

PILLPORT: AN IoT BASED AUTOMATED MEDICINE DISPENSER

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Abstract—The demand for efficient medication dispensing systems in public spaces, particularly in rural areas, remains a significant challenge. This paper presents an innovative IoT-based Automated Medicine Dispenser designed to address these challenges by automating the medication distribution process. The system integrates advanced technologies, including RFID, mobile applications, and automated dispensing machines, to ensure accurate and efficient medication delivery. Doctors and patients register on the app, after which patients are issued unique RFID cards. During consultations, doctors enter prescriptions, which are securely transmitted to a central backend system. Patients can then visit a dispensing machine, insert their RFID card for identity verification, and receive their prescribed medication. The system is designed with accessibility in mind, incorporating voice assistance through the app to guide users with limited technical knowledge. The machine operates sustainably using solar power, ensuring reliable functionality in areas with limited electricity. Additionally, patient data is securely stored to maintain privacy and confidentiality. The system also features a web-based interface that allows patients to request assistance, ensuring comprehensive support. This automated solution offers a scalable and sustainable approach to improving healthcare access, efficiency, and medication management in rural and underserved communities.

Index Terms—IoT, RFID, Healthcare, Prescription Management, Sustainability, Data Privacy, Voice Assistance.

I. INTRODUCTION

Medication dispensing in public spaces, including rural areas and healthcare facilities such as hospitals, poses significant challenges due to the reliance on manual processes to ensure accurate and timely delivery of prescribed medications. Traditional methods often depend on healthcare personnel, which can introduce the potential for human error, delays, and operational inefficiencies. While these issues exist in various

healthcare settings, a particular concern in rural areas is the lack of reliable electricity infrastructure, further complicating the deployment of automated systems that require consistent power sources. To address these challenges, this paper introduces an IoT-based Automated Medicine Dispenser that not only automates the medication dispensing process but also leverages solar power to ensure reliable and sustainable operation in both rural and hospital environments. By utilizing solar energy, the system remains operational even in areas with unstable or limited access to electrical grids, making it adaptable to a range of healthcare settings, from remote rural locations to well-established hospitals. The system integrates advanced technologies such as Radio Frequency Identification (RFID), mobile applications, and automated dispensing units, ensuring accurate and secure medication distribution. Patients and healthcare providers can register on the mobile app, where patients are issued unique RFID cards. Prescriptions are securely entered by doctors and transmitted to a centralized backend system. Patients can then visit the dispensing machine, verify their identity using the RFID card, and receive the prescribed medication. By automating the medication dispensing process, the system minimizes human error and enhances the accuracy of medication delivery. Additionally, the inclusion of voice assistance in the mobile app ensures accessibility for users with varying levels of technical proficiency. The solar-powered operation provides a sustainable and cost-effective solution, particularly for rural areas with unreliable electricity while remaining suitable for hospitals where power infrastructure is stable. This paper demonstrates the potential of combining IoT, renewable energy, and automation to improve healthcare delivery, offering a scalable, efficient, and sustainable solution for medication management in both rural and hospital settings.

A. PROBLEM STATEMENT

Medication dispensing in public spaces, particularly in rural areas and healthcare settings, faces significant challenges that impact both operational efficiency and the safety of patients. Traditional methods of dispensing medications rely heavily on manual processes, which are prone to human error, delays, and inefficiencies. This reliance on healthcare workers for accurate medication delivery often leads to mistakes in medication administration, resulting in potential adverse health outcomes. Additionally, the process is time-consuming, with long waiting periods for patients and increased labor costs for healthcare providers. In rural areas, the lack of reliable electricity infrastructure further complicates the situation, making it difficult to implement automated solutions that require a constant power source. Furthermore, many existing systems are not designed to accommodate patients with limited technical knowledge, leading to barriers in accessing medications. Traditional pharmacies also struggle with data management, regulatory compliance, and inventory control, further increasing the likelihood of errors and reducing the overall effectiveness of healthcare delivery. Given these challenges, there is a clear need for an innovative, automated solution that can streamline the medication dispensing process, improve accuracy, and provide equitable access to medications in both rural and hospital settings. This paper proposes the development of an IoT-based Automated Medicine Dispenser that incorporates RFID technology, mobile applications, and solar power to address these challenges. The system aims to automate medication dispensing, reduce human error, enhance accessibility, and ensure reliable operation even in areas with unstable power supply, ultimately improving healthcare delivery and patient safety.

II. LITERATURE SURVEY

The literature review focuses on recent advancements in IoT technology and automation in the healthcare sector, particularly for medication management. Researchers have demonstrated that IoT-based solutions can greatly improve medication adherence, especially for elderly and disabled patients who may struggle with managing their medications independently. Studies highlight how automated medicine dispensers ensure accurate and timely medication delivery, reducing the risks of overdosing or underdosing. By integrating features like real-time alerts and communication with caregivers, these systems help foster patient independence while keeping medical staff informed. Additionally, IoT-enabled dispensers are designed to be scalable and user-friendly, ensuring that patients with varying medical needs can benefit from the technology. This review also explores how IoT-based solutions, such as cloud integration and real-time monitoring, enhance the overall efficiency and safety of medication management systems, making them a reliable tool in modern healthcare. We selected three papers for the survey: [1] Design and Development

of Smart Medicine Dispenser IoT, [2] An IoT based Smart Medicine Dispenser Model for Healthcare, [3] IoTAAMD: Experimental Analysis of IoT Assisted Systematic Medicine Dispenser with Logical Sensors Association.

A. Design And Development Of Smart Medicine Dispenser IoT

India's aging population and increasing number of disabled individuals underscore the urgent need for efficient healthcare solutions, particularly in medication management. To address this, Smart Medicine Dispenser (SMD) was proposed that ensures timely and accurate medication delivery through a microcontroller-based system. The SMD automates medication dispensing, tracks schedules, and allows real-time updates via a secure cloud platform. It also includes an emergency SOS feature to alert caregivers and medical personnel in critical situations. This system improves medication adherence, reduces errors, and enhances caregiver involvement by offering remote monitoring capabilities. With its high accuracy, reliability, and safety features, the Smart Medicine Dispenser presents a promising solution for elderly and disabled individuals, improving health outcomes and supporting caregivers in managing complex medication regimens.

B. An IoT based Smart Medicine Dispenser Model for Healthcare

This system, the IoT-based medicine dispenser, presents an innovative solution to enhance medication adherence, especially for elderly and disabled individuals. By automating medication dispensing, providing timely alerts, and facilitating communication between patients and caregivers, it ensures accurate and reliable medication delivery. The dispenser reduces the risk of overdosing and underdosing, empowering patients to manage their medications independently while keeping caregivers informed. With its scalability and adaptability, the device is suitable for a wide range of healthcare needs. Despite challenges like internet connectivity and data security, the IoT-based medicine dispenser has the potential to transform medication management, improve health outcomes, and support the growing elderly population.

C. IoTAAMD: Experimental Analysis of IoT Assisted Systematic Medicine Dispenser with Logical Sensors Association

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III. METHODOLOGY

The Smart Medicine Dispenser system combines advanced RFID technology, IoT integration, and automation to ensure efficient and accurate medication management. The process begins when doctors and patients sign up through the mobile application. Patients receive RFID cards containing unique IDs, which are used to identify them securely. The doctors record prescriptions during consultations, and these are automatically transmitted to the backend system for processing.

The system utilizes an automated dispensing machine equipped with an RFID reader, which verifies the patient's identity when they insert their RFID card. Upon successful identification, the machine communicates with the backend system to retrieve prescription data. This information is used to determine the correct medication and dosage, which is then dispensed through the machine's automated dispensing mechanism.

The system is equipped with solar-powered units to ensure sustainability, particularly in remote locations. It also includes a voice assistant feature, designed to guide patients through the process, making it user-friendly for elderly or non-tech-savvy individuals.

Communication between the mobile app, backend system, and dispensing machine is managed via secure cloud servers, ensuring real-time updates on patient medication schedules and logs. Additionally, the system is designed with a help button on the web app, allowing patients to request immediate assistance when necessary.

The integration of these technologies enables the system to provide a reliable, automated solution for medication adherence, enhancing the quality of care while reducing the risk of errors. The system is fully automated for dispensing and tracking medication, empowering patients to manage their medication schedules independently, while offering caregivers real-time monitoring capabilities.

IV. PROPOSED SYSTEM

The proposed system, PillPort, is an IoT-based automatic medicine dispenser designed to improve medication accessibility, particularly in remote and underserved areas. It integrates RFID technology for secure patient identification, a stepper motor for precise medication dispensing, a solar panel for sustainable power, and both web and Android applications for seamless management and user interaction. The system enhances medication adherence, reduces errors, and ensures continuous operation, making it an innovative solution for improving healthcare accessibility and efficiency.

A. Microcontroller: The System's Brain

The microcontroller is the central processing unit of the PillPort system, responsible for orchestrating all operations. It acts as the "brain" that connects and controls the various components, including the RFID reader, stepper motor, solar panel, and communication systems for both the Android and web applications. When a patient inserts their RFID card into the dispenser, the microcontroller processes the card's unique identification details, communicates with the backend to fetch the patient's prescription, and sends commands to the stepper motor to dispense the correct dosage. The microcontroller's ability to handle multiple inputs and outputs efficiently ensures the system operates smoothly and responds in real-time, making it a critical part of the system's functionality.

B. Stepper Motor: Precise Medication Dispensing

The stepper motor plays a pivotal role in the PillPort system by providing accurate and controlled dispensing of medications. Unlike traditional motors, stepper motors move in discrete steps, which allows for precise positioning and dosage control. This is especially important when dispensing medications in specific quantities, as prescribed by the doctor. The stepper motor works in conjunction with the microcontroller to automate the dispensing process, ensuring that only the correct amount of medication is released. By reducing the need for manual intervention, the stepper motor minimizes the risk of human error in medication administration, enhancing patient safety and adherence to prescribed treatments.

C. Solar Panel: Sustainable Power for Remote Areas

A key feature of the PillPort system is its solar-powered design, which ensures the system remains functional even in areas with limited or unreliable electricity. The solar panel captures sunlight and converts it into electrical energy, which is stored in a battery for later use. This energy-efficient solution allows the system to operate continuously without the need for external power sources, making it ideal for remote or underserved areas where access to electricity may be scarce or inconsistent. The incorporation of solar power not only ensures the PillPort system is operational at all times but also aligns with sustainability goals by reducing the reliance on traditional, non-renewable energy sources, further enhancing its appeal in off-grid locations.

D. Android Application: Voice-Guided Patient Interface

The Android application in the PillPort system is designed to be an accessible, user-friendly interface for patients. It provides step-by-step guidance through the medication retrieval process, with the added benefit of voice assistance. This feature is especially valuable for elderly patients or individuals who may not be familiar with technology, as it enables them to interact with the system without requiring extensive technical knowledge. The voice guidance helps patients understand each step clearly, ensuring they can independently retrieve their medications from the dispenser. Additionally, the app allows patients to access their profiles, view medication history,

and receive reminders, making it a comprehensive tool for managing health in a convenient and accessible way.

E. Web Application: Centralized Management for Admins, Doctors, and Patients

The web application serves as the control hub for the entire PillPort system, providing essential functionalities for administrators, doctors, and patients. For administrators, the web app offers secure login and user management features, allowing them to register and manage both doctors and patients. It also facilitates inventory tracking, medicine registration, and restocking, ensuring the system runs efficiently and accurately. Doctors can use the web application to log in, prescribe medications, and track patient interactions, ensuring that prescriptions are automatically synced with the dispensing system. For patients, the web app provides access to personal profiles, medication history, and payment information, allowing them to view and manage their health records easily. By centralizing all interactions on one platform, the web application ensures that each user role—admin, doctor, and patient—can efficiently access and manage their relevant data.

F. Backend System: Secure Data Storage and Synchronization

The backend system is the backbone of the PillPort solution, ensuring the secure storage and synchronization of all critical data, including patient profiles, prescriptions, and dispensing records. All data is stored in a secure, encrypted database to protect patient privacy and maintain confidentiality. The backend communicates seamlessly with both the web and Android applications, ensuring that any updates to prescriptions, user accounts, or inventory are immediately reflected across the system in real-time. This centralized data storage not only facilitates efficient access and retrieval of information by authorized users but also helps ensure that the system operates smoothly and that any potential issues are quickly identified and addressed. By maintaining data integrity and real-time synchronization, the backend system plays a crucial role in ensuring the overall reliability and security of the PillPort solution.

V. PROPOSED SYSTEM DESIGN

The PillPort system integrates IoT technology with a seamless, automated medicine dispensing solution aimed at improving medication access, especially in remote and underserved areas. The system combines RFID-based authentication, automated dispensing using stepper motors, and solar-powered sustainability, with user interfaces through web and Android applications for smooth management. The entire framework includes the backend system, which securely manages patient profiles, prescriptions, and dispensing records. The system ensures accuracy, privacy, and a user-friendly experience for doctors, administrators, and patients. The block diagram of the proposed system is shown in figure 1

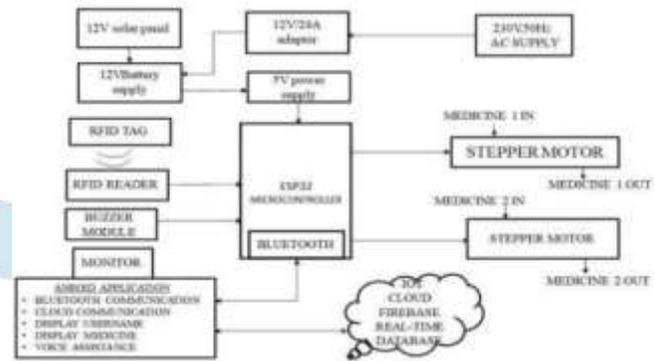


Fig. 1. Block Diagram

A. Training Phase (Web and System Setup)

- **Dataset Preparation:** setting up the database with patient profiles, doctor prescriptions, and medicine details. This data is used to build the backend, which links patients' RFID cards to their prescriptions and medication histories.
- **Data Integration and Augmentation:** Data related to users, doctors, and medicines are populated into the system. Medicine inventory is tracked and augmented with features like real-time stock updates and replenishment alerts.
- **System Setup:** The system is split into roles for admins, doctors, and patients, each with tailored functionalities.
- **System Architecture:** The backend securely stores data, while RFID scans link patients to prescriptions.

B. Operational Phase

- **Input:** Patients use their RFID cards to authenticate at the dispenser.
- **Data Processing:** The system fetches prescriptions from the backend and verifies availability.
- **Medicine Dispensing:** The stepper motor accurately dispenses the prescribed medication.
- **User Feedback:** The Android app's voice assistant guides the patient through the process.
- **History Payment:** The system updates the patient's medication history, and payments are processed via the app.

C. System Components

1) Web and Android Application

- The web app allows admins to manage users and inventory, while doctors input prescriptions. The Android app provides patient access and voice assistance for easy navigation.

2) Medicine Dispenser

- RFID reader and microcontroller manage patient identification and dispensing. Stepper motor ensures precise medication delivery.

3) Solar Power

- Solar panels power the dispenser, ensuring continuous operation in off-grid areas.

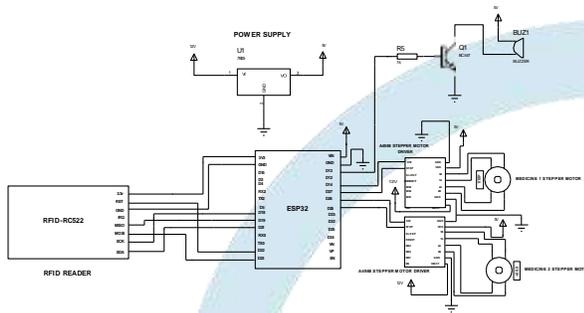


Fig. 2. Circuit Diagram

REFERENCES

- [1] Mallikarjun K & Rajathreddy S & Syed Maaz & Tanish S & Dr. Prasanna Kumar , "Design And Development Of Smart Medicine Dispenser IoT", International Journal of Research Publication and Reviews, Vol 4, no 8, pp 1745-1750 August 2023
- [2] C. H. Patil & Nakia Lightwala & Mehul Sherdiwala & Amol D. Vibhute & Sachin A Naik & Shankar M. Mali, "n IoT based Smart Medicine Dispenser Model for Health- care", 2022 IEEE World Conference on Applied Intelligence and Computing (AIC)
- [3] N. Dheerthi & A. Kishore Kumar & J. M. Priyadarsheni & A. Murugarajan. "IoTAAMD: Experimental Analysis of IoT Assisted System-atic Medicine Dispenser with Logical Sensors Association.", 2023 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES)
- [4] Simone Casciaro & Lucio Massa , "A Smart Pill Dispenser to support Elderly People in Medication Adherence" 5th International Conference on Smart and Sustainable Technologies
- [5] G. Anitha, " Efficient Internet of Things Enabled SmartHealthcare Monitoring System Using RFID Security Scheme". Intelligent Technologies for Sensors, 1st Edition, 2023, Apple Academic Press, ISBN: 9781003314851
- [6] K R Karthikeyan and E Dharan Babu, "Smart Pill Dispenser for Aged Patients", "Smart Pill Dispenser for Aged Patients" International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation, DOI: 10.1109/ICAECA52838.2021.9675784, 2021.
- [7] Kartik Arora and Ujjwal Singh, "Smart pill dispenser using iot" Smart pill Dispenser using Internet of Things, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH TECHNOLOGY (IJERT) Volume 07, Issue 07 (July 2018)].
- [8] Jyothis Philip & Feba Mary Abraham & Ken Kurian Giboy & B J Feslina & Teena Rajan. "Automatic Medicine Dispenser using iot"
- [9] Feslina and Teena Rajan, "Smart medicine dispense" Department of Electronics and Communication Engineering, Mar Baselios College of Engineering .
- [10] Neiman, A. B., Ruppert, T., Ho, M., Garber, L., Weidle, P. J., Hong Thorpe, P. G., "improving medication adherence for chronic disease management—innovations and opportunities" (2017). CDC grand rounds: . MMWR. Morbidity and mortality weekly report.
- [11] Chandramohan P, Kanagaraj Venusamy, "Automated Medicine Dispenser with Personal Healthcare Monitoring Using IoT". Eighth International Conference on Science Technology Engineering and Mathematics. ibitem12M. Shanthini; U. Vedhavarshini; N. Prem; K. Gouri; V.S. Roshan; S.S. Reena Josephine "Design and Implementation of IoT based Automatic Medicine Dispenser for Patients."
- [12] Deepan P; Hemavarshini J P; Kowsalya P; C. Rajasekaran. "IoT Based Intelligent Pill Dispenser for Elderly People".
- [13] K R Karthikeyan; E Dharan Babu; S Ranjith; S Arunkumar "Smart Pill Dispenser for Aged Patients," 2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA)
- [14] Md. Mizanur Rahman; Romana Aktar; Samrat Kumar Dey. "Design and Implementation of a Low-Cost Automated Medicine Dispenser."
- [15] Abhishek Madankar; Akhilesh Agrawal; Vedant Yede "IoT based Advance Pill Reminder System for Distinct Patients." 2021 Fifth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)
- [16] C. Sharanya Department of ECE, Vels Institute of Science Technology and Advanced Studies, Chennai, Tamil Nadu, India ; Kayalvizhi. S; Raghav Srivatsav. T.R "Pill Dispenser for Elderly Care using IOT" 2024 4th Asian Conference on Innovation in Technology (ASIANCON)
- [17] A Harini; S Thejasvi; Varshini U Abinaya; S. Sumathi "Curie – A Smart Voice Assistant Based Hospital Companion with Medicine Dispenser", 2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS)
- [18] S. Aakash Bharadwaj; Divyank Yarravarapu; Sadiparala Charan Kumar Reddy; Thirumalaraju Prudhvi; K. S. P. Sandeep; Obulam Siva Dheeraj Reddy "Enhancing healthcare using m-Care box (Monitoring non-compliance of medication)", 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)