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IoT Based Patient Health Monitoring System

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ABSTRACT:

It's true that the Internet of Things (IoT) is changing the healthcare sector by making remote patient care possible. With this system, patients' vital signs can be monitored instantly, including heart rate, blood pressure, and blood oxygen saturation. Mobile devices are used to collect the data, which is then transmitted wirelessly to a central care center or cloud platform. The collected data is analyzed using advanced techniques to detect any gaps or deviations in the patient's health. In case of a critical incident, the system will notify the doctor or nurse to take action. This proposed system is expected to improve patient outcomes, enhance care efficiency, and lower healthcare costs by enabling personalized and individualized care. The sensor is connected to a small computer, which is further connected to a monitor to keep track of the patient's condition. If there is any change in the patient's heart rate or blood pressure, it will automatically alert the doctor via the Internet. This system displays the patient's heart rate, blood pressure, in real-time, which helps monitor the patient's health and alerts doctors early for appropriate treatment. The best part is that it is easy to install and works great.

Keywords: Embedded system, IoT, Patient monitoring system, Arduino Uno, Electrocardiogram, Global System for Mobile Communication, Sensors

I. INTRODUCTION

The Internet has grown to play a significant role in our daily lives nowadays. The way people live, work, play and learn has been transformed. The Internet is used for education, finance, business, manufacturing, entertainment, social networking, shopping, etc. it functions as a tool for several purposes such as the new mega trend of the future internet is IoT. Imagine a place where several objects share data through sensors, private net protocols, or public networks can be implemented through Converged intelligence networks for analysis, design, and decision-making are made possible by connected objects that continuously gather, evaluate, and act upon data. This is the universe of the Internet of Things. The Internet of Things (IoT) primarily refers to any object that is linked to the Internet and provides remote control or monitoring capabilities. However, building a highly invisible network that is discoverable, controllable, and programmable is the definition of the Internet of Things.

IoT-based products include embedded technologies that allow them to communicate with each other or the Internet, and by 2020, 8-50 billion devices are expected to be connected. When these tools are available online, they improve lives, make communities safer and more productive, and change the healthcare industry. In low- and middle-income countries, the number of people suffering from chronic diseases is increasing due to different risk factors, such as nutritional imbalances and physical inactivity. Chronic diseases differ in their symptoms, evolution, and treatment. Some are life-threatening if not detected and treated early.

Daily readings are sent to doctors, allowing them to recommend medications and exercise regimens that can improve quality of life and help overcome illness. Internet of Things (IoT) applications for patient care and monitoring are becoming more common in the healthcare industry to improve health outcomes. Arduino is a programmable gadget that has environmental sensing and interaction capabilities. Combining the Internet of Things with Arduino is a new way to introduce IoT in patient health monitoring. Variable sensors, gateways, and wireless networks are the components of the Internet of Things concept that allow users to exchange and access data. IoT provides greater confidence in the health concept. The adage "health is wealth" states that innovation is crucial to progress. Sensor data is gathered by Arduino Uno and sent to an IoT website.

In the past, it was impossible to monitor doctors at long distances. Therefore, we provide a method that continuously monitors the patient's condition and automatically sends data to the server, so that the doctor can access the data continuously and can be alerted when the patient's condition is critical. In the previous method, patient monitoring could only be done by using different devices for different parameters. Therefore, we decided to collect various tools in one module and monitor the needs of our patients. Today, IoT is a widely used technology. The growth of the Internet has been extraordinary and has been developed to connect things through the Internet. All devices are connected with some smart technology.

Creating a ubiquitous network called the Internet of Everything (IoT). We record the data of each sensor and upload the data to the server. We've seen data on multiple devices with secure internet logins and passwords.

A centralized system that provides wireless transmission of patient data using sensors, software, and data exchange over the Internet. IoT-Based Patient Health Monitoring System" when there is an emergency, when patients need healthcare the most. The Internet of Things (IoT) gives us enough technology and modules to focus on healthcare systems, embed technology to keep patients safe and healthy, and provide enough capabilities for supervisors to continuously monitor.

Still, the use of This type of module can now reach greater heights and are ubiquitous. It is true that many other technological developments can happen with IOT for better health monitoring . Because the system monitors the patient continuously, this work can be used in health care facilities and for patients who are constantly under observation while traveling. A wireless sensor network (WSN) consists of autonomous devices distributed in a structured manner, such technology must adhere to strict safety, security, and reliability. We can expect to see the Internet of Things accelerate in the next few years as IoT plays a role in the digital transformation of the healthcare industry and leverages the efforts of various stakeholders. The integration of Internet of Things technology into healthcare has changed the way patients' health is monitored and managed. IoT-based patient health monitoring systems offer real-time data collection, analysis, and communication, enabling healthcare providers to provide proactive and personalized care while empowering patients to actively participate in their own health management. The system also displays real-time data on the patient's heart rate tracked over the Internet. Therefore, an IoT-based patient health monitoring system uses the Internet to effectively monitor the health of patients and help users monitor and save their lives. This is how sensor technology is built. Each time the sensor data is sent to the doctor.

II. LITERATURE REVIEW

As you are undoubtedly aware, a lot of projects rely on Internet of Things-based systems for monitoring people's well-being that use remote sensor techniques. Initially, the researchers created a framework for monitoring patient well-being using an Atmega-8 microcontroller and a sensing network. The ECG sensor, and heartbeat sensor are the sensors used in this work. The Arduino Uno is used in the suggested patient monitoring system method to track various health parameters of the patient.The use of Arduino has increased dramatically over the past few years, enabling information sharing. Sensor data is gathered, saved, and processed here.It is made up of multiple wired and wireless sensors.

These embedded sensors on the human body assist in monitoring the health of the body without interfering with the patient's step-by-step plan and precise noticing system. It has GSM modems, displays, sensors, and microcontrollers to talk to boom or bust or skilled professionals. As a result, a comparable type of GSM modem is used in specialist offices. Telling the patients will cost some money.

1. Sensor Technologies:

IoT systems include ECG sensors, blood pressure monitors Oxygen level, etc. A review of the paper on the various types of sensors used for health monitoring, including the various devices used to detect and measure physical properties or conditions. Some sensors are temperature sensor, motion sensor, pressure sensor

2. Data transfer and communication protocol:

Conduct research on communication protocols used to transfer patient health data in IoT networks, including Bluetooth, Wi-Fi, Zigbee, and cellular networks. This is necessary to ensure reliable and efficient communication between devices and systems. They play an important role in establishing communication through various systems and technologies, facilitating the exchange of information in today's digital environment.

3. Data Processing and Analysis:

Research focuses on data processing techniques, including data aggregation, filtering, and analysis algorithms used to derive meaningful insights from collected health data. This includes various methods and techniques for extracting insights, patterns and valuable information from raw data.

4. Security and Privacy:

To review research that addresses security and privacy issues such as encryption techniques, authentication mechanisms, and data anonymization techniques in IoT-based health monitoring systems.

5. Remote monitoring and telemedicine:

To review research that addresses real-time patient monitoring with IoT technology and the implementation of IoT-enabled remote monitoring solutions and telemedicine platforms for healthcare services.

6. Application and Clinical Examples:

Research studies demonstrate the effectiveness of IoT-based health monitoring systems in clinical settings, including experiments, case studies, and user feedback evaluations.

7. Regulatory and ethical considerations:

To review the literature discussing regulatory requirements, compliance standards, and ethical considerations related to the implementation of iodine-based patient health monitoring systems.

III. METHODOLOGY OF PROPOSED SYSTEM

1.1 Components Required

1. Arduino uno

The microcontroller that powers the Arduino Uno board is based on the ATmega328P. It includes every part required to run the microcontroller. The battery can be charged by users using an AC-to-DC adapter or battery, or by connecting it via USB to a computer. It offers a simple setup procedure to get you going.

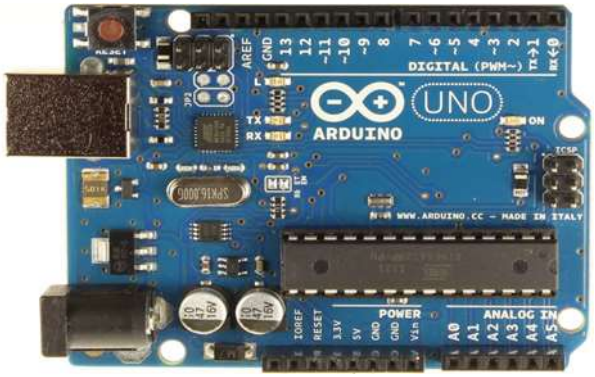

Figure 1. Arduino Uno

2. ECG AD8232

ECG AD8232 is a single lead electrocardiogram (ECG) sensor module commonly used in medical applications. It usually consists of an instrument amplifier, a right-hand drive safety, and a preset circuit. The AD8232 is designed to provide accurate ECG waveforms with low power consumption. It is used to measure heart rate and detect heart problems.

The electrocardiograph, or EKG, is a device that graphs all of the electrical signals that the human heart produces. It can help comprehend physiological changes in an individual and provide a deeper understanding of the psychological state of the patient. Based on the investigation of physiological issues. we often do not understand the source of this change when we are a person in our daily life. Unfortunately, this is untrue even though we frequently believe that everything is good on a mental and physical level. It is generally assumed that the drug's effects will be similar to those of epinephrine, though they might cause some irritation or none at all. Epinephrine activates a person's central nervous system, so taking such a drug can cause changes such as increased heart rate or pupil dilation. This disease can be prevented by early detection or monitoring with the help of ECG signals. In order to measure the electrical activity of the heart, an integrated circuit called the AD8232 was developed. An electrocardiogram, or EKG, can be plotted as a result of these electrical changes.

Figure 2. ECG AD8232

Trying to implement an IoT project without breaking the bank. Depending on the algorithm used, multiple readings may be needed for ECG or heartbeat detection. Heart rate and oxygen saturation can be determined from EKG readings. According to standard nomenclature, a complete ECG setup includes at least four electrodes on the upper body or extremities (RA = right arm; LA = left arm; RL = right leg; LL = left leg). Skin electrodes and EKG conduction are usually enhanced by applying a conductive gel to the wet path.

3. GSM Sim900A

Most countries use the architecture of the Global System for Mobile Communication (GSM) for mobile communication. Among the wireless modems designed especially for tying computers to GSM and GPRS networks is the GSM modem. Just like cell phones, it requires a SIM (Subscriber Identity Module) card in order to connect to the network. Each modem is also equipped with an IMEI (International Mobile Equipment Identity) number for identification purposes. Functionally, a GSM modem can undertake the following tasks:

1.Manage incoming, outgoing, or deleted SMS messages stored on a SIM card.

2.Access, add, search, or modify phonebook entries stored on the SIM card.

3.Initiate, receive, or decline voice calls.

Figure 3. GSM Sim9ooA

For the MODEM to interact with the processor and controller which communicate via serial communication it needs commands. The processor or controller transmits out these instructions. To communicate with the GSM cellular network, the processor, controller, or computer can send multiple AT commands that are allowed by the MODEM.

4. Spo2 Max30102

The MAX30102 is a pulse oximeter and heart-rate sensor module. It measures the oxygen saturation level (SpO2) and heart rate by shining red and infrared light through the skin and measuring the amount of light that is absorbed. It's commonly used in wearable devices for fitness tracking and medical applications for monitoring vital signs.

Figure 4. Spo2 Max30102

5. Jumper Wire

In electronics and prototyping, jumper wires are frequently used to temporarily connect components on a circuit board, breadboard, or other electronic platforms. utilized in a variety of ways in the testing, development, and prototyping phases of patient health monitoring systems. Although jumper wires are not directly integrated into the final deployed system, they are useful during the development and testing stages of an Lifecycle of an IoT-based patient health monitoring system. This allows for quick prototyping, experimentation, and validation of the system prior to its real-world deployment.

1. Breadboarding Sensors
2. Connecting Modules

3. Debugging and Testing
4. Temporary Connections

Figure 5. Jumper Wires

1. Breadboarding Sensors:

Jumper wires can be used to connect different sensors (like motion, temperature, and heart rate sensors) to the microcontroller or development board during the first prototyping stage. This makes it possible to quickly and simply experiment with various sensor connections and configurations.

2. Connecting Modules:

In projects where different modules are used for data acquisition, processing, and communication, jumper wires may be used to establish connections between these modules. For example, jumper wires could connect a sensor module to a microcontroller or a communication module (such as Wi-Fi or Bluetooth) to transmit data to a central server or cloud platform.

3. Debugging and Testing:

During the testing and debugging phase, jumper wires can be invaluable for troubleshooting connectivity issues or verifying the functionality of individual components. They allow for easy access to different points in the circuit, facilitating measurements and debugging with test equipment.

4. Temporary Connections:

Jumper wires provide a convenient way to make temporary connections between components or peripherals for testing different configurations or conducting experiments. For example, they could be used to connect an external display or indicator LED to visualize real-time data from sensors.

5. Connecting Wires:

Connecting wires are essential components in electronics and electrical applications, serving to establish electrical connections between various components. They are typically made of conductive materials, such as copper or aluminum, and come in various gauges and lengths to suit specific needs. These wires are often insulated to prevent electrical shorts and protect against external factors like sensors. Their color-coding helps identify the purpose of each wire, making it easier to connect components correctly Connecting wires have many uses in various contexts, from simple circuit connections.

1.2 Block Diagram:

This data is gathered by the gateway and securely sent over the internet. The information is processed and stored on a cloud server after traveling over the internet. This server is capable of processing and analyzing large amounts of data quickly. A secure application or web portal is suitable for use by medical professionals, for example, to access patient data. They can keep an eye on the person's medical trends and get notifications when anything seriously changes.

1. Power Supply: - Choose a reliable power source to ensure continuous operation of the system. Consider backup options such as batteries in case of power outages.

2. Oxygen Level Sensor: - Utilize pulse oximeters or similar sensors to measure the oxygen saturation level in the patient's blood. These sensors typically use infrared light to determine oxygen levels.

3. Heart Rate Sensor: - Operation for heart rate monitoring devices or sensors like photoplethysmography (PPG) sensors. These sensors detect blood volume changes, providing heart rate data.

4. ECG Module: - Integrate an ECG module that captures the electrical activity of the heart. This could include electrodes attached to the patient, with the module processing and transmitting ECG data.

5.Microcontroller: - Choose a microcontroller (e.g., Arduino, Raspberry Pi) capable of processing data from sensors, managing communication with other modules, and executing control logic.

6. GSM Module:- To facilitate cellular communication, include a GSM module. The system can send SMS alerts to specific mobile numbers because of to this module.

7. SMS Sending Module: - Develop a module within the microcontroller that triggers SMS alerts when critical health parameters are detected. This could involve setting threshold values for oxygen levels, heart rate, or ECG abnormalities.

8. Website for Monitoring: - Design a web-based interface using technologies like HTML, CSS, and JavaScript. Use a backend framework (e.g., Node.js, Django) to manage data storage, retrieval, and display. Implement secure authentication for authorized access.

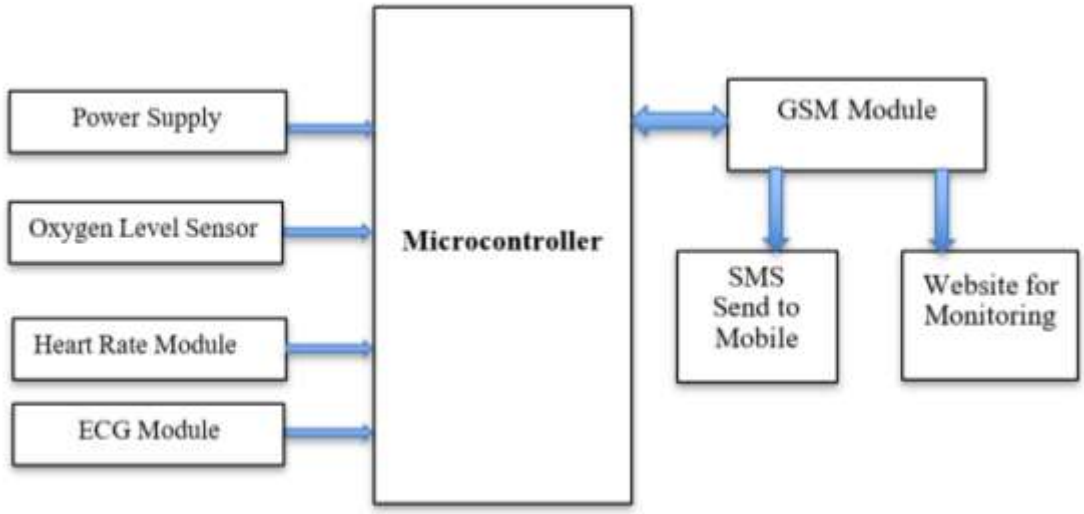

Figure 6. Block Diagram of Proposed system

IV. APPLICATIONS & ADVANTAGES

Applications:

1) Continuous Monitoring.
2) Remote Patient Monitoring.
3) Clinical Trials and Research.
4) Wellness and Preventive care.

Advantages:

1) Improve Patient Outcomes
2) Enhance Patient Engagement
3) Remote Monitoring
4) Data- driven decision making

V. EXPERIMENTAL RESULTS

Figure 7. Results

VI. CONCLUSION AND FUTURE WORK

These systems enable continuous and remote monitoring of patients' health parameters in real-time, allowing for early detection of abnormalities and timely interventions. By providing access to comprehensive, personalized patient data, IoT technology facilitates data-driven decision-making, leading to improved patient outcomes and enhanced quality of care. The pulse rate sensor is employed to monitor heartbeats, the internet, these sensors send the gathered data to the cloud. Conveniently, the data is shown on an LCD screen so that patients can monitor their health status simultaneously. In emergency scenarios, such as critical health fluctuations, a notification is dispatched to the doctor's mobile device, accompanied by an audible alert from a buzzer to notify the caregiver.

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