of the IoT healthcare system for smart homes includes integrating advanced AI and machine learning to analyze health data trends for predictive diagnostics and early detection of diseases. The system can expand to monitor additional parameters like ECG and glucose levels through wearable devices and sophisticated sensors. Improved user interfaces, including AI-driven virtual assistants and multilingual support, will make the system more accessible, especially for elderly or non-tech-savvy users. Integration with national health databases can enable seamless medical record updates and better coordination with healthcare providers. Enhanced connectivity through 5G and edge computing will ensure faster, more reliable data transmission, while smart home integration with IoT devices will create a unified health and lifestyle management ecosystem. Ultimately, the system can evolve into a fully automated, AI-powered solution, empowering users with real-time health insights and supporting smarter, connected healthcare.

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