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# IoT-Based Medication Dosage Management System Using ESP32 and RFID Detection

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**Abstract**

This paper proposes an IoT-based Medication Dosage Management System using ESP32, RFID technology and an OLED display to save and retrieve medication dosage information accurately. The system operates in two modes: Set dosage schedules with Set Mode and Read stored medication data from RFID tags with Read Mode. LED indicators provide real-time visual feedback for reliable and user-friendly operation. The proposed solution assists to enhance medication adherence, minimize dosage-related errors, and easing medication management for elderly patients and people with chronic illnesses. Its low cost, portability and ability to operate offline make it an ideal tool for use in both home and clinical healthcare settings.

**Keywords:** ESP32, RFID, RC522, Medication Management, IoT, Healthcare, OLED Display, Medication Adherence, Embedded Systems, Smart Healthcare.

## I. INTRODUCTION

People use pills daily for their health and to get better after getting sick. But most patients neglect to take their medicine, miss their dose of medicine or give the wrong dose of medicine. This is more likely to happen in older people and those who have multiple

medicines. If you miss a dose or if you take the wrong medicine, it may not be effective and can cause other health issues.

Most people today use their memory, mobile alarms or family members to remember to take their medicines when needed. These

Sometimes these methods are ineffective, particularly if medicines have to be taken at different times of the day. Because of this,

A simpler system is needed that can assist patients to adhere to their medication regimens.

In this study, we observed that many elderly patients need reminders from family members or from mobile alarms about their medication timings. This motivated us to develop an easy-to-use solution for medicine management using IoT.

The smart system is developed in healthcare applications with the advent of IoT technology. With the help of IoT, we can:

combine reminders and monitoring features into a single device, making medication management easier and more convenient.

The aim of this project is to propose an IoT-based Medication Dosage Management System which will facilitate patients to take medicines at the proper time. The remind and assists in adherence to the prescribed dosage schedule in the system. The aim of this project is to enhance medication management to ensure that medicines are taken correctly and that the medication-taking process is more organised and reliable.

## II. SYSTEM ARCHITECTURE

The IoT-Based Medication Dosage Management System employs a well-structured methodology that involves the ESP32 microcontroller. Ensures that medication information is stored, retrieved and displayed. Fig. 1 shows the block diagram of the system.

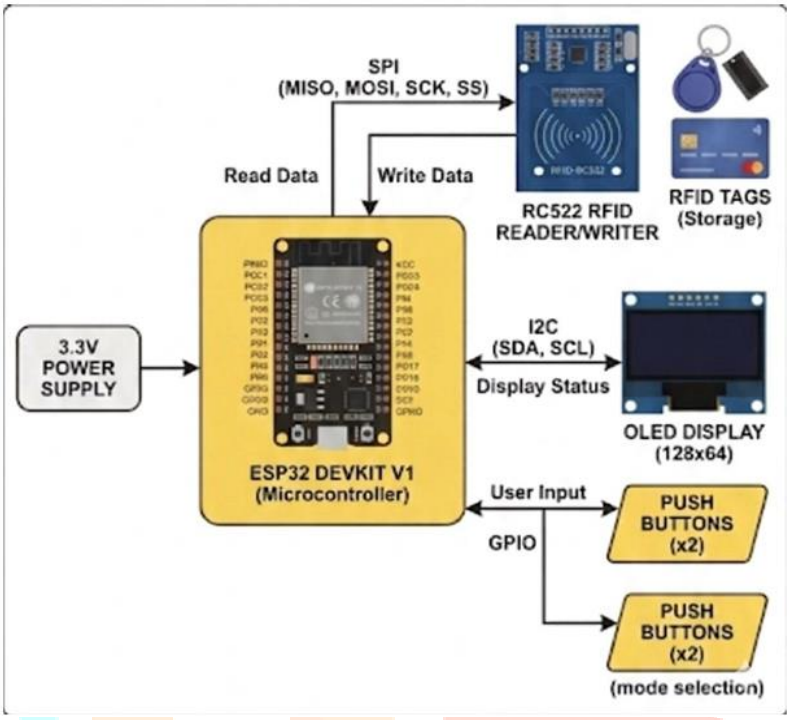


**Fig. 1: System Block Diagram**

The system starts up the ESP32 and initialises all components that are connected to it, including the RC522 RFID reader and the OLED. Display, push buttons and light-emitting diodes. The buttons are used to switch into Set Mode or Read Mode. In Set Mode, medication dose information is programmed and stored on the tag, which is then scanned by the RFID reader. In Read Mode, the RFID tag can be scanned. The stored dosage data is retrieved. The ESP32 reads the data and sends it to the OLED screen, which shows the details of the medicine. LED indicators provide Visual feedback during operation of the system for the user to check the successful storage and retrieval of data. When the operation has been performed, Continuous and reliable medication management is achieved as the system returns to the main menu, waiting for the next RFID tag.

## III. WORKING MECHANISM AND FLOWCHART

Fig. 2 shows a system flowchart. This process starts with the initialisation of the system and the selection of the mode. In Set Mode, the RFID tag is scanned, and medication dosage information is programmed and stored on the tag. During the Read Mode, the RFID tag is scanned, and the dosage information is retrieved and stored.

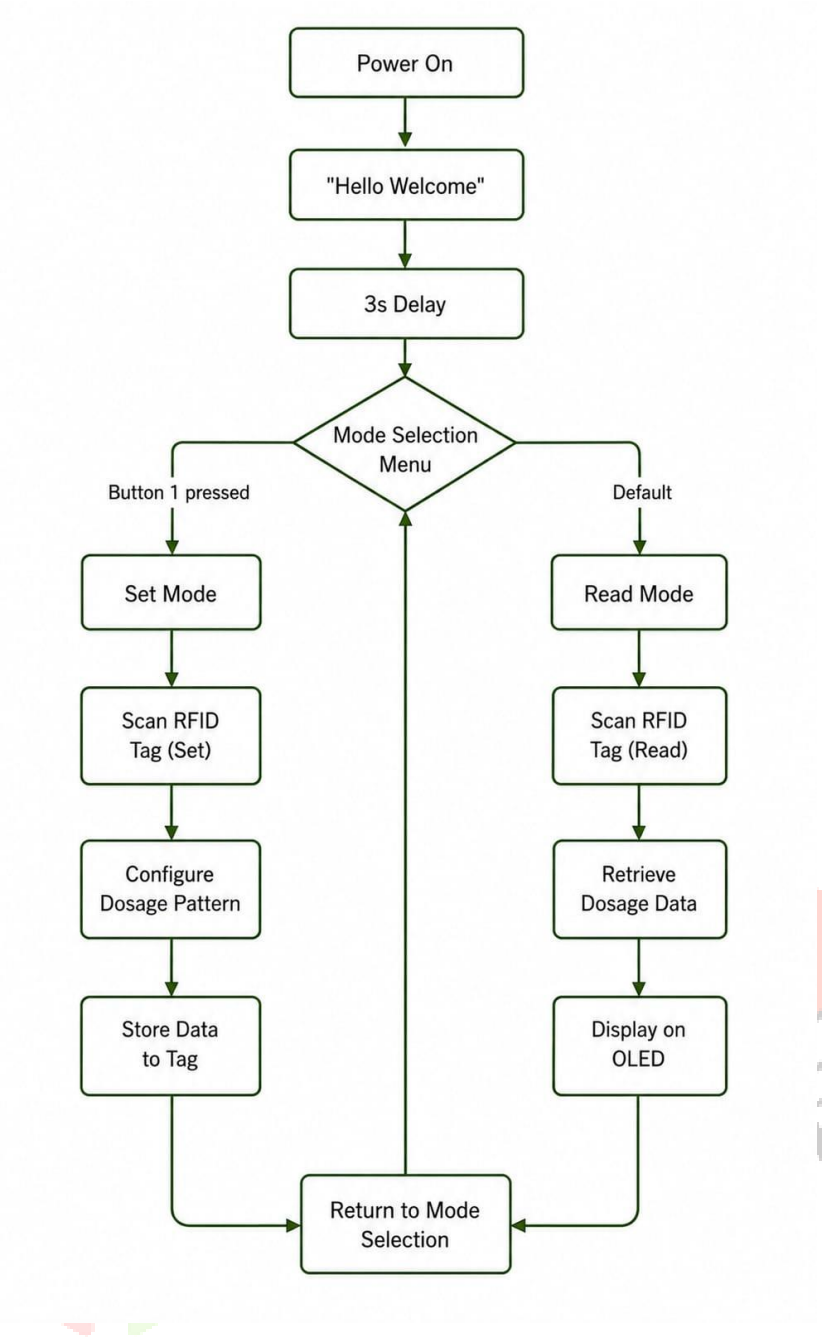


**Fig. 2: System Flowchart**

The retrieved data is sent to ESP32, where it is further processed, and the information about the medicines is displayed on the OLED screen. LED indicators provide visual feedback during operation. The system will display or store the data, and after that, it will go back to the main menu and wait for the next RFID tag, ensuring continuous and reliable medication management.

## IV. CIRCUIT DIAGRAM

The proposed system's circuit diagram is shown in Fig. 3. The ESP32 microcontroller is the CPU and is connected to the RC522 RFID reader, OLED display, push buttons and LED indicators.

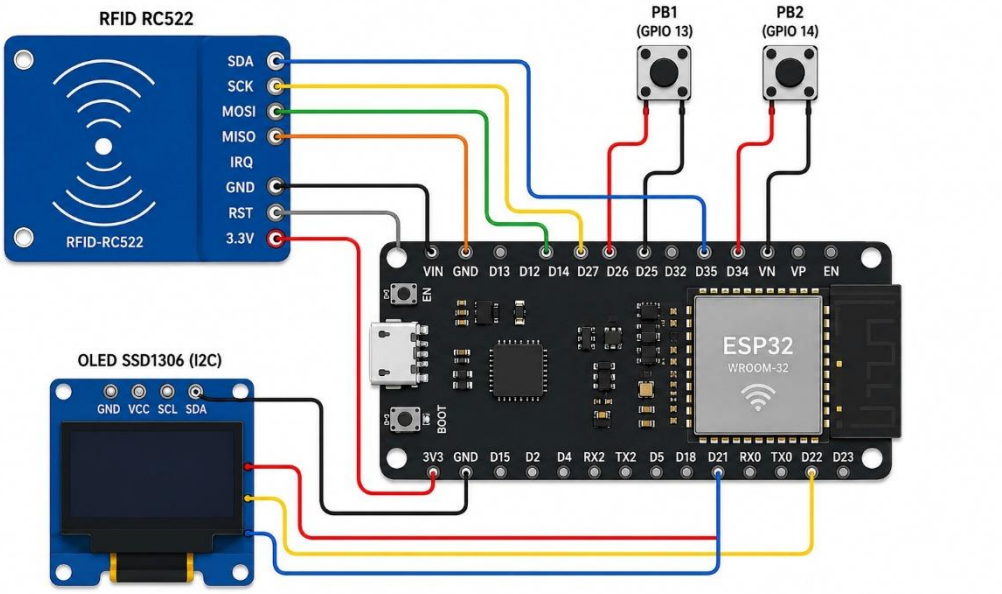


**Fig. 3: System Circuit Diagram**

The ESP32 communicates with the RFID reader, which can read and write information about the doses of medicines attached to RFID tags. The OLED display and push buttons are used to select the mode and input the value, and provide information on the dose and system state. LED indicators provide visual feedback provided during system operations and indicate reliable medication data storage and retrieval.

## V. RESULTS

A series of different RFID tags were used to test the system, in which the dosage details of the medicines were recorded. The RC522 RFID reader was able to successfully retrieve the information stored in it, and the dosage information was processed and displayed on the OLED screen using the ESP32. During operation, the system proved to be effective in storing, retrieving and switching modes as per the RFID system.

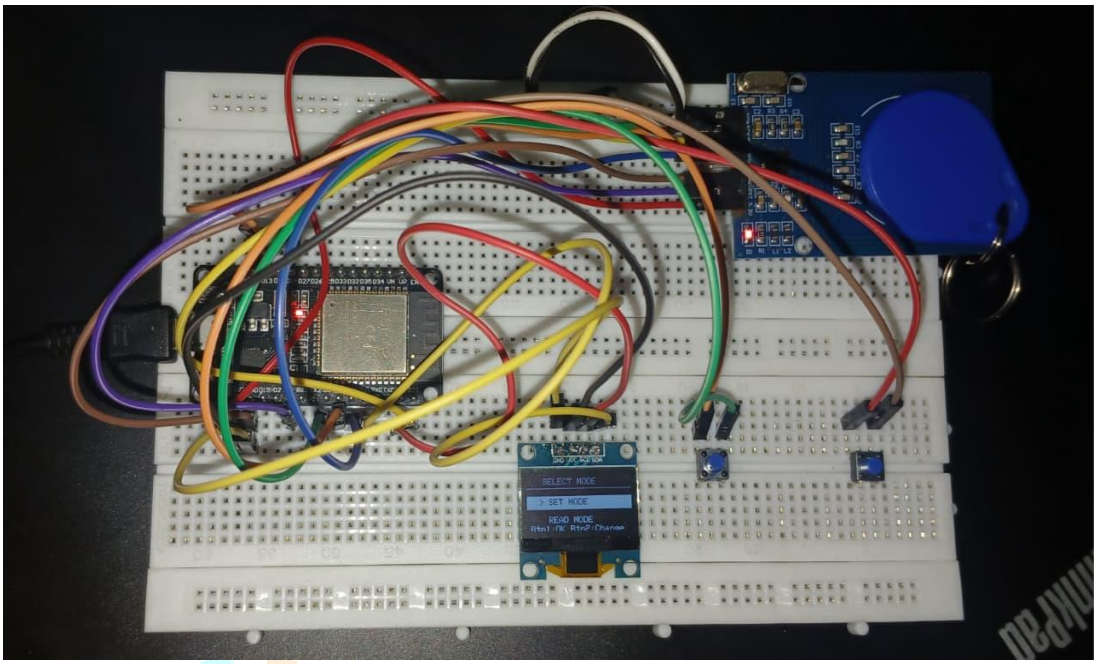

**Fig. 4: Fabricated System Model**

**Phase 1 — Startup**

1. Power On → ESP32 boots up and initialises all peripherals (RFID module, OLED display, LEDs, button)
2. "Hello Welcome" → A welcome message is displayed on the OLED screen
3. 3s Delay → System waits 3 seconds, giving the user time to read the message and for all modules to stabilise

**Phase 2 — Mode Selection**

4. Mode Selection Menu appears on OLED with two options:

- Button 1 Pressed → Enters Set Mode (for writing/configuring data to an RFID tag)
- Default (no press) → Enters Read Mode (for reading existing patient/medicine data)

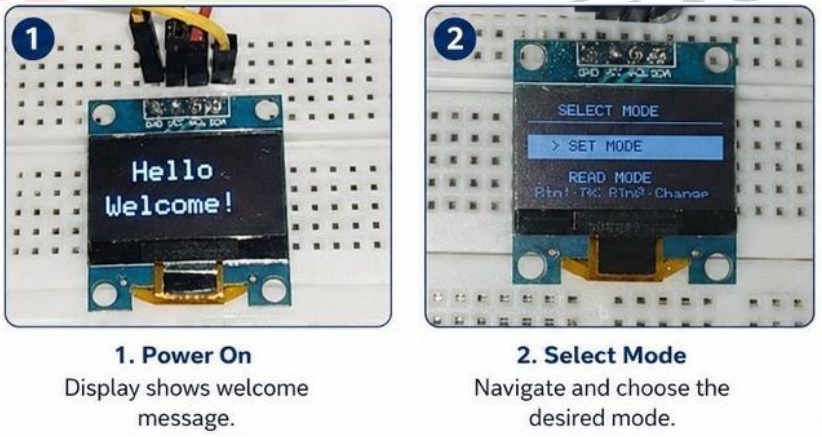


**Fig.5: Start mode**

**Phase 3A — SET MODE (Doctor/Admin side)**

5. Set Mode activates — OLED prompts the user to bring the RFID tag near
6. Scan RFID Tag (Set) → ESP32 reads the UID of the tag placed near the RC522 module
7. Configure Dosage Pattern → The system (via serial input, web dashboard, or Claude API) accepts:

- Medicine name
- Dosage amount
- Timing/frequency (e.g., morning, night)

8. Store Data to Tag → The configured dosage data is written onto the RFID tag's memory blocks
9. Return to Mode Selection → The system loops back, ready for the next operation

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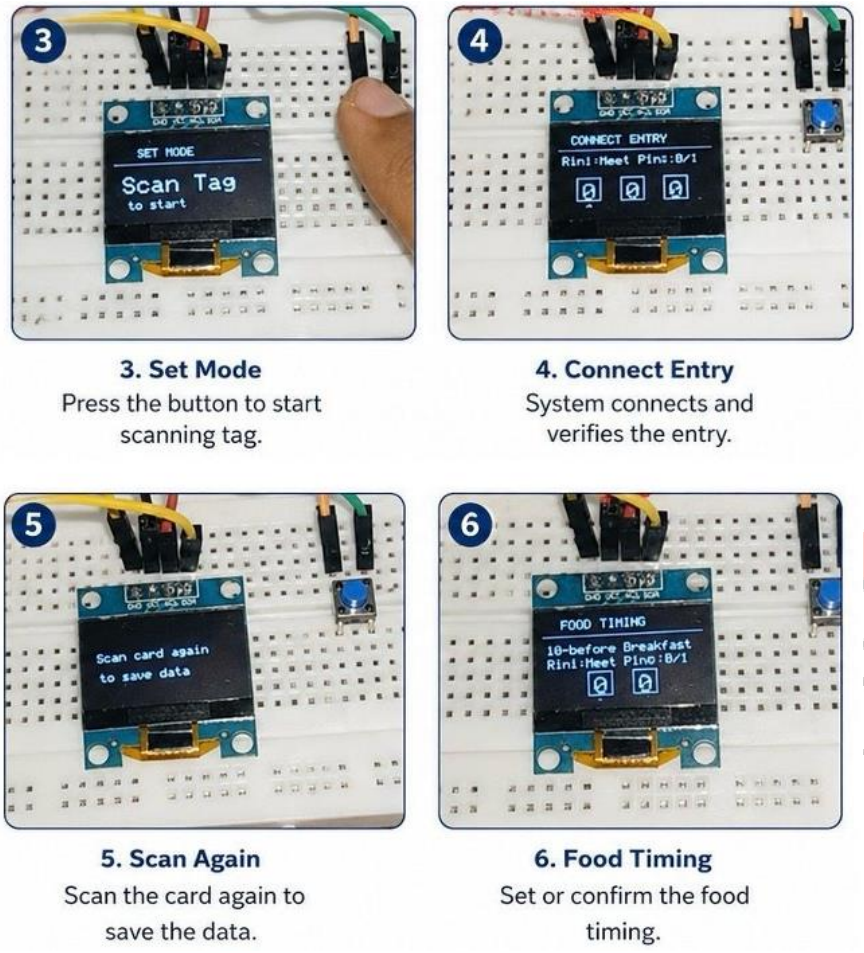


**Fig.6: Dosage setting**

**Phase 3B — READ MODE (Patient/Caretaker side)**

5. Read Mode activates — OLED prompts to scan the tag
6. Scan RFID Tag (Read) → ESP32 detects and reads the UID of the patient's RFID tag
7. Retrieve Dosage Data → The data stored on the tag (medicine name, dosage, timing) is fetched from the tag's memory
8. Display on OLED → The retrieved information is shown clearly on the 128x64 OLED screen for the user to read

9. Return to Mode Selection → The system loops back for the next patient

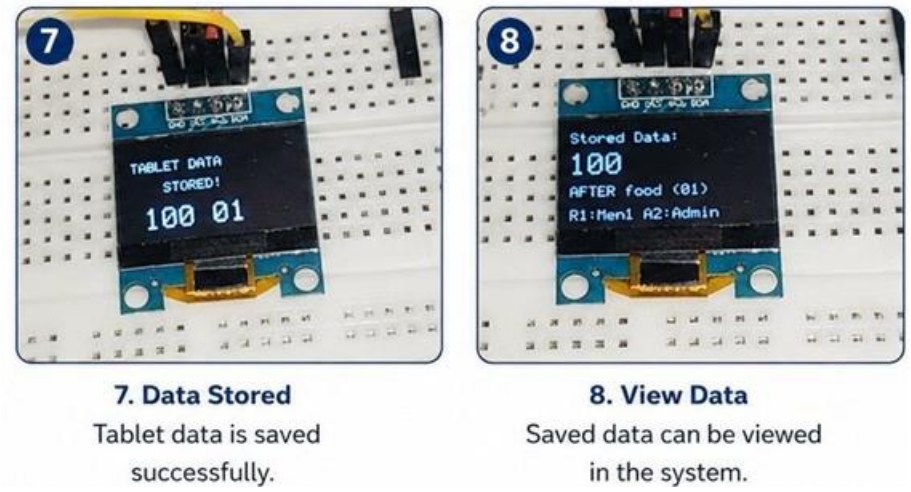


**Fig.7: Retrieve Dosage Data**

**Technical Outcomes:**

- Functional RFID System: Successfully read and write dosage data to RFID tags with 100% accuracy
- Reliable Mode Switching: Seamless transition between Set Mode and Read Mode using button controls
- User-Friendly Interface: Clear OLED display messages for all system states
- Data Persistence: Dosage information retained on RFID tags without power supply

## VI. CONCLUSION

The major goal of developing the IoT-Based Medication Dosage Management System has been fulfilled. The system could identify the medication record by using the RFID technique and get accurate dose information using the RFID tags. The push-button interface, OLED display, and RC522 RFID reader required these features to ensure that data is securely stored, accessed, and interacted with in real-time by users. There are two ways to use the medication management process: Set Mode and Read Mode. Set Mode allowed health care professionals to program and store the dosage information into an RFID tag, while Read Mode allowed patients to quickly read the information from the tagged medicine. The OLED display provided clear and easy reading of the dosage information, and the LED indicators provided immediate confirmation of the dose, improving ease of use and reliability. The system was able to accurately handle the RFID data, seamlessly switch between the modes, and store medication data even when access to the internet was not always available. The combination of embedded systems and RFID technology and its use of IoT concepts provides a low-cost, easy-to-use solution that improves medication adherence, reduces dosage errors and assists in the management of home or clinical health care.

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