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Patient Health Monitoring System Using IOT

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Abstract

The project aims to develop an IoT-based patient health monitoring system that continuously tracks vital signs such as Respiratory and body temperature. The system uses sensors to collect data, which is then processed and displayed on an LCD screen. The data is also sent to a cloud platform for remote monitoring and analysis.

I. Introduction

This method is provided by electronic innovation, which reduces human needs and, as a result, improves people's well-being. As a result, a patient's condition should be monitored on a regular basis. However, it is a difficult task. This can be made easier by deploying GSM technology, which sends a message to the doctor or guardian regarding the patient's condition if any changes in health parameters occur. This innovation also makes use of a GPS module to keep track of the patient's whereabouts. As a result, the patient is not required to remain in the doctor's presence at all times. When the patient is at home or in another location, his condition will be continuously recorded. Consistent monitoring of the patient's vital signs, such as temperature, heart rate, and voltage. This structure is intended for usage by family members of patients who do not appear to be in critical condition but should be examined for health on a regular basis. In any emergency, an SMS is sent to a professional or a family member. The tilt direction of the user part is read by our proposed system. Mounting the accelerometer on the glove demonstrates how the device works. To send a message, the user now only needs to tilt the smartphone at a specific angle. Different messages are conveyed by tilting the gadget in different directions. We're going to use an accelerometer to measure motion statistics. It then sends the information to the microcontroller. The data is processed by the microcontroller, which then displays the appropriate message based on the input. The associated message is now shown on the LCD screen by the microcontroller. When it receives a motion signal from the accelerometer, it also sounds a buzzer and displays a message. If no one is available to respond to the message displayed on the LCD, the patient can opt to tilt the device, which will send an SMS to the patient's registered caretaker with the message that the patient wishes to express using a GSM modem.

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II. Literature Survey

"MEMS Wear bio monitoring System for Remote Vital Signs Monitoring,"F. Tay, D. Guo, L. Xu, M. Nyan, and K. Yap, 2009. This paper proposes a remote vital signs monitoring system, which integrate wireless body area network (WBAN) and personal digital assistant (PDA) phone technology. Four different physiological signs, e.g., ECG, SpO2,temperature and blood pressure, can be continuously acquired or derived from two wireless sensor nodes ECG sensor and integrated SpO2/temperature sensor. Once sentinel events happened or the request to real-time display vital signs is confirmed, all physiological signs and critical indices will be immediately transmitted to patient's PDA phone through Bluetooth and further relayed to doctor's PDA phone through global system for mobile communication (GSM) technology. A prototype of such system has been successfully developed and implemented, which will offer high standard of healthcare with a major reduction in cost for our society.

"Design and Implementation of a Healthcare Monitoring System,"
A.Sagahyroon, H. Raddy, A. Ghazy, and U. Suleman, 2009.A wearable healthcare monitoring unit that integrates various technologies was Developed to provide patients with the option of leading a healthy and Independent life without risks or confinement to medical facilities. The unit Consists of various sensors integrated to a microcontroller and attached to the Patient's body, reading vital signs and transmitting these readings via a Bluetooth Link to the patient's mobile phone. Short-Messaging-Service (SMS) is Incorporated in the design to alert a physician in emergency cases. Additionally, An application program running on the mobile phone uses the internet to update (at regular intervals) the patient recordsin a hospital database with the most recent Readings. To reduce development costs, the components used were both off-theshelf and affordable.

"Wireless technology in the evolution of patient monitoring on general hospital wards ".Sahandi, R., Noroozi, S., Roushanbakhti, G., Heaslip,V. & Liu, Y., 2010. The evolution of patient monitoring on general hospital wards is discussed. Patients on general wards are monitored according to the severity of theirconditions, which can be subjective at best. A report by the Commission for Healthcare Audit and Inspection in 2008 indicated dissatisfaction with patient monitoring. Commitment to providing quality health service by healthcareorganizations encourages the implementation of other mechanisms for patient care. Remote patient monitoring (RPM), by supplementing the role of nurses, can improve efficiency and patient care on general wards. Developments in technology made it possible for wireless sensors to measure and transmit physiological data from patients to a control room for monitoring and recording. Two approaches in the application of wireless ZigBee sensor networks are discussed and their performances compared in a simulation environment. The role of RPM in early detection of deteriorating patients' conditions, reducing morbidity and mortality rates are also discussed.

III. IMPLEMENTATION

Existing System:

Traditional health monitoring systems are often confined to hospitals and clinics,requiring patients to visit healthcare facilities for regular check-ups. These systems are typically bulky, expensive, and not suitable for continuous monitoring. Additionally, remote health monitoring is limited, making itchallenging to provide timely medical care to patients in remote areas.

Proposed System:

The proposed Patient Health Monitoring System uses IoT technology to enable continuous and remote monitoring of patients' vital signs. The system integrates Respiratory sensor, and temperature sensors to collect real-time health data. The NodeMCU microcontroller processes the data and displays it on an LCD screen. The IOT tecnology transmits the data to a remote server or healthcare provider, allowing for real-time monitoring and timely medical intervention. This system is compact, cost-effective, and suitable for both home and clinical use.

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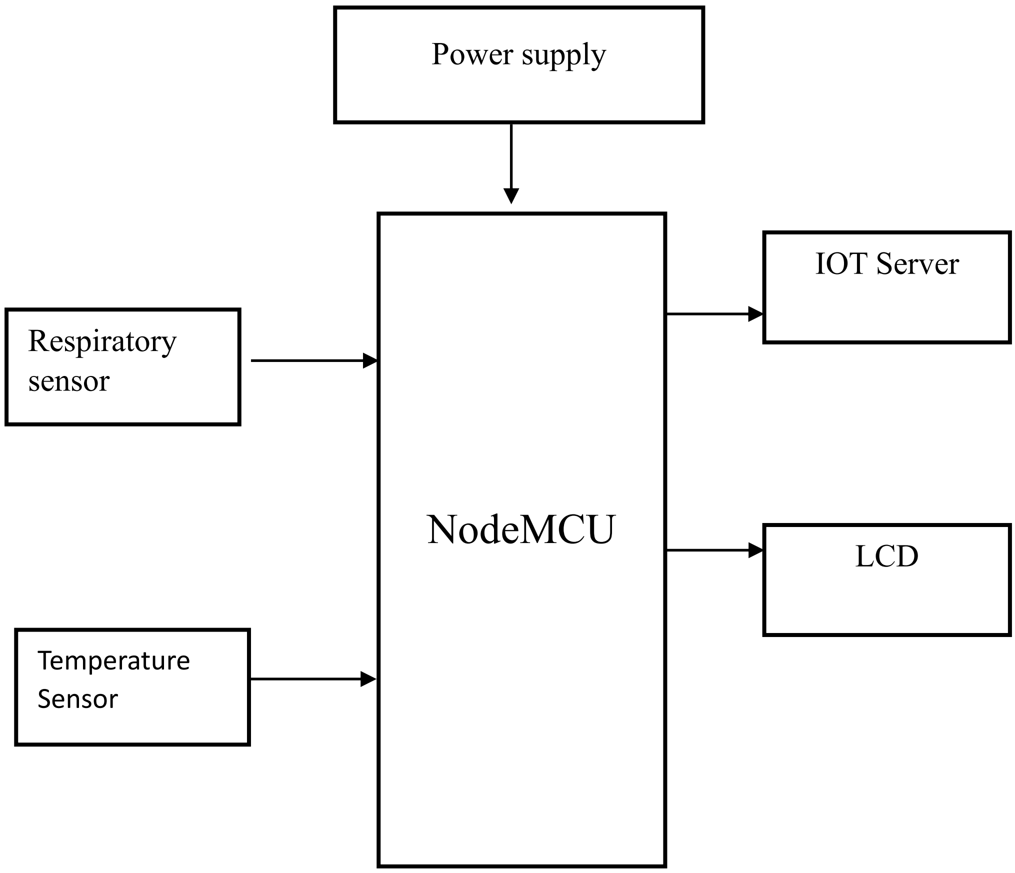
Block diagram:



block diagram for proposed system

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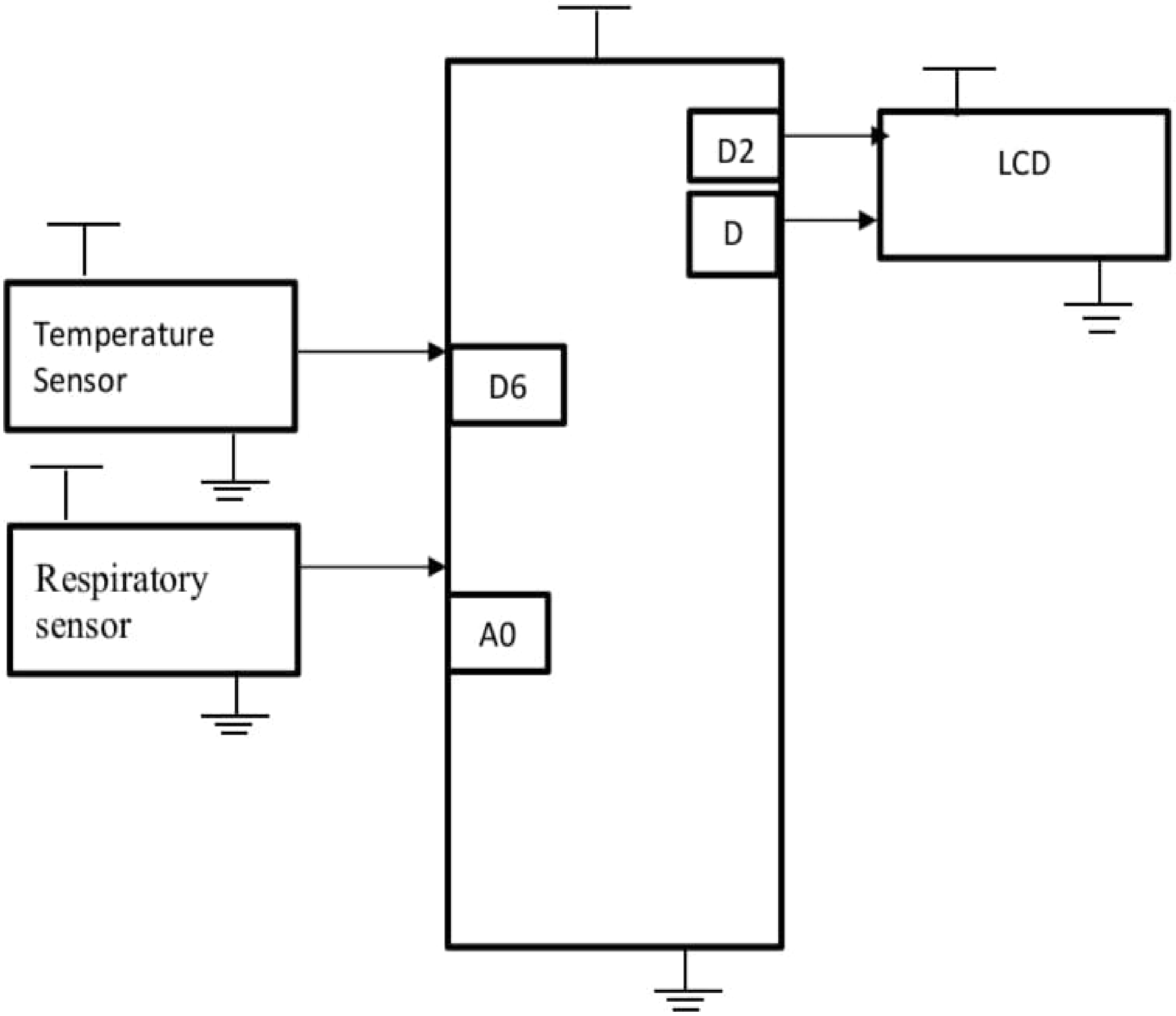
Schematic Diagram:



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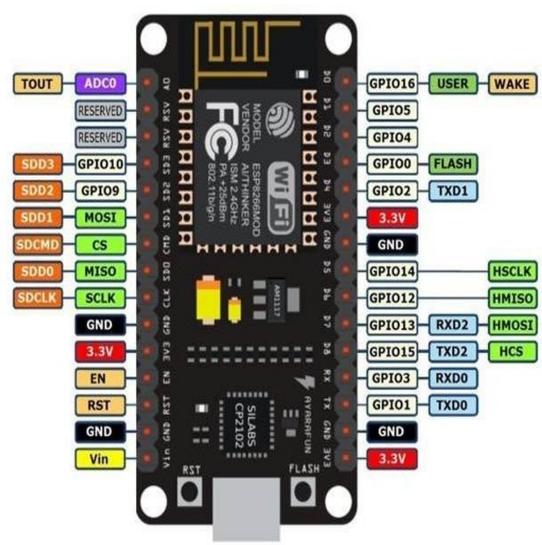
Node MCU:

Technically speaking NodeMCU is a firmware for ESP8266 developed using C Programming Language, Espressif NON-OS SDK and Lua scripting language. Traditionally, we write code for our Microcontrollers like Arduino, STM32, 8051 etc., either in C or C++ and compile it with a set of tools and generate a binary file. This binary file is then uploaded into the flash memory of the microcontroller and it gets executed. Things are quite different with NodeMCU. You can consider the NodeMCU firmware as an interpreter for Lua Scripts. So, if your ESP8266 is loaded with NodeMCU Firmware, you can simply write your application in Lua and send it to the ESP8266.NodeMCU Firmware will interpret the byte code and executes the commands. There is no compilation, no binary file etc. Just write a script and run it the team which developed NodeMCU Firmware also developed a breakout board for ESP-12E module called the NodeMCU Devkit. So, many of us are actually using the board called NodeMCU and programming it with Arduino IDE and not the Lua Scripts.

ESP8266 Wi-Fi module



ESP8266 Wi-Fi module

Temperature Sensor:

Temperature sensors A temperature sensor is a device, typically, a thermocouple or resistance temperature detector, that provides temperature measurement in a readable form through an electrical signal. A thermometer is the most basic form of a temperature meter that is used to measure the degree of hotness and coolness.

Spirometer:

A spirometer is a device used to measure lung function and capacity. It measures the flow of air through your lungs and estimates the amount of air in your lungs. Spirometer is used to diagnose asthma, chronic obstructive pulmonary disease (COPD) and other conditions that affect breathing. It may also be used periodically to monitor your lung condition and check whether a treatment for a chronic lung condition is helping you breathe better. After the test, you can return to your normal daily..

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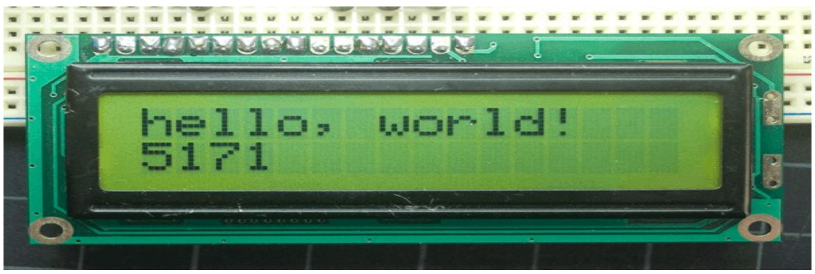
LCD

LCD is a flat display technology, stands for "Liquid Crystal Display," which is generally used in computer monitors, instrument panels, cell phones, digital cameras, TVs, laptops, tablets, and calculators. It is a thin display device that offers support for large resolutions and better picture quality. The older CRT display technology has replaced by LCDs, and new display technologies like OLEDs have started to replace LCDs. An LCD display is most commonly found with Dell laptop computers and is available as an active-matrix, passive-matrix, or dual-scan display. The picture is an example of an LCD computer monitor.

The Liquid Crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.



Output of the sketch on a 16x2 LCD

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins:

- A **register select (RS) pin** that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.
- A **Read/Write (R/W) pin** that selects reading mode or writing mode
- An **Enable pin** that enables writing to the registers
- 8 **data pins (D0 -D7)**. The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

There's also a **display contrast pin (Vo)**, **power supply pins (+5V and GND)** and **LED Backlight (Bklt+ and BKlt-)** pins that you can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.

The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register. The Liquid Crystal Library simplifies this for you so you don't need to know the low-level instructions.

The Hitachi-compatible LCDs can be controlled in two modes: 4-bit or 8-bit. The 4-bit mode requires seven I/O pins from the Arduino, while the 8-bit mode requires 11 pins. For displaying text on the screen, you can do most everything in 4-bit mode, so example shows how to control a 16x2 LCD in 4-bit mode.

LCD Pin Description:

The LCD requires 3 control lines (RS, R/W, and EN) and 8(or 4) data lines. The number of data lines depends on the mode of operation. If operated in 8-bit mode then 8-bit data lines are required. And if the operation is in 4-bit mode then 4-bit data lines are required. The 8-bit mode is faster than the 4-bit mode. In 8-bit mode, LCD uses a total of 14 pins including 8 data lines, 3 control lines, and 3 power supply lines (Vee Vss and Vee)

1. **Power Supply:** The LCD discussed here uses three power supply pins (Vcc, Vss, and Vee) Vcc and Vss pins are used to provide +5V and ground respectively. The pin Vee is used for controlling LCD contrast.
2. **Control Lines:** There are three control lines in the LCD. These three are used to control the LCD operations there are two very important registers inside the LCD: the command register and the data register. The RS (Register select) pin is used to select the register out of these two. If RS = 0 the command register is selected and the user is allowed to send the command to the LCD. If RS = 1, the data register is selected and the data sent by the user is displayed on the LCD.

R / W (Read/ Write) pin allows the user to read/write the information (data or code) to/ from the LCD. R /W = 1 when reading and R/W=0 when the writing operation is performed.

Another control pin EN (Enable) is used to latch the data present on the data pins. A high-low signal is required to latch the data. The LCD interprets and executes the commands at the instant the EN line is brought low.

3. **Data lines:** The 8-bits data pins. D (0)-D (7) are used to send the information to the LCD or read the contents of the LCD's internal register.

LCD Interfacing:

The LCD can be interfaced to the microprocessor 8085 using the programmable peripheral interface (PPI-8255) IC. To display letters and numbers. ASCII code for the letters A to Z, a to 7, and numbers 0 to 9 is sent to the data lines (D0 -D7). These codes may be sent to LCD data lines through one port of 8255 (PPI), port A is used as the output port and send the data to the LCD. The EN pin and RS pin are connected to port B of the 8255. Since it is used as a normal display R/W is made low by connecting to the ground directly. Power supply connections are provided to Vcc and Vss pins. The Vee pin is connected to the EE moving node of the potentiometer which is connected between the Vcc and Vss pins. By moving the potentiometer the contrast of the LCD can be changed.

IOT (Internet of Things)

The Internet of Things (IoT) refers to a network of physical devices, vehicles, appliances, and other physical objects that are embedded with sensors, software, and network connectivity, allowing them to collect and share data.

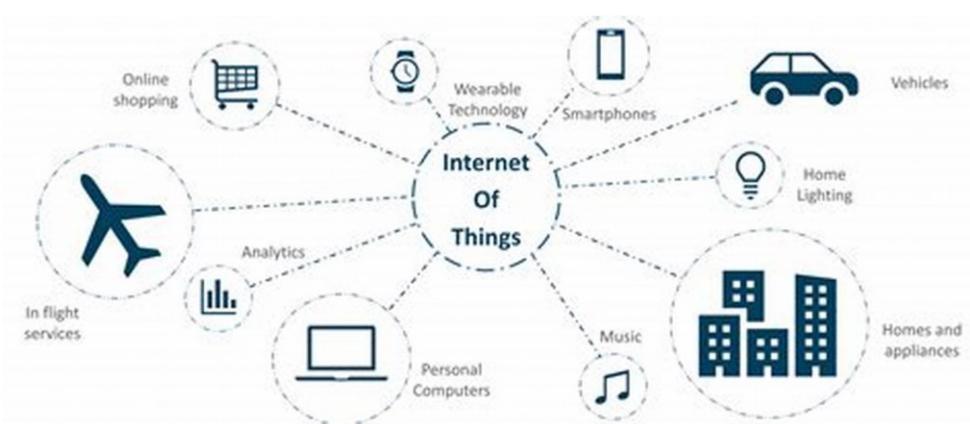
IoT devices—also known as "smart objects"—can range from simple "smart home" devices like smart thermostats, to wearables like smart watches and RFID-enabled clothing, to complex industrial machinery and transportation systems. Technologists are even envisioning entire "smart cities" predicated on IoT technologies.

IoT enables these smart devices to communicate with each other and with other internet-enabled devices. Like smartphones and gateways, creating a vast network of interconnected devices that can exchange data and perform various tasks autonomously. This can include:

- monitoring environmental conditions in farms
- managing traffic patterns with smart cars and other smart automotive devices
- controlling machines and processes in factories
- tracking inventory and shipments in warehouses

The potential applications of IoT are vast and varied, and its impact is already being felt across a wide range of industries, including manufacturing, transportation, healthcare, and agriculture. As the number of internet-connected devices continues to grow, IoT is likely to play an increasingly important role in shaping our world. Transforming the way that we live, work, and interact with each other.

In an enterprise context, IoT devices are used to monitor a wide range of parameters such as temperature, humidity, air quality, energy consumption, and machine performance. This data can be analyzed in real time to identify patterns, trends, and anomalies that can help businesses optimize their operations and improve their bottom line.



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RESULT

The implemented of patient health monitoring system using iot. To successfully monitoring respiratory and body temperature in real-time using appropriate sensor. The data was accurately displayed on a 16*2 LCD and transmissited to the Blynk IoT platform for remote access

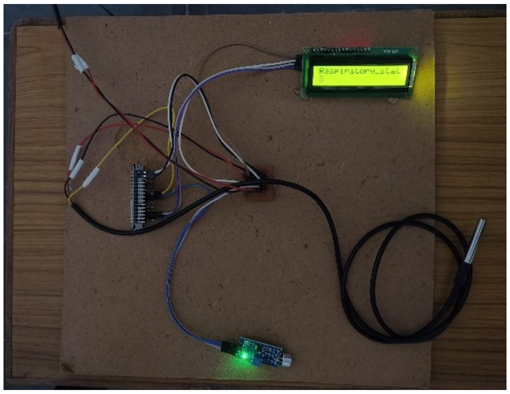

Fig-8.1: On state of monitoring Body Temperature

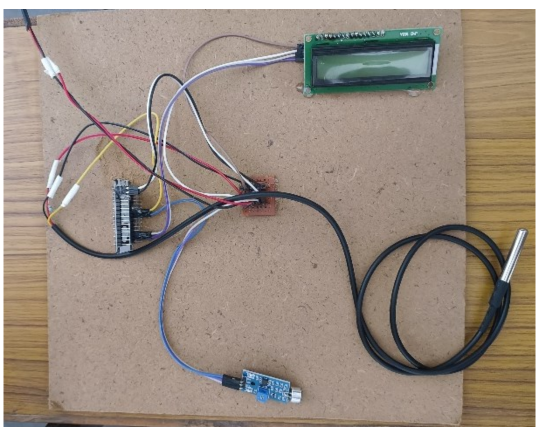

Fig-8.2: Off state of monitoring Body Temperature

Future Scope:

The future of patient health monitoring systems using IoT is incredibly promising, with the potential to revolutionize healthcare. Currently, IoT-enabled systems are already making strides in remote patient monitoring, but the future holds even more advanced and integrated applications.

One major area of growth is in enhanced data collection and analysis. Future systems will integrate a wider array of sensors, from wearable devices to implantable sensors, to collect more comprehensive health data. This data will include vital signs, activity levels, sleep patterns, and even biochemical markers. Advanced analytics, powered by artificial intelligence (AI) and machine learning (ML), will analyze this data to provide personalized insights and predict potential health issues. This will enable proactive interventions and prevent hospitalizations.

Another key area is improved patient engagement and empowerment. IoT devices will facilitate better communication between patients and healthcare providers. Patients will have real-time access to their health data, allowing them to take a more active role in managing their health. Telemedicine and virtual consultations will become more seamless, providing convenient access to healthcare, especially for those in remote areas.

Expanded applications are also on the horizon. IoT will play a significant role in chronic disease management, mental health support, and medication adherence. Smart homes will be integrated with healthcare systems, providing a safe and supportive environment for patients. IoT will also be used in hospitals to improve efficiency, reduce errors, and enhance patient safety.

However, there are challenges to address. Data privacy and security are paramount, and robust measures must be implemented to protect patient information. Interoperability between different devices and systems is crucial to ensure seamless data exchange. Ethical considerations, such as algorithmic bias, also need to be carefully addressed.

In summary, the future of patient health monitoring systems using IoT is bright. The convergence of advanced sensors, AI-powered analytics, and improved connectivity will lead to more proactive, personalized, and accessible healthcare, ultimately improving patient outcomes and quality of life.

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