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IoT-based Pill Dispenser System

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Abstract

Real-time data collection and patient database recording have been facilitated by the internet of things (IoT). One of the most common reasons a treatment plan does not work for a patient is that the drug is not taken at the prescribed time. People 50 years of age and beyond are more likely to suffer from diabetes, high blood pressure, Alzheimer's disease, Parkinson's disease, and other illnesses. For a patient like this, missing a dose can have detrimental effects. It is crucial that patients take their drugs on time as a result. The IoT-based pill dispenser reminder system improves medication adherence by utilizing networked devices. It includes a smart dispenser that automatically delivers pills at specified times and is linked to a mobile app. Users receive timely reminders and messages on their smartphones, ensuring that they follow the specified medication schedule. The device also allows caregivers or healthcare providers to monitor medication compliance remotely and intervene as needed. This solution encourages patient independence by seamlessly integrating IoT technologies, decreases prescription errors, and improves overall health outcomes.

Keywords: Health monitoring, internet of things (IoT), reminder system, infrared (IR) sensor, RTCDS3231, Arduino

INTRODUCTION

Internet of things (IoT) is defined as the gathering and exchange of critical data from network-connected devices via a secure service layer. IoT, to put it simply, is a wireless network of linked devices that share data and information to communicate, create new information, record it, and analyze it for use at a later time.

IoThas made it easier to record patient databases and collect real-time data. Not taking the medication at the recommended time is one of the most frequent causes of a treatment plan failing to heal a patient. A number of disorders, including diabetes, high blood pressure, Alzheimer's, and Parkinson's, are more common in those 50 years of age and older. For such patients, skipping a dosage can have serious consequences. Therefore, it is essential that patients take their medications on schedule. It has been shown that individuals generally disregard their health and prioritize other activities over taking prescribed medications. Online health community (OHC) platforms are one of the key disruptive technologies of the future. OHCs offer a forum for patients, healthcare professionals, physicians, caregivers, and others to exchange ideas and create solutions for pressing issues [1]. Clinical expertise could be beneficial for 62.1% of patient posts, according to a survey conducted with the most active OHCs on WebMD.com [2]. The most frequent issue facing the pharmaceutical and medical industries is medication errors, which arise

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from incorrect administration, dispensing, and transcribe writing. Numerous efforts have been made in research, development, and implementation of information and communication technologies (ICT) to prevent medication errors as a result of the worrisome data about these errors.

There are various steps involved in prescription and managing a patient's medicine, such as the following [3]:

- *Ordering:* The doctor is responsible for choosing the right drug, dose, and frequency.
- *Transcribing:* The pharmacist needs to read and comprehend the handwritten prescriptions.

When dispensing medication, the pharmacist must ensure that the right dosage is being administered while taking into account any potential chemical matching. Administration: Correct dosage and timing of drug administration are crucial for the proper patient to receive and consume.

Senior citizens frequently forget to take their medicine on time and fail to understand how to take it in the proper manner and dosages. These issues can be fatal to them, particularly for individuals suffering from chronic illnesses. As a result, this research presents an IoT smart pill dispenser with a monitoring system for elderly individuals. This project was created with the intention of assisting patients with their medicine intake by providing the correct dosage at a predetermined time. This solution allows users to maintain and create pill schedules through a mobile application. The mobile application will communicate with Arduino using Firebase, which serves as a connecting store for both components [4–7].

Users can preload prescriptions into the system, which will then automatically dispense the correct dosage at the appropriate times based on a predetermined schedule. Supervisors or healthcare practitioners, with the user's agreement, can monitor medication adherence and receive reminders in the event of missed doses or system difficulties. In this system, there is an emergency situation in which pulse rate sensor that are used in emergency situations. If a person's pulse rate rises above a certain limit or threshold value, a notification is sent to the guardian via an IoT application [8].

LITERATURE SURVEY

There are some studies that have focused on this problem and some of them havesolved the problem but there is much non-compliance and problems which we noticed that some of them are unable to resolve. So we analyzed many previous research papers and we tried to solve the problem which were not present in their work. We find that none of them were giving emergency facilities to the patient in emergency situations. We implement that whenever pulse rate of the patient will go higher than its threshold value, then it will automatically send notifications to the guardians of the patient through the IoT-based application [9].

We are working on our project to make it IoT based instead of any Raspberry Pi to make it more affordable and sustainable for the users [10, 11].

Proposed Work

We are preparing to implement numerous ideas that will make the system simpler and more elegant to use. Our project will be divided into three parts that will all operate together for the patient's convenience. Installing thermal and pulse rate sensors in dispenser machines to monitor patient temperature and pulse rate. An emergency facility option has been introduced to send alerts to users in case of an emergency. Adding time slots to our app to monitor medication compliance.

Each module must be located in a certain area before proceeding with the final design of the pillbox. These modules will include the pill refilling mechanism, the pill dispensing mechanism, and the electronic module, which will house the majority of the circuitry such as the Arduino, switches, and other components. In addition, the graphics must include the location of the pill tray from which each pill will exit the pillbox.

Proposed System

We are proposing a system in which we are using a health monitoring module for displaying the pulse rate and body temperature when measured: pulse rate sensor for measuring the pulse rate of the patient, and an infrared (IR) sensor for measuring the body temperature. We are using Arduino, which controls the buzzer, motor, LCD, LEDs. A block diagram of the proposed system is shown in Figure 1.

We will use IoT application for controlling RTC (real-time clock) and transmitting data, which helps patient's guardian for controlling digitally instead of manually.

METHODOLOGY

In this system, we use five modules that work sequentially to complete the procedure. The functionality of each module is outlined below.

Module 1

This is a switched mode power supply (SMPS) as shown in Figure 2. It reduces voltage efficiently by employing high-frequency switching mechanisms. The input AC voltage is adjusted and filtered to produce DC voltage. A controller governs the switching of a high-power semiconductor switch (usually a MOSFET) to manage energy transfer to the output. A transformer isolates the output, reducing voltage while retaining electrical isolation. The rectified and filtered output is controlled with feedback to stabilize voltage and current, resulting in a steady 12 V output at up to 5 A. Compared to standard linear power supplies, this design is more efficient, smaller, and lighter in weight, making it suitable for a wide range of applications.

Module 2

The NodeMCU ESP32 as shown in Figure 3 is a flexible microcontroller board built around the ESP32 chip. It supports both Wi-Fi and Bluetooth connectivity, making it perfect for IoT projects. It runs on a 32-bit Ten silica Xtensa LX6 CPU, which provides enough computing capability for a variety of tasks. It supports numerous communication protocols and includes built-in general-purpose input/output (GPIOs), Analog to Digital Converter (ADCs), and Digital to Analog Converter (DACs), allowing for smooth interaction with sensors, actuators, and other devices. Its interoperability with the Arduino IDE facilitates development, and its small size and low power consumption make it useful for a wide range of projects.

Module 3

A pulse rate sensor as shown in Figure 4 typically uses light to detect changes in blood volume in peripheral blood vessels. It usually includes an LED light source and a photodetector.

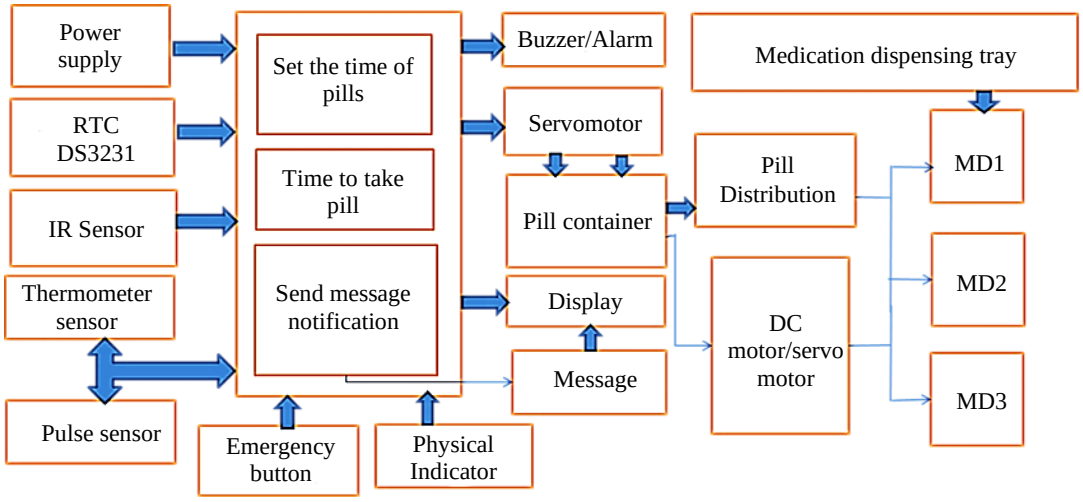

Figure 1. Block diagram of the proposed system.

Figure 2. Switched mode power supply (SMPS).

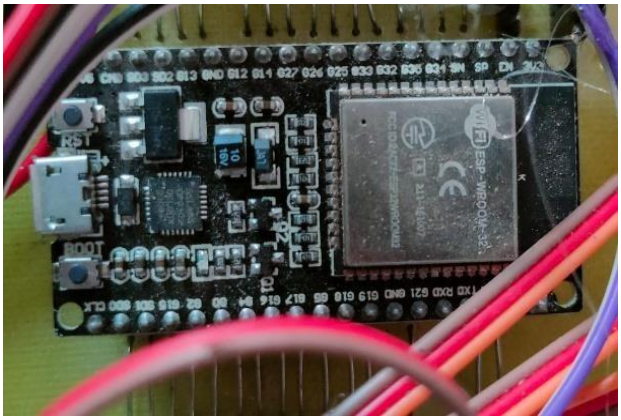

Figure 3. Node MCU ESP32.

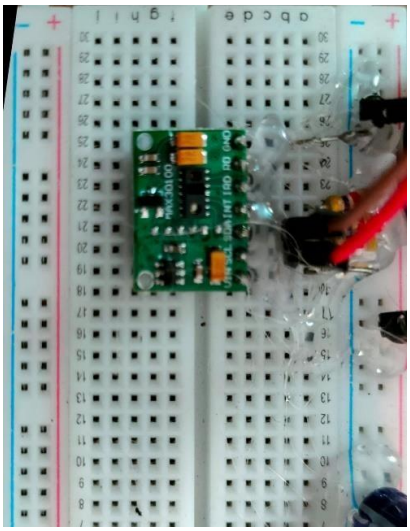

Figure 4. Pulse sensor.

The LED transmits light into the skin, and the photodetector detects the strength of light reflected or transmitted through it. As blood volume changes with each heartbeat, the amount of light absorbed changes, allowing the sensor to detect the variations and calculate the pulse rate based on the observed signals.

Module 4

A 16 × 2 LCD (liquid crystal display) as shown in Figure 5 contains 16 columns and 2 rows of characters. It makes use of liquid crystal material, which becomes opaque or transparent when an electric field is applied, as controlled by an array of electrodes. Each character is created by placing the electrodes in specified ways. An electrical controller delivers data and commands to the LCD, determining which pixels to illuminate to show characters. Backlighting increases visibility. It is widely used in embedded systems and provides a simple and effective way to display numeric information.

Module 5

A Bluetooth serial monitor enables wireless connection between devices. It typically consists of a Bluetooth module, such as the HC-05 or HC-06, linked to a microcontroller. The module uses the serial port profile to establish a serial communication link with a linked device, such as a smartphone or PC. The microcontroller processes the data transmitted over this link and displays it on the associated device's monitor or terminal application. This configuration allows the remote monitoring and management of the microcontroller-based system via a Bluetooth connection. The Bluetooth serial monitor is shown in Figure 6.

RESULTS

This project is working properly and all the modules are in working position and the pill is dispensed at the correct time when you will save it through phone. We can check whether the pill is taken or not by patient in Telegram, it will show when patient took their medicine or is the pill dispenser is working properly or not. We also provide pulse sensor and temperature sensor and it displays on the screen. All the output of pulse sensor and room temperature sensor will show on the 16 × 2 LCD display.

Figure 5. LCD display.

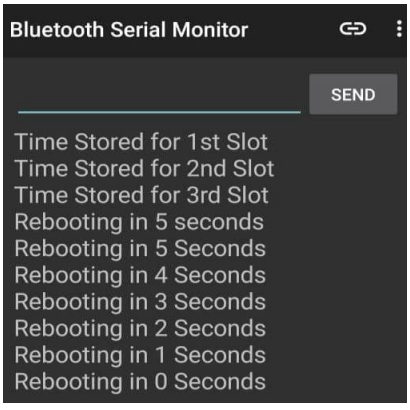

Figure 6. Bluetooth serial monitor.

We use Bluetooth serial monitor to set the time of the medicine dispensing and when medicine will dispense, it will automatically show in Telegram as shown in Figure 7 and in case there is any delay in taking medicine by patient, it will also notify in Telegram.

We also provide 3 LED and buzzer when it is time to dispense the medicine. It will help the patient to recognize from the distance which slot he/she has to take and we use buzzer as alarm because sometimes patient is sleeping so it will help to notify them to take their medicine.

We also provide 3 motors to slide the slot of the medication. It helps the patient to find out that which slot they have to open and we give 1 minute of delay time to the motors so that medicine can take easily by patients. In case the patient did not take their medicine, it will automatically notify in the Telegram of the care taker and also buzzer for a minute. The pill dispenser model is shown in Figure 8.

Figure 7. Telegram window.

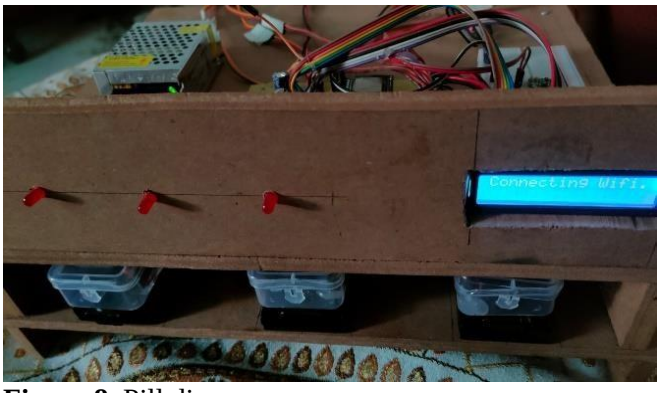

Figure 8. Pill dispenser.

CONCLUSIONS

The components of IoT-based pill dispenser are very affordable and it works properly and can give accurate output. It has the ability to perform multiple tasks at a time because of Arduino. The Arduino we are using is very low cost and easily available and the pulse and temperature sensors work very satisfactorily because there is no error in the output and information is displayed on the screen with no delay.

Future Scope

1. Integration of more advanced modules so it can also dispense liquid medications.
2. Integration of an emergency to call an ambulance in case of critical situation.
3. Integration of a module, which can purify the room toxication according to the patient.
4. Integrate camera so that caretaker can see the patient's condition.

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