
SMART PILL MEDICATOR: AN IOT-BASED APPROACH FOR EFFECTIVE MEDICATION ADHERENCE

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ABSTRACT

The Pill Medicator is an IoT-based smart system designed to help elderly people take their medicines easily, safely, and on time. Many senior citizens forget to take medicines or take the wrong dosage, which can lead to serious health problems. This project aims to solve this issue by using an IoT device integrated with a web application. The IoT-based pill medicator stores and dispenses medicines according to a predefined schedule. It provides alerts and reminders using sound and notification signal lights to inform the user when it is time to take the medicine. The device is connected to the internet, allowing real-time monitoring and control through a web application. Medication intake reports can also be generated for data tracking and record maintenance. The web application enables caretakers or family members to manage medication schedules, monitor medicine intake status, and receive alerts if a dose is missed. This system reduces human error, improves medication adherence, and ensures better healthcare support for elderly people. The hardware components of the IoT system include a motion sensor, Arduino Nano board, LED indicators, a buzzer, and a DC motor for dispensing tablets. The web application is developed using HTML and CSS to provide a simple and user-friendly interface for accessing and tracking patient medication data. This integrated system ensures timely medication reminders, improves patient adherence, and supports efficient health management. Overall, the proposed system offers a reliable, user-friendly, and efficient solution for medication management using IoT technology and web-based monitoring, enhancing the quality of life and independence of senior citizens

KEYWORDS: Internet of Things, Internet of Things (IoT), Web-Based Healthcare Systems.

1. INTRODUCTION

Medication non-adherence is a major problem in healthcare where patients do not follow the prescribed medication instructions[1]. This includes missing doses, taking medicine at the wrong time, using incorrect dosages, or stopping treatment early. It is especially common among elderly people and patients with chronic diseases such as diabetes, hypertension, and heart disease, who often need to take multiple medicines daily [2].

When patients do not take medicines properly, treatments become less effective and diseases may worsen. This can lead to complications, frequent hospital visits, longer recovery times, and higher healthcare costs. Factors such as memory problems, managing multiple medications (polypharmacy), and lack of caregiver support often contribute to medication non-adherence.

To solve this issue, the Pill Medicator project introduces an IoT-based smart medication management system [3]. The device stores medicines and automatically dispenses them at the scheduled time while providing reminders through alarms or notifications. It also ensures the correct medicine and dosage are given [4].

The system records medication usage and sends adherence data to a web-based monitoring platform. Caregivers and healthcare providers can remotely track whether patients take their medicine on time. This helps detect missed doses quickly and improves patient care[5].

Overall, the Pill Medicator system improves medication adherence, reduces health risks, and supports elderly patients in managing their medication safely and independently using IoT technology [6][7].

2. PROPOSED METHODOLOGY

The proposed Pill Medicator system is designed as a cyber-physical IoT-based healthcare solution that integrates mechanical pill dispensing with digital monitoring and control. The methodology focuses on ensuring timely medication intake, real-time tracking, and user-friendly interaction for elderly patients or individuals requiring regular medication.

2.1 SYSTEM INITIALIZATION AND SETUP

Initially, the medication tablets are manually loaded into separate storage compartments inside the pill medicator unit. Each compartment is assigned to a specific time schedule

(morning, afternoon, evening, etc.). The caregiver or administrator configures the medicine schedule through a web-based application, which is connected to the IoT device. The scheduling data is stored digitally and synchronized with the microcontroller embedded in the device.

2.2 TIME MONITORING AND SCHEDULING

The system continuously monitors time using programmed intervals. When the present medication time is reached, the controller activates the alert mechanism. This ensures that: Medicines are dispensed only at the scheduled time, Dosage timing errors are minimized and Patients receive reminders without manual supervision.

2.3 ALERT AND NOTIFICATION MECHANISM

At the scheduled time, the device triggers the LED indicators for visual notification, Buzzer alerts for audible notification and also alerts ensure that even elderly users with hearing or vision limitations can recognize the reminder. The alert continues for a predefined duration until the patient responds.

2.4 AUTOMATED PILL DISPENSING

Once the alert is triggered, a DC motor mechanism rotates to dispense the correct pill from the assigned compartment. The mechanical structure ensures controlled and limited dispensing to prevent overdose or accidental multiple releases.

The dispensing unit is designed to:

- Rotate only for a specific duration.
- Release a single dose per alert cycle.
- Stop automatically after dispensing.

2.5 INTAKE DETECTION AND MONITORING

A PIR motion sensor is integrated into the system to detect user interaction near the device. When motion is detected after the alert, it is assumed that the patient has approached and taken the medicine. This event is recorded and transmitted to the IoT server for logging and future reference.

2.6 IOT DATA LOGGING AND WEB MONITORING

The system uses a Wi-Fi module (ESP8266/ESP32) to transmit data to a web server. The web application performs the following functions:

- Stores medication intake records.
- Displays alert history logs.
- Allows caregivers to monitor patient compliance remotely.
- Maintains health-related medication records.
- All events such as:
 - "Medicine Alert Sent"
 - "Medicine Taken"
- Missed alerts are recorded with timestamps for analysis.

2.7 DATA ANALYSIS AND HEALTH RECORD MAINTENANCE

The stored data can be used to:

- Monitor patient medication adherence.
- Identify missed doses.
- Support medical consultations with accurate intake history.
- Improve treatment effectiveness through.

The structure and smart pill medicator: an IOT-based approach for effective medication adherence is shown below

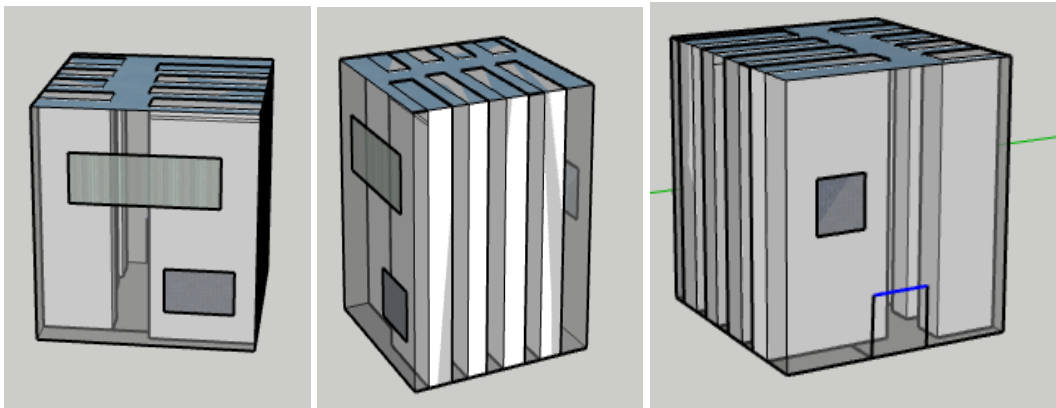


Fig 1: Structure of hardware component.

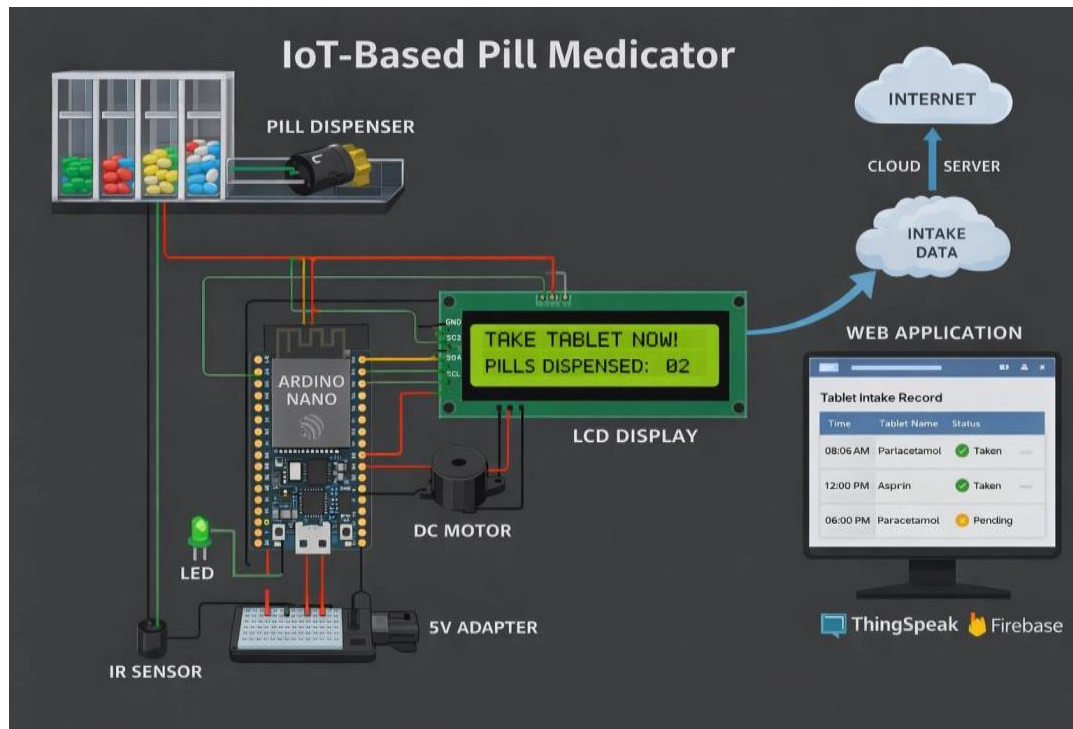


Fig 2: IoT Based Pill Medicator system.

2.8 WEB APPLICATION DESCRIPTION

The web application is the management interface for the Pill Medicator system, enabling caregivers to configure schedules, associate medications with containers, and review adherence data. It maintains structured records of patient activity.

1. Configure medication schedules: Set reminders and timings for patients to take their meds.
2. Associate medications with containers: Link specific meds to the Pill Medicator's containers, so patients get the right pills at the right time.
3. Review patient adherence data: Check patients medication history and see if they're sticking to their schedules.
4. Maintain structured records: Keep organized records of patient activity, making it easier to track progress.

3. WORKFLOW OF PROPOSED SYSTEM

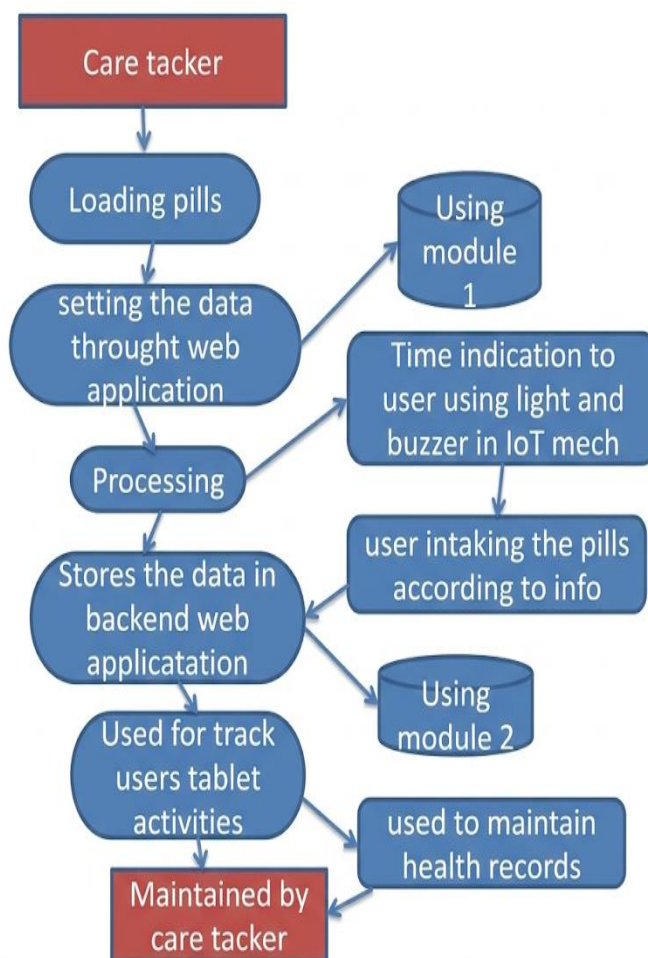


Fig 3: Workflow of proposed System.

4. CONCLUSION

The Pill Medicator project demonstrates how Internet of Things (IoT) technology can effectively address the challenges associated with medication adherence. One of its key advantages is providing timely alerts, which remind patients to take their medicines according to the prescribed schedule. It also maintains digital records that track medication history, making it easier for caregivers and healthcare providers to monitor a patient's progress. In addition, the system promotes patient autonomy by allowing individuals to manage their medication routines more independently. The impact of this solution is particularly significant for elderly populations, who often require additional support in managing their medications. Furthermore, the Pill Medicator represents an important step toward smart healthcare delivery, offering a reliable framework for integrating IoT technologies to improve patient outcomes. With its practical design and functionality, the system has strong potential for real-world deployment, enabling widespread adoption and

contributing to better public health. Overall, the Pill Medicator project highlights how IoT can create meaningful improvements in healthcare, especially for vulnerable groups.

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