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IOT Based Smart Medicine Suppliers

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Abstract - IoT-Based Scheduled Medicine Dispensing System for Adherence This project focuses on utilizing the Internet of Things (IoT) to develop a dedicated system for scheduled medicine dispensing, specifically targeting improved patient adherence. The primary function of this system is to accurately and reliably dispense prescribed medication at the exact, pre-programmed time. The system integrates a smart dispensing mechanism with an IoT platform, ensuring that the right medicine is delivered at the right moment as defined by the patient's schedule. Key features include real-time clock synchronization and automated activation of the dispenser at the scheduled time. By limiting the scope solely to timely dispensing, the solution provides a focused, reliable, and user-friendly intervention to overcome the common challenge of patients forgetting or incorrectly timing their medication intake. Data related to successful dispensing events can be logged and transmitted to the cloud, offering a foundational element for simple adherence monitoring by caregivers. This project proposes and implements an Internet of Things (IoT)-based smart medicine dispenser designed to improve patient compliance and provide real-time monitoring for caregivers. The system integrates a secure hardware module with a mobile application to automate and manage complex medication schedules. The core hardware features an electronically controlled single-compartment medicine dispenser capable of handling various pill sizes (small, medium, large). Upon a scheduled dispensing time, the system initiates an alert using a buzzer sound to notify the patient. Crucially, the name of the dispensed medicine is simultaneously shown on a local LCD display and transmitted to a mobile application for enhanced clarity and verification. enabling remote tracking of dispensing logs and adherence patterns, thereby providing a comprehensive solution for improved patient safety and medication management.

Key Words: Internet of Things (IoT), Smart Medicine Dispenser, Medication Adherence / Non-AdherenceRemote Patient Monitoring (RPM), Chronic Disease Management, Automated Dispensing System, Real-Time Clock (RTC), Microcontroller (e.g., ESP32), MQTT Protocol, Cloud Computing / Backend, Mobile Application / User Interface (UI), Healthcare Technology, Elderly Care, Polypharmacy

1.INTRODUCTION

Medication non-adherence failing to take prescribed medicines as directed remains a major global health challenge, leading to poor health outcomes and increased healthcare costs. A primary cause of non-adherence is simply forgetting to take medication at the correct, scheduled time. This project addresses this critical issue by focusing the power of the Internet of Things (IoT) on the specific task of automated, scheduled medicine dispensing. The proposed system moves beyond simple reminder applications by integrating a physical dispenser with an IoT network to ensure the accurate and reliable delivery of medication precisely at the designated time. By prioritizing punctual and automatic dispensing, the system offers a direct technological intervention to ensure patients receive their required dosage exactly when they need it.

2.OVERVIEW

This IoT based smart medicine suppliers project is a targeted application of the Internet of Things (IoT)designed to solve the significant healthcare problem of medication non-adherence, specifically focusing on the timing of medication intake. The core function of this system is to act as a smart medicine supplier that strictly adheres to the prescribed schedule.

3.PROBLEM STATEMENT

The challenge is to mitigate the risks and consequences of medication non-adherence, specifically focusing on issues arising from forgetting doses, incorrect timing, and administering the wrong medicine. Medication non-

adherence is a pervasive and costly healthcare issue. Patients, particularly the elderly or those managing multiple chronic conditions, frequently face difficulties maintaining complex medication schedules.

Existing methods such as traditional pill boxes, phone alarms, or written schedules rely heavily on patient memory and manual sorting, which are prone to human error. There is a critical need for an automated, verifiable, and intelligent system that can physically manage and dispense medication doses precisely according to a pre-set schedule.To develop an IoT-based smart medicine dispensing system that automatically and accurately delivers the correct medicine (dose and type) at the right scheduled time, thereby significantly improving patient adherence, treatment efficacy, and overall safety.

4. OBJECTIVE

This project is a targeted application of the Internet of Things (IoT) designed to solve the significant healthcare problem of medication non-adherence, specifically focusing on the timing of medication intake.The core function of this system is to act as a smart medicine supplier that strictly adheres to the prescribed schedule.

1.Accurate Scheduling and Dispensing: To design and implement a robust system that can accurately store, retrieve, and dispense the correct dosage of medicine at pre-set, scheduled times using an integrated Real-Time Clock (RTC) module.

2.Remote Schedule Management: To enable users (or caregivers) to remotely set, modify, and view the medication schedule via a dedicated mobile application or web dashboard connected to a cloud platform.

3.Real-Time Status Monitoring: To provide continuous feedback on the device's operational status, including confirmation of successful dispensing, low medicine inventory, and system errors, accessible through the user interface.

4.Cost-Effective and Scalable Design: To utilize readily available, low-cost components to ensure the final prototype is economical and has the potential for mass production and wider adoption.

5.Design a User-Friendly Interface: To develop an intuitive mobile application that allows users to easily input complex medication schedules and receive push notifications regarding device status and missed doses.

5.MOTIVATION

The core motivation for this project stems from addressing the significant public health challenge of non-adherence to medication schedules, especially among the elderly, individuals with chronic conditions, or those managing complex polypharmacy (taking multiple medications).The motivation for the IoT Smart Medicine Dispenser is to move beyond simple reminders and offer a comprehensive medication management ecosystem that is: Reliable (Automated Dispensing),Connected (Remote Monitoring),Actionable (Immediate Alerts) Ultimately, the project is motivated by a desire to improve patient safety, treatment efficacy, and overall healthcare outcomes through the application of smart technology.

6.APPLICATION

1. Home Healthcare and Elderly Care

The primary application is to enable independent living for seniors and individuals with memory issues. The

device acts as an automated, reliable assistant, ensuring the correct medicine is dispensed on time. This provides crucial remote oversight and peace of mind for caregivers who can monitor adherence without needing to be physically present.

2. Chronic Disease Management

It provides a high level of adherence assurance for patients managing complex, long-term conditions (like hypertension or diabetes). For these conditions, where missed or incorrect doses can lead to serious health deterioration, the system ensures strict compliance with complex, multi-drug regimens, improving health outcomes.

3. Clinical Trials and Research

The dispenser offers a solution for objective data collection. It automatically records the precise time of dispensing, providing researchers with unbiased, verifiable adherence metrics. This high-quality data is essential for validating drug efficacy and meeting regulatory requirements in clinical studies.

4. Healthcare Systems and Pharmacies

It supports Remote Patient Monitoring (RPM) by feeding adherence data directly to doctors and healthcare providers. It also streamlines logistical operations by automatically alerting the patient or pharmacy when medicine inventory is low, facilitating timely refills and reducing treatment interruption.

7. Aim

The Aim of your IoT-based Smart Medicine Dispenser project is to Design, develop, and deploy a reliable, automated, and interconnected system that significantly improves patient adherence to prescribed medication schedules through precise dispensing, real-time remote monitoring, and proactive alert notifications.

1.Reliable and Automated: To replace human-dependent methods (manual sorting, memory) with a fault-tolerant mechanical and electronic system.

2.Interconnected (IoT): To leverage cloud technology to bridge the gap between the patient, the device, and the caregiver/doctor, allowing for remote management and monitoring.

3.Significantly Improve Adherence: This is the core goal—to increase the percentage of patients taking the correct dose at the correct time, thereby improving treatment effectiveness.

4.Proactive Alert Notifications: To ensure the user receives timely, multi-modal reminders (audible, visual, mobile app push) to prevent missed doses. This single aim

encapsulates the functional necessity, the technical approach, and the desired impact of your project.

3. Problem Statement

Medication non-adherence the failure of patients to take their prescribed medication as directed is a critical public health issue, particularly among the elderly, those with chronic illnesses, and individuals managing complex drug regimens (polypharmacy).

Key Issues:

1.Human Error and Forgetfulness: Patients frequently miss scheduled doses, take the incorrect dosage, or mistakenly double-dose due to memory lapses, complex schedules, and cognitive decline.

2.Lack of Caregiver Oversight: Current medication management methods often lack a reliable, real-time mechanism for caregivers or healthcare providers to monitor patient adherence remotely. This leads to delayed intervention when doses are missed.

3.Adverse Health Outcomes: Non-adherence results in disease progression, avoidable hospitalizations, increased healthcare costs, and diminished quality of life for the patient.

8. Architecture

An IoT-based smart medicine dispenser typically follows a standard three or four-tier architecture. Here is a breakdown of the architecture, covering the device (IoT/Edge), Backend (Cloud), and Frontend (User Interface). Smart Medicine Dispenser Architecture The project can be visualized as three main layers: Device, Cloud/Backend, and Application/Frontend.

8.1. Device Layer (The Smart Dispenser)

This is the physical hardware that handles the core function of storing, sensing, and dispensing medication.

1.Microcontroller (MCU): An ESP32 is ideal due to built-in Wi-Fi for connectivity. This is the brain of the device.

Actuator System:

2.Stepper Motors : Used to precisely rotate a mechanism (like a carousel or chute gate) to dispense the correct tablet from the right compartment at the right time.

Sensing & Input:

3.Real-Time Clock (RTC) Module : Critical for keeping accurate time, even if the Wi-Fi is temporarily disconnected, ensuring dispensing is always on schedule.

4.IR Sensor: To detect if a tablet has actually been dispensed or if the user has collected the medicine.

Power Supply: Battery backup is crucial for reliability.

5.Wi-Fi Module: To connect to the internet.

MQTT Client: The standard lightweight messaging protocol used to communicate securely and efficiently .

the cloud backend (sending status updates and receiving)

8.2 Cloud/Backend Layer (The Server)

This is the central hub that manages all devices, stores user data, and handles scheduling logic.

IoT Broker (e.g., Mosquitto, AWS IoT, Google Cloud IoT):

Role: Acts as the secure middleman for all communication between the physical device and the application. The device subscribes to commands (e.g., "DISPENSE NOW") and publishes status (e.g., "MEDICINE DISPENSED").

API Gateway (e.g., Node.js/Express, Python/Flask, Spring Boot):

Role: Secure entry point for the Frontend. It handles user login, registration, and communication with the database.

Database (DB): Relational (e.g., PostgreSQL, MySQL):

For storing structured data like user profiles, medication names, dosage instructions, and refill alerts.
NoSQL (e.g., MongoDB, DynamoDB): Can be used for storing device logs, historical dispensing records, and time-series data.

Scheduling Service/Engine:

Role: A microservice that checks the database schedules continuously. When a scheduled time arrives, it sends the dispense command through the MQTT Broker to the specific device.

8.2 Frontend Layer (User Interface)

This is the client-side application that users interact with to manage their schedule and monitor the device.
Objective: Must be intuitive for setting schedules and getting immediate status updates.
Platforms:
Mobile App (Recommended): Built with React Native or Flutter for cross-platform (iOS/Android) support.
Web Dashboard: Built with React, Vue.js, or Angular for administrative or desktop viewing.

Key Features:

Medication/Dosage Setup: Interface for defining the pill name, the quantity to dispense, and the exact times.
Schedule View: A clear calendar or list view of upcoming and missed doses.
Real-time Status: Shows if the dispenser is connected, battery level, and current pill count (if using inventory sensors).
Notification: Push notifications for Dispense Time Alert (time to take meds) and Missed Dose Alert.

8.4.Block diagram

This block diagram illustrates the architecture and data flow of a Medicine Dispenser system, showing how different components interact, primarily using an ESP32 Microcontroller as the central processing unit.

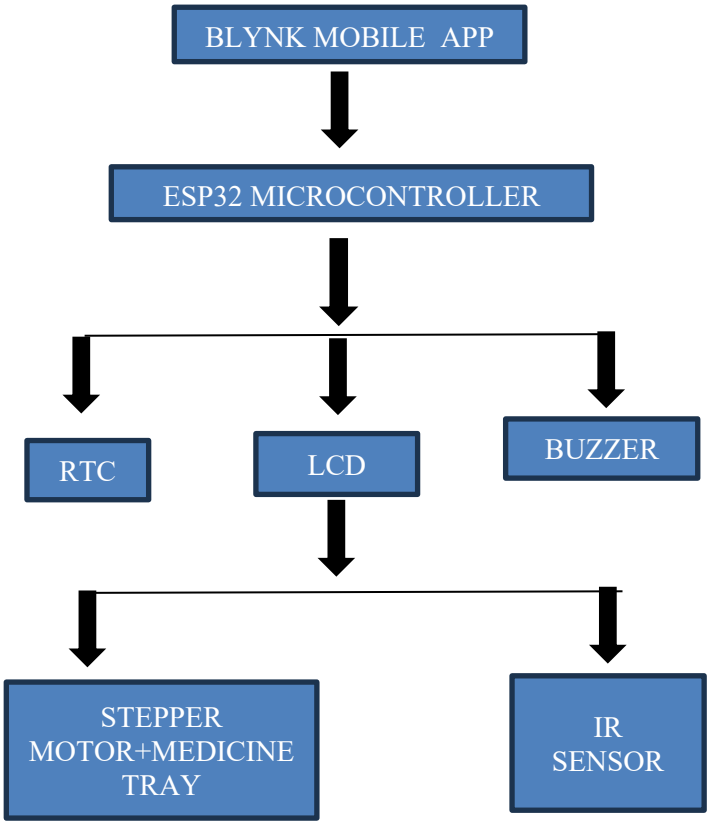

Fig 1:block diagram

The system is designed to dispense medicine at set times, alert the user, and confirm if the medicine has been taken. It can be divided into three main sections: the User Interface (Blynk Mobile App), the Control System (ESP32 and Peripherals), and the Dispensing and Sensing Mechanism.

Blynk Mobile App (User Interface)

The Blynk Mobile App is the user interface and acts as the remote control and monitoring station. It communicates with the ESP32 via Wi-Fi (Internet) for:
Setting Alarm Time: Users can remotely set the required medicine dispensing times.
Getting Status: The app can query the current state of the dispenser (e.g., if medicine is in the slot, battery status, etc.).
Receiving Alerts: The app receives Notifications/Events from the ESP32, such as an alert that it's time to take medicine or if the medicine hasn't been taken.

ESP32 Microcontroller (Control System)

The ESP32 Microcontroller is the core of the system. It handles the logic and communication between the app and the physical components. Its main functions include:
Wi-Fi + Blynk Communication: Maintains the internet connection and communicates with the mobile app.
Alarm Logic: Determines when an alarm time matches the real time and triggers the dispensing sequence.

Stepper Motor Control: Sends signals to move the medicine tray/slot.
IR Sensor Reading: Reads the status of the IR sensor to detect if the medicine is present or taken.
Buzzer Alert Control: Activates the buzzer to generate sound alerts.
Time Sync (NTP + RTC): Synchronizes time, likely using NTP (Network Time Protocol) over Wi-Fi for initial sync and the RTC (Real-Time Clock) module for continuous tracking.

Peripherals and Actuators
These components are connected directly to the ESP32 and manage the physical actions and local display.
Time and Alert
RTC: A Real-Time Clock module that stores real time independently, ensuring accurate timing even if the ESP32 loses power or Wi-Fi temporarily.
Buzzer: Produces a sound alert when it's time for the medicine to be taken.
LCD 16x2 (I²C): A small display that shows time & messages (like "Time to take medicine") directly on the device.

Dispensing and Sensing
Stepper Motor + Medicine Tray: This is the actuator responsible for dispensing. It moves to a specific slot as controlled by the ESP32 when the alarm is triggered, pushing the medicine into the retrieval area.
IR Sensor (Slot): An Infrared Sensor placed at the dispensing slot. Its purpose is to detect if medicine is taken or not. The ESP32 uses this reading to confirm compliance and send appropriate alerts to the Blynk App.

9 . Conclusion

The successful development of this IoT-based Smart Medicine Dispenser marks a significant step forward in personalized digital healthcare. This project effectively validates the feasibility and efficacy of using interconnected technology to combat the pervasive and costly issue of medication non-adherence, thereby addressing a critical gap in home-based patient care.
By successfully integrating a robust ESP32 microcontroller with a custom-designed mechanical dispensing system and a secure cloud-based platform, we have created a seamless, end-to-end solution. The system is fundamentally designed to eliminate human error and memory lapses by automating the delivery of the correct dosage at precise scheduled times, as maintained by the highly accurate Real-Time Clock (RTC) module. This automation establishes a new standard for reliability, directly addressing the complexities of polypharmacy. Furthermore, the implementation of the MQTT protocol ensures a reliable, low-latency communication channel, providing caregivers and healthcare providers with crucial remote monitoring capabilities. This feature moves beyond simple alerts, offering verifiable, time-stamped adherence data and enabling proactive intervention within minutes of a missed dose. Ultimately, the project fulfills its core aim: to elevate patient safety, increase treatment efficacy, and sustainably enhance the quality of life for individuals managing complex medication regimens, particularly the elderly.
In essence, this smart dispenser is not merely a device; it is a comprehensive digital medication management ecosystem poised to transform the way chronic care is administered. Its success demonstrates the tangible benefit of applying smart technology to routine health challenges, offering a cost-effective and scalable model for the future of remote healthcare monitor.

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