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Medicine Dispensing using ESP – 32 CAM

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Abstract: *This project focuses on developing a smart dispensing system for medicine using the ESP32-CAM module coupled with Arduino. This shall automate the dispensation process of prescribed medication dose volumes at scheduled times so as to ensure patient compliance. There is real-time monitoring provided by the ESP32-CAM, allowing a remote access via Wi-Fi; through this, caregivers or the healthcare providers can monitor its use. A compact mechanical dispenser accurately dispenses the medicine. The system combines a user-friendly interface inputting schedules and dosage information in addition to dispatching on a smartphone application. Characteristics include image verification, reminding, and logging dispensing activities to keep track. It is cheap, scalable and solves medication adherence challenges- particularly with old or chronically ill patients.*

Keywords: CAM module

I. INTRODUCTION

For medication management, adherence to medications is a critical determinant for effectiveness, especially in the cases of chronic patients and geriatric patients. The most common error, though, in manual management is missing or overdosing and can be fatal. In response to this, the following project
introduces a smart medicine dispensing system that incorporates the use of an ESP32-
CAM module with an Arduino.
The ESP32-CAM also has Wi-Fi and Camera capabilities, making it real-time monitor and manage system remotely. Arduino micro controller is used for precise adjustment of the dispensing apparatus to ensure that there is right release of drugs according to a pre-defined schedule with a user-friendly interface placed for caregivers or patients, where they can enter the scheduled dosing time and information.
The key features of this system include automatic dispensing, reminders with notification, image-based verification to provide extra security, and data logging for tracking the medication adherence. The device is compact, cost-effective, and scalable, making it appropriate for home use or small healthcare facilities. This is meant to enhance medication compliance, reduce human error, and improve overall healthcare outcomes

II. LITERATURE REVIEW

Medication non-adherence has been an issue extensively studied in healthcare. Such research has indicated that this is the reason for poor treatment outcomes and high healthcare costs. Traditional methods of pill organizers and manual tracking have been proven to be deficient, especially in elderly patients or those with multiple drugs. These inadequacies have driven the development of automated medicine dispensing systems. Current automated dispensers, for example, MedMinder and Philips Medication Dispenser, have alarms and reminders as features, but most are very expensive and incapable of real-time monitoring. The emerging studies, however, will focus on integrating Internet of Things (IoT) to bridge the gaps. IoT-enabled devices include connectivity that enables remote supervisions and data logging, thus very essential for caregivers and healthcare providers.
The ESP32-CAM, with its built-in camera and Wi-Fi module, has been studied in several IoT applications for real-time monitoring and control. Its use in medicine dispensing is emerging, with some prototypes demonstrating potential in combining automated dispensing with image verification. Arduino-based systems are also gaining traction due to their affordability, reliability, and flexibility in controlling mechanical components.

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Although many of these systems hold promise, power efficiency, scalability, and user interface design issues in systems that are accessible to the nontechnical user are present. This project expands on past work by integrating the ESP32-CAM and Arduino, building a low-cost compact medicine dispenser with an easier-to- use system. These gaps are addressed through real-time monitoring, dosage tracking, and other alerts, contributing to the overall improvement in medication adherence and better healthcare outcomes.

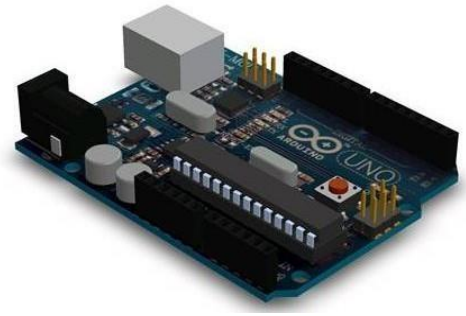
Technical requirement:

- ESP32 Cam
- Arduino UNO
- Jump wires
- DC Motor
- Bread Board
- Motor driver
- Battery
- Servo motor

1. ESP32 Cam

Interfacing the ESP32-CAM with the Arduino Uno is mainly about communication. The ESP32-CAM handles the camera operations and can be controlled via serial communication with the Arduino Uno, which can handle additional logic, sensors, or actuators. The Arduino Uno cannot directly process camera images, but it can trigger actions on the ESP32- CAM and handle control tasks.

2. Arduino UNO



The Arduino UNO is a microcontroller board based on the ATmega328P, designed for beginners and hobbyists. It has 14 digital and 6 analogy input/output pins to interface with components such as sensors and motors. Easy- to-use software and a large community make it perfect for prototyping and learning.

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3. Jump Wires

Jump wires are electrical wires with connector pins on each end to connect components on a breadboard or between devices. They are available in male-to-male, male-to-female, and female-to-female configurations. These are indispensable for building temporary circuits without soldering.

4. DC Motor

A DC motor converts electrical energy into mechanical motion, allowing it to rotate or move linearly. It is used in robotics and machinery of small size for wheel-rotating, fan operations, or other moving objects. The speed and the direction can be controlled through a motor driver.

5. Breadboard

A breadboard is a reusable platform used to build and test electronic circuits without soldering. It has rows and columns of interconnected sockets that can hold components such as resistors, LEDs, and ICs. Useful for prototyping and circuit experimenting.

6. Motor Driver

L298N Motor Driver

A motor driver serves as an interface connecting the microcontroller to the motor, making it easy to regulate speed and direction of the motor. It amplifies low-powered control signals to higher powered drives for the motor. The examples are L298N and L293D ICs.

7. Battery

A battery provides portable electrical power to the circuit, ensuring devices can operate independently of external power sources. Its voltage and capacity must match the requirements of the components in the system. Rechargeable and disposable types are available.

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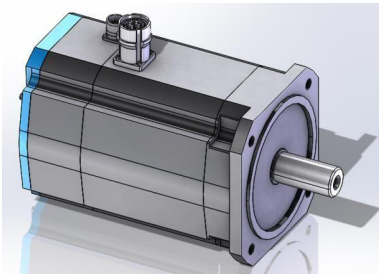
8. Servo Motor

A servo motor is a high-precision motor used for angular or linear positioning. It integrates a motor, a position feedback sensor, and control electronics into one unit. It is usually applied in robotics, automation, and projects that require precise movement control.



Servo Motor

Objectives:

1. Automated Medicine Dispensing:

Develop a system capable of dispensing accurate doses of medication at scheduled intervals without human intervention.

2. Real-Time Monitoring:

Integrate the ESP32-CAM for live monitoring of the dispensing process, ensuring reliability and accountability.

3. User-Friendly Interface:

Design an intuitive interface for patients or caregivers to input medication schedules and dosage requirements easily.

4. Remote Access and Control:

Enable remote monitoring and control of the system through Wi-Fi connectivity, allowing caregivers or healthcare providers to supervise usage.

5. Notification and Reminders:

Implement notifications via smartphone applications or SMS to alert patients of scheduled doses and remind them to collect their medicine.

6. Error Reduction:

Minimize errors in dosage and timing through automated control, ensuring precise dispensing.

7. Data Logging and Tracking:

Maintain logs of dispensing activities for analysis, allowing caregivers to track medication adherence over time.

8. Scalability and Affordability:

Develop a cost-effective and scalable solution suitable for use in homes, clinics, or small healthcare facilities.

9. Enhanced Security:

Incorporate image verification using the ESP32-CAM to ensure the correct recipient collects the medication.

10. Promote Medication Adherence:

Address challenges in adherence, especially for elderly or chronically ill patients, to improve health outcomes.

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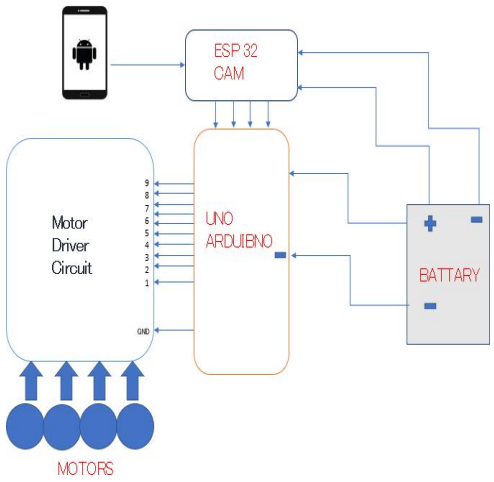
III. METHODOLOGY

The project starts with an in-depth analysis of the requirements for an automated medicine dispensing system, including hardware components such as the ESP32-CAM, Arduino, servo motors, and supporting software functionalities. A mechanical dispensing unit is designed and assembled, with Arduino programmed to control its operations, ensuring accurate dosage release. The ESP32-CAM is configured for Wi-Fi connectivity and real-time monitoring, enabling remote access. A user- friendly mobile or web-based interface is developed to allow patients or caregivers to input medication schedules, receive reminders, and track adherence.

The ESP32-CAM integrates with Arduino to have a synchronization of dispensing through image-based verification for recipient authentication. It has implemented notifications and reminders, which alert patients that there is a scheduled dose due for them. Also, a data logging system keeps track of medication adherence and monitors the same for review purposes. The hardware and the software, including image capture and notification features, will undergo rigorous testing to verify its functionality and reliability.

Once successfully integrated, the dispensing mechanism is fine-tuned to deliver the accuracy desired and user interface enhanced based on user feedback. The system is deployed in a controlled environment for testing in the real world, performance and user experience evaluated, and then refined through feedback obtained from the trials to scale up while maintaining cost-effectiveness and efficacy in improving adherence to medication.

Block Diagram



Advantages:

Using an ESP32-CAM for medicine dispensing has several benefits are:

1. Monitoring and Control from a Distant Location:

With the ESP32-CAM, one may connect it to a network for remote monitoring of the dispensing process. Health professionals or caretakers can keep track of the process and verify whether the drugs are being dispensed properly and record any anomalies.

2. Camera for verification

The integrated camera can be used for visual verification, such as checking if the right medication is being dispensed and ensuring that the medication matches the prescription. This could help prevent errors in dispensing.

3. Barcode/QR Code Scanning

The camera can read QR codes or barcodes on packaging of medication or prescription labels. This will automatically identify the medication and confirm that the right medication is being dispensed.

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4. Cost-Effective
The ESP32-CAM is a low-cost and compact solution for building automated medicine dispensing systems, making it an affordable option for small-scale applications or healthcare facilities with limited budgets.

5. Connectivity and Integration
The ESP32-CAM supports Wi-Fi and Bluetooth, making it possible to integrate with cloud-based systems or databases. This would allow for logging of dispensing records, sending notifications, or even providing remote access for inventory management and auditing.

6. Automation and Accuracy
The ESP32-CAM will help automate the dispensing process by including sensors (for example, weight or RFID) for accurate amounts and minimizing human error. Automating this process can make the dispensing process more efficient and faster.

7. Customizable Alerts
The system can be programmed to throw a notification or alert due to irregularities, including the dispensing of inappropriate medication or dose, low stock level, and system failure.

8. Integration with Prescription Management Systems
The ESP32-CAM can integrate an electronic health record or even a pharmacy management system; that's the reason why it becomes feasible in the tracking of medication through proper dispensing, all with easy documentation.

9. Security Features
Secure user authentication mechanisms using facial recognition through the camera of ESP32-CAM or RFID cards can also be integrated in order that only authorized personnel can access the dispensing system.

10. Compact and Flexible Design
Due to its small size and flexibility, it can be easily integrated into existing medicine dispensing machines, vending machines, or automated cabinets. This makes it an easy tool to work with in various healthcare environments.

11. Energy Efficiency
The ESP32-CAM is energy-efficient, so it can be used in any kind of environment, including ones that require it to run on batteries, without taking too much power.

12. Real-time Data Collection
Utilizing the ESP32-CAM processing capabilities and networking, one can collect in real time data about dispensing procedures for analysis and improvement.
The bottom line is that an integration of the ESP32-CAM to a medicine dispensing system makes it more efficient, secure, and accurate to operate at a lower price for the healthcare providers.

IV. CONCLUSION

The integration of the ESP32-CAM in medicine dispensing systems presents many advantages that improve efficiency and accuracy. The system can verify drugs by using the camera to look at them or scan a barcode or QR code, so the right drug is dispensed. Its connectivity features include Wi-Fi and Bluetooth for remote monitoring, real-time data collection, and integration with cloud systems for inventory management and record-keeping. This ESP32- CAM has a very compact and low-cost design, making it very appropriate for small-scale healthcare applications in relation to the budget. Furthermore, the automation by means of the ESP32-CAM minimizes human error. Accuracy in the dosage and medicine dispensement would therefore be increased. Security, which includes user authentication through facial recognition or RFID, would also prevent entry for unauthorized people. The system's ability to send alerts in case of

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irregularities or low inventory helps maintain continuous service and patient safety. Its energy efficiency ensures long-term operation, even in battery-powered setups. In addition, the ESP32-CAM's small form factor allows for seamless integration into existing machines or automated cabinets, thus making it adaptable to various healthcare environments. In medicine dispensing, overall, ESP32-CAM use enhances workflow, reduces errors, and enhances security and ensures higher reliability. Therefore, this technology has proved to be invaluable for healthcare providers.

REFERENCES

[1] Wissam Antoun, Ali Abdo, Suleiman Al- Yaman, Abdallah Kassem, Mustapha Hamad, and Chady El-Moucary, "Smart Medicine Dispenser (SMD)," 2018 IEEE 4th Middle East Conference on Biomedical Engineering (MECBME), pp. 20–23, 2018.
[2] A. V. Dhukaram and C. Baber, "Elderly Cardiac Patients' Medication Management: Patient Day-to-Day Needs and Review of Medication Management System," 2013 IEEE International Conference on Healthcare Informatics, pp. 107–114, 2013.
[3] World Health Organization, "Medicines," Available at: http://www.who.int/medicines/en/, Accessed: July 21, 2017.
[4] S. L. Gray, J. E. Mahoney, and D. K. Blough, "Medication Adherence in Elderly Patients Receiving Home Health Services Following Hospital Discharge," Annals of Pharmacotherapy, vol. 35, no. 5, pp. 539–545, 2001.
[5] IoT Dunia, "IoT Architecture," Available at: https://iotdunia.com/iot-architecture/.
[6] ResearchGate, "Internal Architecture of SQLite," Availableat: https://www.researchgate.net/figure/Internal -architecture-of-SQLite_fig1_271891972.
[7] Pak, J., & Park, K., "Construction of a Smart Medication Dispenser with High Degree of Scalability and Remote Manageability," Journal of Biomedicine and Biotechnology, 2012.
[8] N. B. Othman and O. P. Ek, "Pill Dispenser with Alarm via Smartphone Notification," 2016 IEEE 5th Global Conference on Consumer Electronics, pp. 1– 2, 2016.
[9] Antoun, W., Abdo, A., Al-Yaman, S., Kassem, A., Hamad, M., & El-Moucary, C., "Smart Medicine Dispenser (SMD)," 2018 IEEE 4th Middle East Conference on Biomedical Engineering (MECBME), pp. 20–23, March 2018.
[10] Google Search, "ESP32 Cam, Arduino UNO, DC Motor, Motor Driver, Servo Motor, Jump Wires."
[11] Dhole, N., Khot, E., Limkar, R., & Thorat, S. "IoT-Based Automatic Medicine Dispenser: A Review," IOSR Journal of Electronics and Communication Engineering, vol. 18, no. 5, pp. 09-10, September-October 2023. Available at: https://www.iosrjournals.org/iosr-jeee/Papers/Vol18- Issue5/Ser-2/B1805020910.pdf.
[12] Bachkar, Y.B., Tekale, A.D., & Pawar, N.S. "IoT-Based Automatic Medicine Dispenser Using ESP32 Microcontroller," International Research Journal of Modernization in Engineering Technology and Science, vol. 6, no. 5, May 2024. Available at: https://www.irjmets.com/uploadedfiles/paper/issue_5 _may_2024/57781/final/fin_irjmets1716809934.pdf.
[13] ResearchGate. "Automatic Medicine Dispenser Using IoT," Available at: https://www.researchgate.net/publication/343811187_Automatic_Medicine_Dispenser_using_IoT.
[14] ResearchGate. "An IoT-Based Smart Medicine Dispenser Model for Healthcare," Available at: https://www.researchgate.net/publication/362934442 _An_IoT_based_Smart_Medicine_Dispenser_Model _for_Healthcare.
[15] Kadam, N. R., Pardeshi, C., Rokade, D., Sawant, O., & Udhane, S. "IoT Based Automatic Medicine Dispenser with Alert System," International Journal of Scientific Research in Computer Science, Engineering and Information Technology, vol. 10, no. 3, May-June 2024. This paper describes a system controlled by the ESP32 microcontroller to dispense medication at specific times and alert caregivers if the medication is not taken'
[16] Dagli, R. "Design and Implementation of Medicine Dispenser," International Advanced Research Journal in Science, Engineering and Technology, vol. 6, no. 6, June 2019. This study discusses the design of a medicine dispenser using Arduino Nano and IR sensors, with potential IoT integration for real-time tracking. Available at: https://iarjset.com/papers/design-and- implementation-of-medicine-dispenser/Sulistiyowati, I., &
[17] Prasetyo, E. "An Inventory Tool for Receiving Practicum Report Based on IoT by Using ESP32-CAM and UV Sterilizer: A Case Study at Muhammadiyah University of Sidoarjo," Journal of Electrical Technology UMY, vol. 1, no.

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2, 2022. This research highlights the use of ESP32-CAM in IoT systems, showcasing its potential for applications like medicine dispensers. Available at: https://www.academia.edu/114182838/.

[18] Sarkar, S., Mondal, A., & Das, S. "IoT- Based Smart Pill Dispenser," International Journal of Engineering Research & Technology (IJERT), vol. 10, no. 4, April 2021. This paper presents a smart pill dispenser using ESP32 and mobile app integration for remote scheduling and alerts. Available at: https://www.ijert.org/iot- based-smart-pill-dispenser.

[19] Sahu, R. K., Mishra, S., & Karthik, A. "Design and Development of IoT-Based Medicine Dispenser Using ESP32," International Journal of Innovative Research in Science, Engineering, and Technology, vol. 12, no. 3, March 2023. This study provides a step-by-step methodology to design a smart medicine dispenser using the ESP32 microcontroller.

[20] Dhole, N., Khot, E., Limkar, R., & Thorat, S. "IoT-Based Automatic Medicine Dispenser: A Review," IOSR Journal of Electronics and Communication Engineering, vol. 18, no. 5, pp. 09-10, September-October 2023. This paper discusses the design and functionality of an IoT-based medicine dispenser using the ESP32 microcontroller to enhance medication adherence among patients. Available at: https://www.iosrjournals.org/iosr- jeee/Papers/Vol18-Issue5/Ser-2/B1805020910.pdf.

[21] Bachkar, Y.B., Tekale, A.D., & Pawar, N.S. "IoT-Based Automatic Medicine Dispenser Using ESP32 Microcontroller," International Research Journal of Modernization in Engineering Technology and Science, vol. 6, no. 5, May 2024. This study presents a detailed design that automates medication dispensing with alerts via a mobile application, utilizing the ESP32 for connectivity and control. Available at: https://www.irjmets.com/uploadedfiles/paper/issue_5_may_2024/57781/final/fin_irjmets1716809934.pdf.

[22] Patil, A., & Patil, S. "Automatic Medicine Dispenser using IoT," International Journal of Engineering Research & Technology (IJERT), vol. 9, no. 8, August 2020. This paper outlines an automatic dispenser capable of dispensing both solid and liquid medications with integrated app features for setting alarms and notifications. Available at: https://www.ijert.org/research/automatic-medicine- dispenser-using-iot-IJERTV9IS080152.pdf.

[23] Nasir, Z., Asif, A., Nawaz, M., & Ali, M. "Automatic Medicine Dispenser using IoT," ResearchGate. This publication proposes an innovative design for a medicine dispenser that utilizes IoT technology to remind users about their medication schedules. Available at: https://www.researchgate.net/publication/343811187 _Automatic_Medicine_Dispenser_using_IoT.

[24] Hussain, S., & Khan, M.A. "An IoT-based Smart Medicine Dispenser Model for Healthcare," ResearchGate. This paper presents a prototype of a smart medicine dispenser that leverages IoT capabilities to assist patients in managing their medication regimens effectively. Available at: https://www.researchgate.net/publication/362934442 _An_IoT_based_Smart_Medicine_Dispenser_Model_for_Healthcare.

[25] Ghosh, S., & Dutta, S. "Smart Pill Dispenser with IoT Integration," IEEE International Conference on Electronics and Communication Systems, 2023. This study explores the integration of IoT in pill dispensers to improve adherence and monitor patient compliance through real-time data sharing.

[26] Patel, S., & Patel, R. "Design and Implementation of Smart Medicine Dispenser Using ESP32," International Journal of Innovative Research in Science, vol. 12, no.March 2024. This paper discusses the technical specifications and operational mechanisms of a smart medicine dispenser powered by the ESP32 microcontroller.