IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, November 2026
Impact Factor: 8.2

Smart Component Organizer using ESP32

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Abstract : *Electronic components are used in various fields, including educational institutions, laboratories and industries. Storing and finding these components can become difficult when there are many different types of items. In most places, components are kept in separate boxes or compartments, and users have to search manually whenever they need a particular item. This takes time and may also lead to confusion or misplacement of components.*

To overcome this problem, we propose a Smart Component Organizer using ESP32. The system is designed to make component storage and retrieval easier with the help of RFID technology. An ESP32 microcontroller is used as the main control unit, and an RFID reader is used to identify the RFID cards assigned to different components. When a registered RFID card is scanned, the ESP32 processes the card information and controls the corresponding servo motor. The servo motor operates the assigned compartment, allowing the user to access the required component. Three RFID cards and three servo motors are used to manage three separate storage sections. A push button is also included for manual operation. The system is powered using a battery, with an IC 7805 used for voltage regulation. This arrangement provides a simple and convenient way to organize electronic components and reduces the time spent searching for them.

Keywords: Smart Component Organizer, ESP32, RFID Technology, RFID Reader, Servo Motor, Component Storage, Embedded System, Automatic Retrieval

I. INTRODUCTION

The use of electronic components has increased in educational institutions, laboratories and industries. Components such as resistors, capacitors, transistors, sensors and integrated circuits are required for different electronic projects and experiments. As the number of components increases, storing and maintaining them in an organized manner becomes a difficult task.

In the traditional method, electronic components are stored in different boxes, containers or compartments. Users have to check each storage section manually to find the required component. Sometimes, components are placed in the wrong location or are difficult to identify. This makes the searching process time-consuming and affects the proper management of available components.

To make this process easier, the proposed project introduces a Smart Component Organizer using ESP32. The system uses RFID technology to identify the required storage section. Each RFID card is assigned to a particular compartment. When the user scans an RFID card using the RFID reader, the ESP32 receives the card information and checks the corresponding operation. Based on the identification, the controller activates the related servo motor to provide access to the required compartment.

Three servo motors are used to control three separate storage sections. The ESP32 acts as the main controller and manages the RFID reader, servo motors and push button. The system is designed to reduce manual searching and make component storage and retrieval more convenient.

The main objective of this project is to develop a simple and cost-effective storage system that helps users find and access electronic components without checking every compartment manually.

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DOI: 10.48175/IJARSCT-40728

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REQUIREMENTS

The proposed Smart Component Organizer consists of an ESP32 microcontroller, RFID reader, three RFID cards, three servo motors, push button, battery, IC 7805, jumper wires and an ON/OFF switch. Each component has a specific role in the operation of the system.

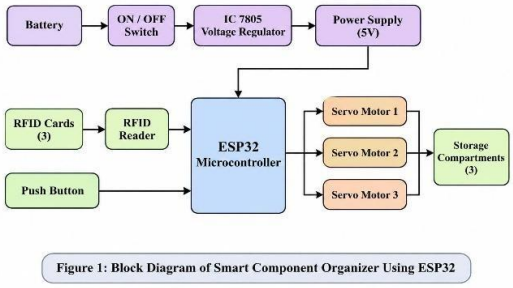


Figure 1: Block Diagram

A. ESP32 Microcontroller

ESP32 is the main controller used in the proposed system. It is a microcontroller with built-in Wi-Fi and Bluetooth capabilities. It is responsible for receiving the information from the RFID reader and controlling the servo motors according to the programmed instructions. It also handles the input received from the push button. The ESP32 coordinates the complete operation of the organizer.

B. RFID Reader

RFID stands for Radio Frequency Identification. The RFID reader is used to read the information stored in an RFID card. When a card is brought near the reader, it identifies the card and sends its unique identification information to the ESP32. The controller uses this information to identify the corresponding storage section.

C. RFID Cards

RFID cards are used to identify the different storage compartments. In this project, three RFID cards are used, with each card assigned to a particular compartment. When a card is scanned, the system identifies the assigned section and performs the corresponding operation. This makes it easier for users to access the required components.

D. Servo Motors

Servo motors are used to control the opening and closing mechanism of the storage compartments. Three servo motors are used in the proposed system, with one motor assigned to each compartment. The ESP32 sends control signals to the corresponding servo motor based on the RFID card identification. This helps the user access the selected storage section.

E. Push Button

A push button is provided as a manual input in the system. It can be used for the additional manual control function implemented in the organizer. The button input is processed by the ESP32 according to the programmed operation.

F. Battery

A battery is used as the power source for the system. It supplies the required electrical power to operate the controller and other connected components. A suitable power supply arrangement is necessary to ensure stable operation of the system.

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G. IC 7805

IC 7805 is a voltage regulator that provides a regulated 5V output. It is used in the power supply section to maintain a suitable voltage for the components that require a 5V supply. This helps provide a stable power source for the circuit.

H. Jumper Wires

Jumper wires are used to establish electrical connections between the ESP32, RFID reader, servo motors, push button and other circuit components. They make the circuit connections easier during assembly and testing.

I. ON/OFF Switch

An ON/OFF switch is used to control the power supply to the system. It allows the user to switch the organizer ON when it is required and turn it OFF when it is not in use.

II. IMPLEMENTATION

A. Circuit Diagram

The circuit mainly consists of an ESP32 microcontroller, an RFID reader, three servo motors, three RFID cards, a push button and a regulated power supply. The ESP32 acts as the central control unit of the entire circuit. The RFID reader is connected to the ESP32 to receive the identification information from the RFID cards. When a card is scanned, the reader sends its unique identification data to the controller. The ESP32 processes the received data and identifies the corresponding compartment. The three servo motors are connected to the control pins of the ESP32. Each motor is assigned to a separate storage compartment.

According to the RFID card detected by the reader, the ESP32 sends the required control signal to the respective servo motor. The motor then operates the compartment mechanism. The push button is connected to the ESP32 as an additional input. The battery provides power to the circuit, while the IC 7805 is used to obtain a regulated 5V supply for the required components. The ON/OFF switch is connected to control the power supply. All the required connections are made using jumper wires. Proper voltage levels and common ground connections are maintained to ensure reliable operation of the circuit.

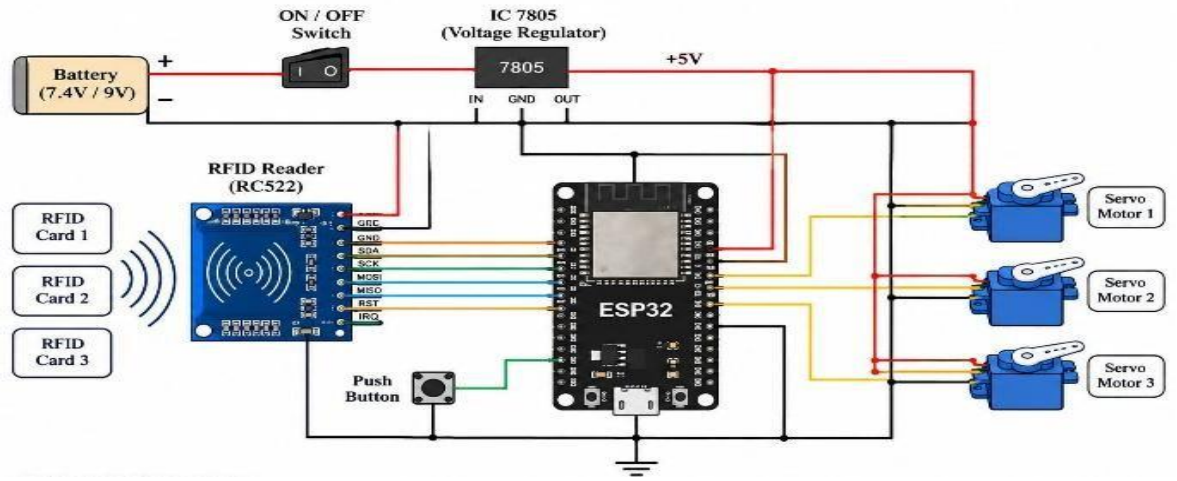


Figure 2: Schematic Diagram

B. Flow Diagram

The operation of the Smart Component Organizer follows a simple sequence. First, the system is switched ON using the ON/OFF switch. The ESP32 and RFID reader are initialized. The user selects the required storage section by scanning its assigned RFID card. The RFID reader reads the card information and sends it to the ESP32.The ESP32 checks the received card ID with the IDs stored in the program.

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If the card ID is recognized, the controller identifies the corresponding compartment. The ESP32 sends a control signal to the assigned servo motor. The servo motor operates the selected compartment, allowing the user to access the stored component. After the required operation, the compartment can be returned to its closed position. The system remains ready to receive the next RFID card.

The flow diagram represents the complete working procedure of the Smart Component Organizer using ESP32. Initially, the system is switched ON using the ON/OFF switch. Once the power is supplied, the ESP32 microcontroller and RFID reader are initialized and become ready for operation. The user scans one of the three RFID cards near the RFID reader to select the required storage compartment. Each RFID card is assigned a unique identification number, which is used to identify the corresponding compartment.

When the card is placed near the reader, the RFID reader detects the card and sends its ID to the ESP32 microcontroller for further processing. After receiving the card information, the ESP32 checks whether the scanned card ID is registered in the system. If the scanned card is not registered, the system does not perform any operation and waits for another card to be scanned. If the card is valid, the ESP32 identifies the corresponding storage compartment based on the registered card ID.

Then, the controller sends a control signal to the respective servo motor to operate the selected compartment. Since the system uses three servo motors, each motor is assigned to a separate storage section

After accessing the component, the compartment can be closed if required. Finally, the system returns to its initial ready state and waits for the next RFID card. This process continues whenever the user needs to access another component. The proposed system reduces manual effort, avoids unnecessary searching and provides an easy way to manage electronic components in laboratories, educational institutions and electronic workshops.

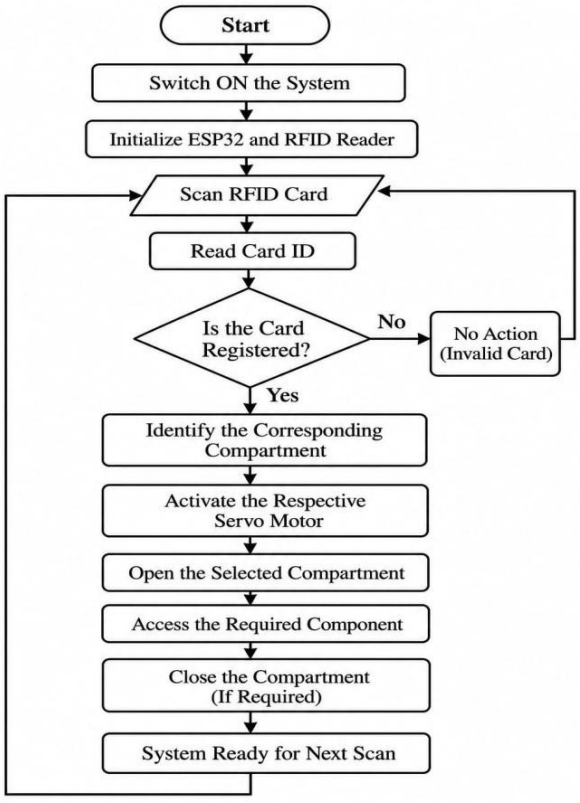


Figure 3: Sequence of Operation

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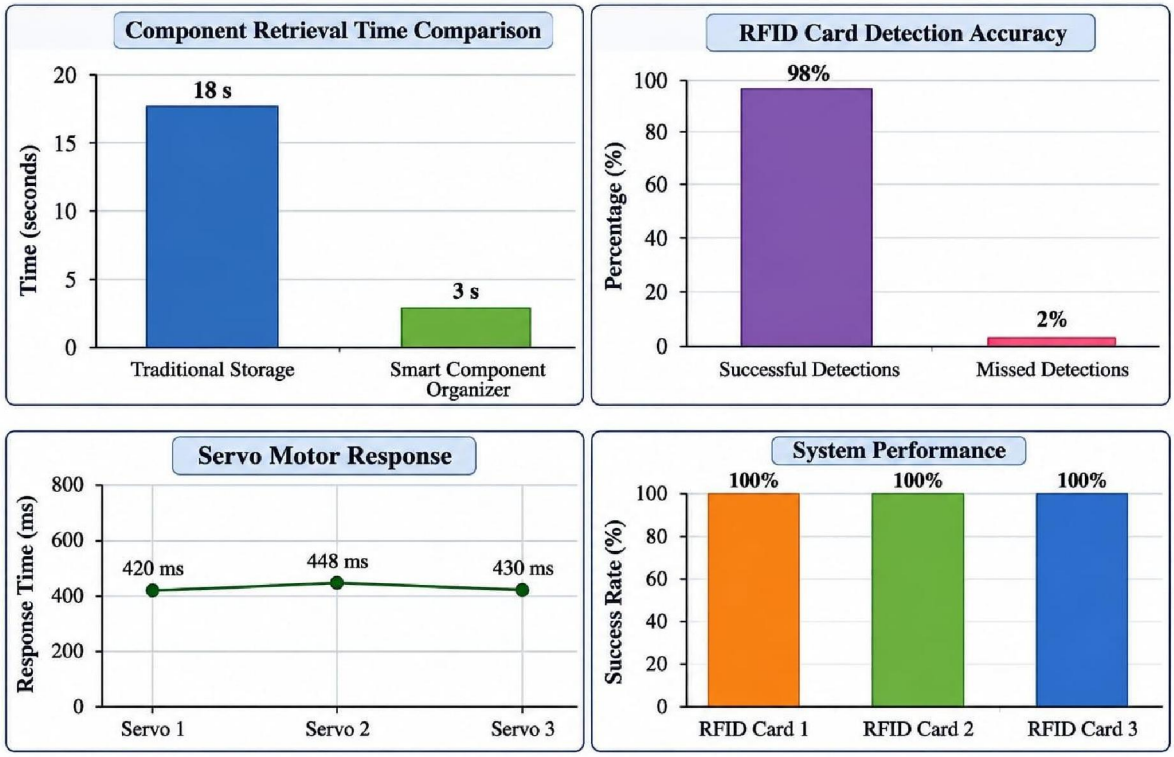
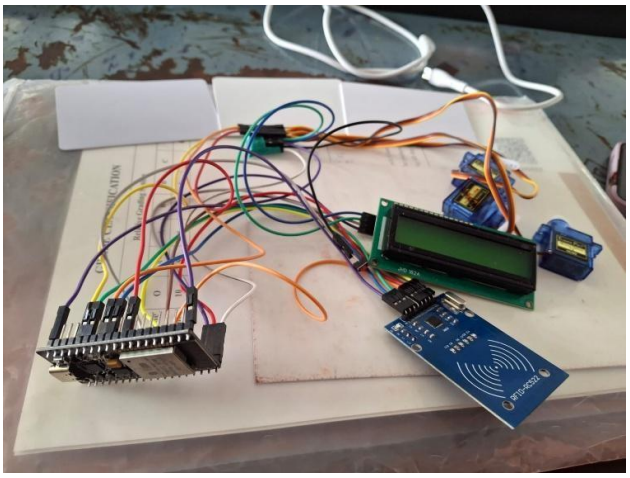


Figure 4: Graph of component organizer

III. OPERATION

• Power ON: The system is switched ON using the ON/OFF switch, and the battery supplies power to the circuit.
• System Initialization: The ESP32 microcontroller and RFID reader are initialized and made ready for operation.
• RFID Card Scanning: The user scans the required RFID card near the RFID reader to select a storage compartment.
• Reading Card ID: The RFID reader detects the unique ID of the card and sends the information to the ESP32.
• Card Verification: The ESP32 checks whether the scanned card ID is registered in the program.
• Invalid Card: If the card is not registered, the system does not perform any operation and waits for another card.
• Compartment Identification: If the card is valid, the ESP32 identifies the storage compartment assigned to that card.
• Servo Motor Activation: The ESP32 sends a control signal to the corresponding servo motor.
• Compartment Opening: The selected servo motor moves to its programmed position and opens the required compartment.
• Component Retrieval: The user can access and take the required electronic component from the selected compartment.
• Compartment Closing: After taking the component, the compartment can be closed by returning the servo motor to its initial position, if required.
• Ready for Next Scan: Finally, the system returns to its ready state and waits for the next RFID card.
• Continuous Operation: The same process is repeated whenever the user needs to access another storage compartment.

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IV. APPLICATIONS

The applications are given below for this project

- Educational Institutions
- Electronics Laboratories
- Electronic Industries
- Project Development Centres.
- Repair and Maintenance Centres.
- Research Laboratories
- Electronic Workshops

V. ADVANTAGES

- Educational Institutions: Used to organize electronic components in college laboratories.
- Electronics Laboratories: Helps students and technicians access components easily.
- Electronic Industries: Used for storing and managing small electronic components.
- Project Development Centres: Helps students find required components during project work.
- Repair and Maintenance Centres: Provides easy access to components needed for repairing electronic devices.

VI. DISADVANTAGES

- The system depends on a continuous power supply for its operation.
- The number of compartments is limited by the available servo motors and hardware connections.
- RFID reader or servo motor failure may affect the proper functioning of the system.

VII. CONCLUSION AND FUTURE WORK

In this paper, it is shown how Smart Component Organizer organizes and manages the components significantly with the use of voice assistant. We believe that the derived smart organizer model is important not only because it helps to improve the efficiency of the operations in the specific domain but it also has good implications to a more general domain. Figure 8 shows the Smart Component Organizer. In future research, we plan to extend our analysis to a more challenging case when the storage space is a decision variable. We also plan to use actuators to push the storage unit of the most promising location identified for the searched component.

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