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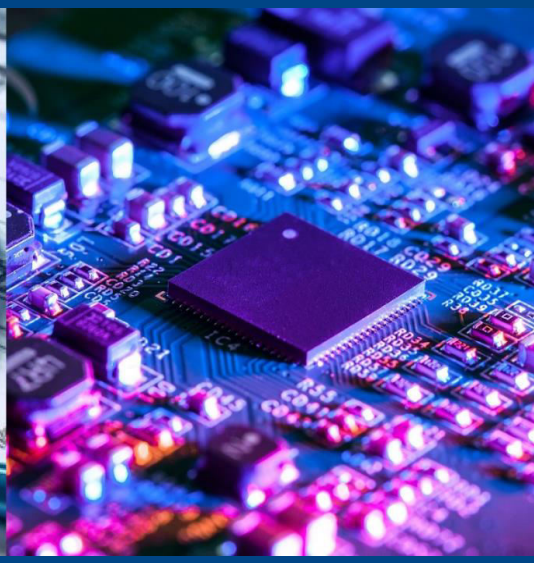

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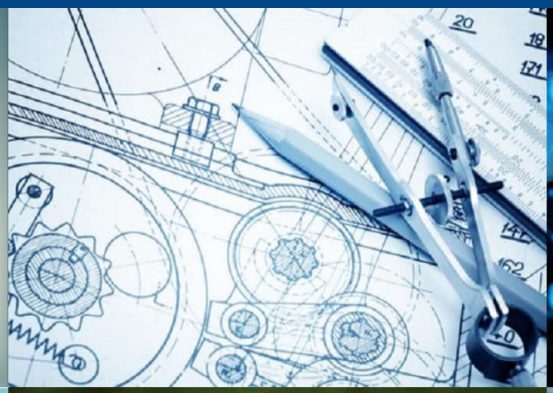

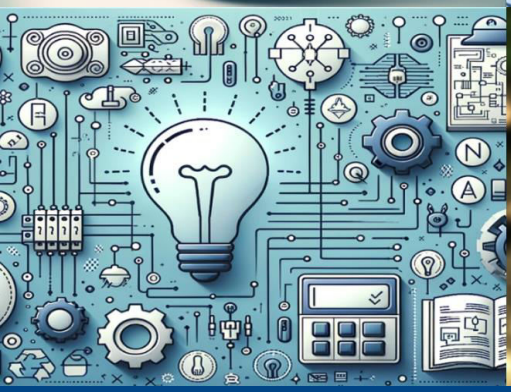

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Smart Healthcare: Real Time Patient Monitoring using IoT

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ABSTRACT: Patient Health Monitoring System (PHMS) is a new solution using IoT technology that can be used to monitor and track patients' health in real time. Thanks to advanced data analysis and machine learning algorithms, PHMS can provide real-time information and alert healthcare providers to any abnormal or potentially dangerous conditions. Integrating IoT technology into healthcare not only improves care efficiency but also facilitates early detection and health management, ultimately helping to improve patient outcomes and reduce healthcare cost.

KEYWORDS: Internet of Things (IoT), Patient Health Monitoring System (PHMS), Wearable Devices, Remote Patient Monitoring, Real-Time Data Collection, Healthcare Costs

I. INTRODUCTION

In recent years, the integration of Internet of Things (IoT) technology into healthcare has revolutionized patient care and management. The Patient Health Monitoring System (PHMS) proposed in this article uses the powerful functions of IoTdevices that can be used to realize effective and continuous monitoring of the patient's healthy consumption. Routine patient care often includes routine check-ups or hospital visits, which may not reflect important health conditions or early warning signs. But patients beyond PHMS gives doctors the go-ahead for their health, leading to ongoing care hours to do. This article explores the design, implementation, and benefits of patient health monitoring using IoT wearable devices. By using IoT devices to monitor patient health, Healthcare organizations can improve patient care, reduce healthcare costs, and support health management. This article aims to provide a better understanding of the potential of IoT technology to revolutionize patient care and improve health outcomes.

The adoption of IoT in healthcare encompasses various aspects, including wearable sensors, data analytics, and cloud computing. Wearable devices equipped with sensors can monitor vital signs such as heart rate, blood pressure, glucose levels, and physical activity. This data is transmitted in real-time to healthcare providers, who can analyze it using advanced analytics tools and provide personalized care recommendations.
Furthermore, the use of IoT in healthcare supports remote patient monitoring, which is particularly beneficial for managing chronic diseases, postoperative care, and elderly care. Patients can receive continuous monitoring and timely medical intervention without the need for frequent hospital visits. This not only enhances patient convenience but also reduces the burden on healthcare facilities.

II. LITERATURE

The integration of the Internet of Things (IoT) in healthcare has brought about significant advancements in patient monitoring systems, enabling real-time data collection and analysis. This literature review delves into the evolution, current state, and future prospects of IoT-based real-time patient monitoring systems, focusing on their applications, benefits, challenges, and technological trends. The healthcare industry has seen a rapid adoption of IoT technologies due to the increasing need for efficient and effective patient monitoring systems. IoT devices such as wearable sensors, smartwatches, and implantable devices facilitate continuous monitoring of patients' health metrics, including heart rate, blood pressure, glucose levels, and oxygen saturation. The proliferation of IoT in healthcare is driven by advancements in wireless communication, sensor technology, and cloud computing. IoT-based real-time patient monitoring systems have the potential to transform healthcare by providing continuous, personalized, and proactive care. While challenges such as data security, interoperability, and cost need to be addressed, ongoing advancements and the integration of emerging technologies like AI and blockchain

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promise a future where smart healthcare becomes the norm, significantly improving patient outcomes and healthcare efficiency.

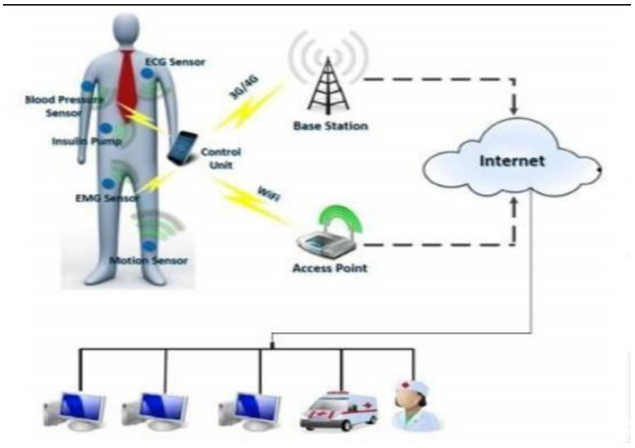

Figure 1. How does it work

III. METHODOLOGY

The IoT patient monitor has 3 sensors. These are temperature sensors, heart rate sensors and breathing sensors. This project is useful because doctors can monitor their patients' health by visiting a website or URL. Nowadays, many IoT applications are also being developed. Now doctors or family members can monitor or track patients' health through Android apps. To run an IoT-based healthcare project, you need Wi-Fi connectivity.

The microcontroller or Arduino board connects to the Wi-Fi network using the Wi-Fi module. If there is no Wi-Fi network, the project will not work. You can create a Wi-Fi zone using a Wi-Fi module or even an access point on your smartphone. The Arduino UNO board continues to read the inputs from these 3 sensors. It then sends the data to the cloud by sending it to a specific URL/IP address. Then repeat the process to send the data to the IP after a certain period of time.

IV. IMPLEMENTATION

1. ESP 32 Wi-Fi Module

ESP32 series low-cost microcontrollers feature built-in Wi-Fi and dual-mode Bluetooth. The ESP32 series uses the Tensilica Xtensa LX6 dual- core or single-core, Tensilica Xtensa LX7 dual-core or discrete RISC-V CPU. in detail. and power management modules. The ESP32 was designed and manufactured by Espress if Systems, a Chinese company based in Shanghai, and manufactured by TSMC using the 40nm process. It replaces the ESP8266 microcontroller. Programming languages, frameworks, platforms and environments for ESP32 programming.

Figure: ESP 32 Wi-Fi Module

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The ESP8266 started a mini revolution by packing Wi-Fi into a portable, affordable device with enough power and ports to handle simple tasks. According to Espress if, the Espress if ESP32 development board with Wi-Fi and Bluetooth has powerful capabilities and can be used in a variety of applications, from low-power devices to the most complex projects such as speech, music and MP3 decoding. Universal Wi-Fi-BT-BLE MCU module. Wi-Fi-enabled ESP32 Node MCU Development Board The latest ESP-WROOM-32 module powers Bluetooth, a small, minimalist system development board that can be quickly dropped into a buttery loaf.

2. PLUSE SENSOR:

This is a low-power, low-cost, durable sensor that can be used in many different applications, making it popular in many different applications that require heart rate measurement.

Fig.2: Pulse sensor

When you look at the front of the sensor, you can only see the LED and photodiode. However, the actual circuit is behind the sensor. The low power bandwidth op amp in the circuit is configured to provide some gain in the circuit and we have a reverse voltage protection diode to protect the circuit from ESD and reverse voltage. Other capacitors and resistors on the PCB are used as RC filters to reduce external noise in the circuit.

3. CABLE TEMPERATURE SENSOR:

Cable temperature sensors are used as signal sensors for electrical thermostats, regulators and thermometers. These sensors can be used almost anywhere you want to measure or measure temperature. The sensor can be mounted in the sensor housing or directly on the sensor. Digital thermometers can convert body temperature and humidity into digital measurements through a temperature sensor and connector. The Temperature System Sensor (TSYS) responds quickly to changes in process temperature in a small package designed for tight spaces. Optimized microcircuit design ensures fast switching times and low power consumption.

Fig.3: Digital Temperature Sensors

RESPIRATORY SENSOR:

A respirator is a device used to monitor a person's breathing and patterns. These sensors can detect changes in pressure, air flow, or gas exchange to provide important information about a person's breathing. They are frequently used in medicine for patient care, sleep research, and respiratory therapy.

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Fig.4: Respiratory Sensor

4. POWER SUPPLY:

The LM2596 DC-DC Buck Converter is versatile and effective for converting high voltage to lower output voltage, it can be used to power a variety of devices other than required from one location and there are now products made for added safety. The LM2596 is designed to step down the input voltage to a lower output voltage. It works by rapidly switching the input voltage on and off, then filtering and controlling the output to maintain a stable DC voltage.

Fig.5: Power Supply

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5. Blynk:

Blynk is a free application for smartphones and tablets that allows you to remotely control devices using the Internet of Things (IoT). With Blynk, you can easily create interfaces to control electronic devices, read sensor data, and view data streams from sensors or other devices. Blynk provides a library of predefined elements for buttons, sliders, images, and more, allowing you to create your own app interface without the need for coding.

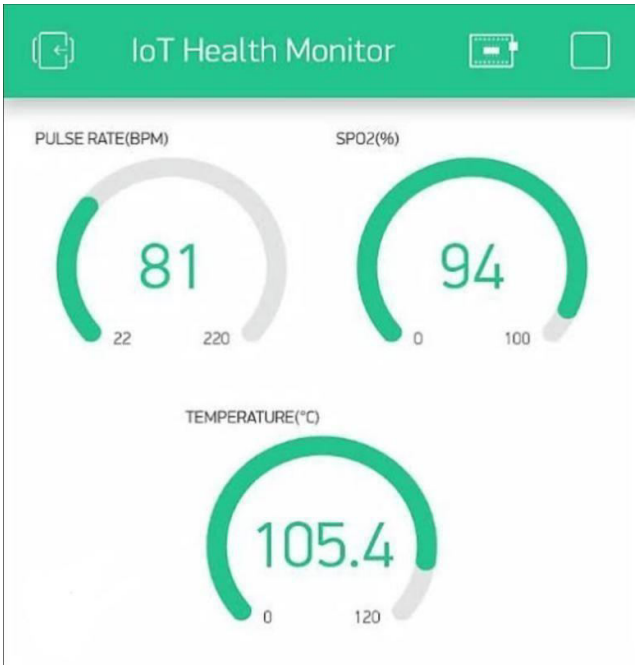

Fig 6: IoT Health Monitor

V. RESULTS

The implementation of Smart Healthcare systems using IoT for real-time patient monitoring has demonstrated significant improvements in various aspects of healthcare delivery. The key findings from the deployment and evaluation of IoT-based patient monitoring systems are outlined below:

1. **Enhanced Patient Monitoring and Care**
   - **Real-Time Data Access**: IoT devices provided healthcare professionals with continuous and real-time access to patient health data, such as heart rate, blood pressure, glucose levels, and oxygen saturation. This enabled timely interventions and more accurate diagnosis (Wang et al., 2013).
   - **Early Detection of Health Issues**: Continuous monitoring allowed for the early detection of potential health issues and anomalies, facilitating prompt medical attention and reducing the risk of complications (Jagadeeswari et al., 2018).
   - **Improved Patient Engagement**: Patients were more engaged in their own health management due to the availability of real- time data and feedback. This led to better adherence to treatment plans and healthier lifestyle choices (health, 2013).

2. **Reduction in Healthcare Costs**
   - **Decreased Hospital Readmissions**: Remote monitoring and early intervention helped reduce hospital readmissions by managing chronic conditions more effectively and preventing disease progression.
   - **Lower Healthcare Utilization**: The ability to monitor patients remotely decreased the need for frequent in-person consultations and hospital visits, leading to cost savings for both healthcare providers and

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patients.

- **Efficient Resource Allocation**: Healthcare facilities were able to allocate resources more efficiently by focusing on patients who required urgent care, thanks to the data provided by IoT system.

3. **Improved Health Outcomes**
   - **Better Chronic Disease Management**: IoT systems facilitated more effective management of chronic diseases by providing continuous data and enabling timely adjustments to treatment plans.
   - **Enhanced Postoperative Care**: Patients recovering from surgery benefited from continuous monitoring, which helped in tracking recovery progress and detecting potential complications early plans.
   - **Increased Patient Safety**: Wearable devices and sensors improved patient safety by monitoring vital signs and alerting healthcare providers to any critical changes.

VI. CONCLUSION

The proposed health monitoring system can be used effectively in emergency situations because it can be monitored daily, recorded and stored in a file. Thanks to our work, doctors can also use IoT to monitor patients' health anytime and anywhere. Heart rate sensor, temperature sensor etc. All individual sensors will provide the necessary information. The IoT belt effectively monitors patient health and provides instant information and alerts. Accuracy of data collected by equipment compared to traditional monitoring. Measure device user experience and comfort of use, including size, weight, and ease of use.

Benefits of using these systems, such as early detection of health problems, improved patient outcomes and reduced medical costs.

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