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IOT-Enabled Medicine Dispenser for Pills and Liquid Medication

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Abstract

This research introduces an IoT-based solution designed to improve medication adherence among elderly individuals. The system offers the capability to dispense both tablets and liquid medications automatically, accompanied by a caregiver-friendly interface. It ensures timely medication intake and streamlines monitoring efforts. At the core of the system is a controller that functions as a secondary unit, managing hardware components including sensors and actuators. A built-in web application facilitates scheduling and communication tasks. Through this platform, caregivers can remotely set medication schedules, receive alerts, and monitor drug consumption effectively.

The implementation of this smart dispenser has shown significant improvements in adherence rates, attributed to features such as real-time alerts and remote supervision. Overall, the IoT-based dispenser addresses the common issue of missed medications in elderly patients, contributing to enhanced health outcomes and improved quality of life.

INTRODUCTION

In today's fast-paced world, proper medication management has become a significant challenge, particularly for elderly individuals, patients with chronic illnesses, and those who require multiple medications at different times. Missing doses or taking incorrect medication can lead to serious health complications. To address this issue, the integration of **Internet of Things (IoT)** technology into healthcare devices is becoming increasingly important.

Medication adherence remains a significant challenge in the healthcare industry, especially among older adults and patients prescribed multiple medications, where the risk of missed doses or accidental overdose is high. Such lapses can lead to severe outcomes, including permanent disability or even fatality, highlighting the urgency of an effective solution.

The proposed solution is an automatic medicine dispenser (AMD), designed to deliver medication at pre- scheduled times. This system has demonstrated its potential in improving adherence through timely dispensing and user notifications.

Among vulnerable populations such as the elderly, chronically ill, or visually impaired, missing doses or taking incorrect medications is a persistent issue that can lead to serious health complications. To address this challenge, automated medicine dispensers have emerged as a promising solution, aiming to ensure timely and accurate delivery of prescribed treatments.

This paper presents the design and implementation of an IoT-enabled medicine dispenser capable of handling both pills and liquid medications. The system is designed to operate autonomously with real-time monitoring, timely reminders, and remote accessibility. It leverages sensors, microcontrollers, and connectivity platforms to dispense precise dosages while notifying caregivers or family members in case of missed doses. By integrating automation and remote communication, the proposed solution contributes to safer medication practices, particularly in home-based healthcare environments.

I. EXISTING SYSTEM

In the current healthcare environment, medication management is largely dependent on manual processes. Most patients rely on traditional methods such as pillboxes, written schedules, or mobile reminders to track their medication intake. These systems depend heavily on human memory and discipline, which often leads to missed or incorrect doses, especially among elderly or chronically ill individuals. Liquid medications add further complexity due to the need for accurate measurement and timely administration. temperature. Some advanced solutions exist in the form of programmable pill dispensers or mobile applications that generate alerts.

II. PROPOSED SYSTEM

The proposed system aims to develop a smart, IoT-enabled medicine dispenser capable of delivering both pills and liquid medications in a timely and accurate manner. It is designed to address the limitations of existing systems by incorporating automation, real- time monitoring, and remote access. The dispenser is built using microcontrollers, sensors, motors, and communication modules to manage dosage schedules without constant human intervention

III. METHODOLOGY

The proposed system is developed through a structured methodology that integrates hardware components, embedded programming, and IoT-based monitoring. The process begins with the system design, where the layout is planned to accommodate both pill and liquid dispensing units. The design ensures user-friendliness, safety, and compactness to suit home or clinical environments.

The hardware setup includes a microcontroller such as

Software development involves programming the microcontroller with logic to handle medication timings, motor control, and sensor inputs. The code is written using embedded C or Circuit Python, depending on the hardware used. The system tracks real-time clock (RTC) data to trigger dispensing actions and alerts at the correct times. Additionally, the system is designed to detect whether the medication has been taken, using infrared or load sensors, and logs this information accordingly.

- With IoT integration, caregivers or doctors can monitor medication adherence from a distance. This is particularly useful in rural or remote areas where regular medical supervision is not feasible.

- Children and individuals with disabilities or cognitive impairments often require assistance with medications.

Arduino or ESP32, which acts as the central processing unit. For pill dispensing, a motor-driven mechanism is employed to release the correct quantity of tablets from a rotating container. For liquid medications, a mini peristaltic pump or solenoid valve is used to dispense precise volumes. Sensors such as DHT11 are included to monitor ambient temperature and humidity, ensuring medicines are stored in appropriate conditions. An OLED or LCD display is used to show medication schedules, and a buzzer provides audio alerts when it is time for the user to take their medicine.

Applications

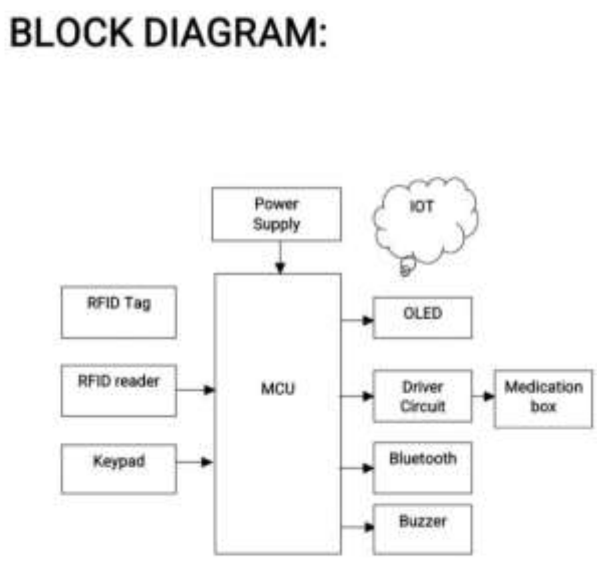

Fig.1 Block Diagram

This system provides a structured, safe way to manage their intake without confusion.

- Patients recovering at home after surgeries often require both pills and liquid medications on a timely basis. This dispenser helps them follow medical instructions precisely.

IV. HARDWARE DETAILS

Microcontroller: The Raspberry Pi Pico W is a compact and efficient microcontroller board developed by the Raspberry Pi Foundation. It is built around the RP2040 chip, a dual-core ARM Cortex-M0+ processor running at 133 MHz, and is equipped with 264KB of SRAM and 2MB of onboard flash memory. What sets the Pico W apart from the original Pico model is its built-in Wi-Fi capability, enabling wireless connectivity for IoT applications. **RFID Reader:** An RFID (Radio Frequency Identification) reader is an electronic device used to read data stored on RFID tags using radio waves. It serves as a contactless identification system, allowing objects, people, or even medications to be uniquely

- This system is highly beneficial for elderly individuals who often struggle to remember their medication schedules. It ensures they receive the correct dose at the right time without relying on memory or supervision.

- The device is suitable for use in home-based healthcare setups, especially for patients who require regular medication but prefer staying at home rather than visiting hospitals frequently.

- Hospitals can deploy such dispensers in wards to automate the distribution of medications, especially during night shifts or in high-patient- load situations, reducing the workload on nurses and caregivers.identified and tracked without physical contact. The reader typically consists of a radio transmitter, receiver, and antenna, which work together to detect nearby RFID tags.

RFID Tag: An RFID (Radio Frequency Identification) tag is a small electronic device that stores digital data which can be read by an RFID reader using radio waves. Each tag contains a microchip that holds a unique identifier (UID) and an antenna that allows it to communicate wirelessly with the reader. n the context of an IoT-based medicine dispenser, RFID tags can be used to identify and authenticate users.

OLED (Organic Light Emitting Diode): An OLED (Organic Light Emitting Diode) display is a type of flat-panel screen that produces images using organic compounds that emit light when an electric current passes through them. Unlike traditional LCDs, OLED displays do not require a backlight, which allows them to be thinner, brighter, and more energy-efficient

Bluetooth: Bluetooth is a wireless communication technology that enables short-range data exchange between electronic devices. It operates in the 2.4 GHz ISM (Industrial, Scientific, and Medical) band and is commonly used for creating personal area networks (PANs). Bluetooth supports both point-to-point and multipoint connections, making it suitable for various smart application

Driver Circuit: A driver circuit is an essential electronic component used to control high-power devices such as motors, pumps, relays, or LEDs using low-power control signals from a microcontroller.

Keypad: A keypad is a user input device consisting of a matrix of buttons arranged in rows and columns. The most commonly used version in embedded systems is the 4x4 or 4x3 membrane keypad, which includes numeric and functional keys. It allows users to enter commands, passwords, or menu selections into the system with ease.

DC Motor: A DC (Direct Current) motor is an electromechanical device that converts electrical energy into mechanical motion using direct current. It operates on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a force that causes rotation. DC motors are widely used in automation and embedded systems due to their simple construction, ease of control, and compact size.

SOFTWARE DETAILS

The software component of the IoT-enabled medicine dispenser is responsible for managing the system's functionality, user interaction, and cloud connectivity. It is developed using embedded programming techniques, primarily with Micro Python or C/C++, depending on the microcontroller used (such as the Raspberry Pi Pico W or ESP32).

Micro Python: Micro Python is a lean and efficient implementation of the Python 3 programming language specifically designed to run on microcontrollers and embedded systems. It provides a simple, readable syntax similar to standard Python but is optimized to operate with limited memory and processing power found in devices like the Raspberry Pi Pico W, ESP32, and other IoT hardware.

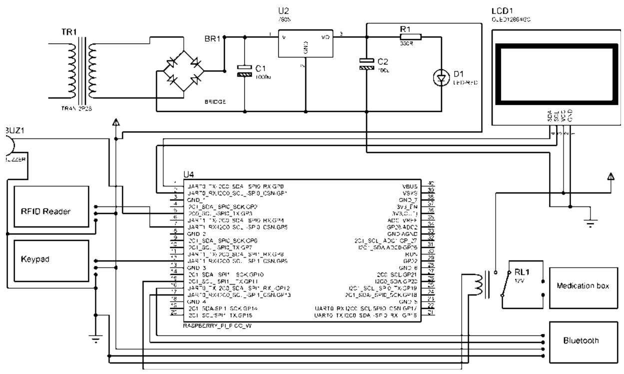

Fig.2 Schematic Diagram

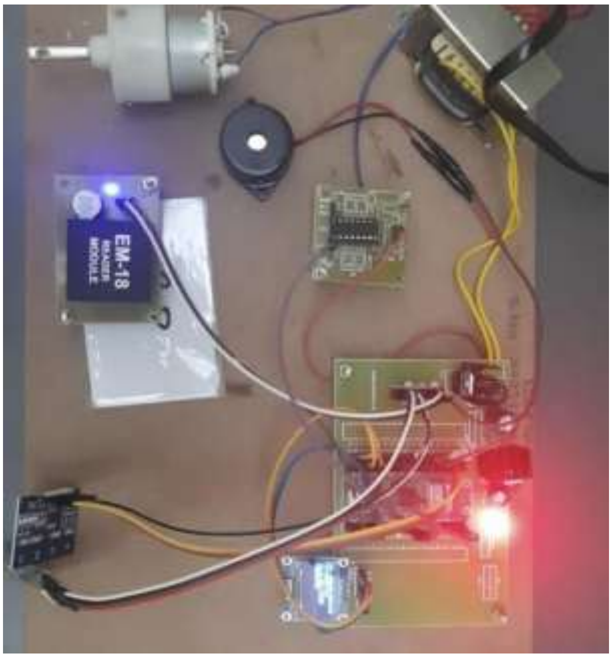

FIG 3 Prototype

V. CONCLUSION

The IoT-enabled medicine dispenser offers an effective and intelligent solution to automate and monitor the process of medication delivery. By integrating components such as RFID authentication, OLED display, DC motors, liquid pumps, sensors, and wireless connectivity through microcontrollers like the Raspberry Pi Pico W, the system ensures accurate, timely, and secure dispensing of both pills and liquid medications. This project addresses common issues such as missed doses, incorrect medication intake, and lack of supervision, especially for elderly patients or those requiring regular medication. Features like remote monitoring via cloud platforms, real-time alerts, and personalized user access add value to modern healthcare systems. monitoring of the solar panel's performance. This project addresses common issues such as missed doses, incorrect medication intake, and lack of supervision.

This project offers a scalable, customizable, and efficient solution for improving medication adherence and reducing manual errors in dosage. It not only supports patients in taking the right medicine at the right time but also empowers caregivers with tools for better supervision and control. With further improvements and real-world testing, this system can be adapted for use in hospitals, nursing homes, and personal home care, marking a progressive move toward smart and connected healthcare.

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