**School of Computer Science Engineering and Information Systems**

**CSE3501 : Information Security Analysis and Audit**

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# Jth Component Review -2

**Project Title-**

# IoT-Enabled RFID Access Control System for Multi-Crop Warehouses

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## ABSTRACT:

This project introduces an IoT-enabled RFID access control system designed for multi-crop warehouses. The system is controlled by an ESP32 microcontroller, which manages both security and environmental monitoring. Each warehouse entrance is equipped with an RFID reader and a servo motor that unlocks the door for authorized farmers. Unauthorized attempts trigger a short buzzer alert. A DHT11 sensor in each warehouse continuously measures temperature and humidity, and when critical levels are detected, a continuous alarm is activated to warn staff about possible fire or spoilage risks. A shared passive buzzer reduces cost, while the system ensures independent control of each warehouse. The design is scalable for adding more warehouses and is IoT-ready, supporting future features like cloud dashboards and mobile alerts. This makes the system a secure, safe, and cost-effective solution for protecting agricultural produce.

## LITERATURE STUDY:

| S.No | Title | Authors | Objective | Methodology | Key Findings | Limitations |
|---|---|---|---|---|---|---|
| 1) | IoT Based Warehouse Management System Leveraging On RFID and Cloud Platform Technologies | Mohamed, N. M., Abdikarim Ali, A., & Rozeha, A. (2024) | To design a warehouse management system using IoT and RFID integrated with cloud services. | IoT sensors + RFID tags for warehouse data collection, cloud storage & processing, IEEE prototype validation. | Improved real-time tracking, reduced human error, and better stock visibility. | Focused on small-scale prototype; lacks large-scale deployment analysis. |
| 2) | Smart Logistics: Leveraging RFID and IoT for Seamless Supply Chains | O. D. Hussein, A. Muhudin (2024) | To optimize supply chain processes through IoT-RFID integration. | Survey + case study of logistics companies, system model for tracking and monitoring. | Increased transparency, improved supply chain resilience, faster goods movement. | Limited to logistics case studies, not tested in multi-crop warehouses. |

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|---|---|---|---|---|---|---|
| 3) | IoT-Enabled RFID in Supply Chain Management: A Comprehensive Review | Ferdousmou ,el al. (SCIRP, 2024) | To review RFID-IoT applications in supply chain and warehouse management. | Literature review of IoT and RFID-based solutions in SCM. | Identifies RFID as critical for traceability and IoT for automation. | Review-based only; lacks experimental validation. |
| 4) | Research on the Impact of IoT on Warehouse Management | Jarašūnienė, A., et al. (2023) | To study IoT's effect on warehouse efficiency and performance | Empirical study with IoT-enabled prototypes & simulation of warehouse operations. | IoT reduces operational costs, enhances monitoring & decision-making. | Regional focus; limited dataset; results may not generalize globally. |
| 5) | RFID IoT-enabled warehouse for safety management using product class-based storage and potential fields methods | Trab, S., Bajic, E., Zouinkhi, A., & Naceur, A. M. (2018) | To design an RFID–IoT integrated warehouse system that ensures safe and efficient storage management. | Proposed a safety-oriented warehouse model using product class-based storage rules and potential fields algorithms; tested through simulation and prototype validation. | Enhanced worker safety, reduced storage hazards, and improved handling efficiency with RFID–IoT integration. | Implemented mainly in simulation; lacks large-scale industrial deployment and real-time performance data. |
| 6) | IoT Based Smart Warehouse Monitoring System | Borwankar, J. (2023) | To monitor warehouses using IoT sensors and RFID for security and efficiency. | IoT architecture with RFID-enabled access control, real-time monitoring through | Enhanced safety, access control, and real-time status of crops. | Focused only on monitoring; lacks optimization of supply chain workflows. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | cloud dashboard. | | |

## EXISTING SYSTEM:

In the current warehouse setup, access control is managed manually using physical locks and keys, which can be easily lost or misused. There is no system in place to log or monitor who enters or exits the warehouses. Environmental factors like temperature and humidity are either checked manually or not monitored at all, making it difficult to detect early signs of spoilage or fire risk. Unauthorized access often goes unnoticed due to the absence of alerts or alarms. Additionally, the system lacks automation, real-time response mechanisms, and scalability. As a result, it is inefficient, insecure, and unsuitable for modern multi-crop storage needs.

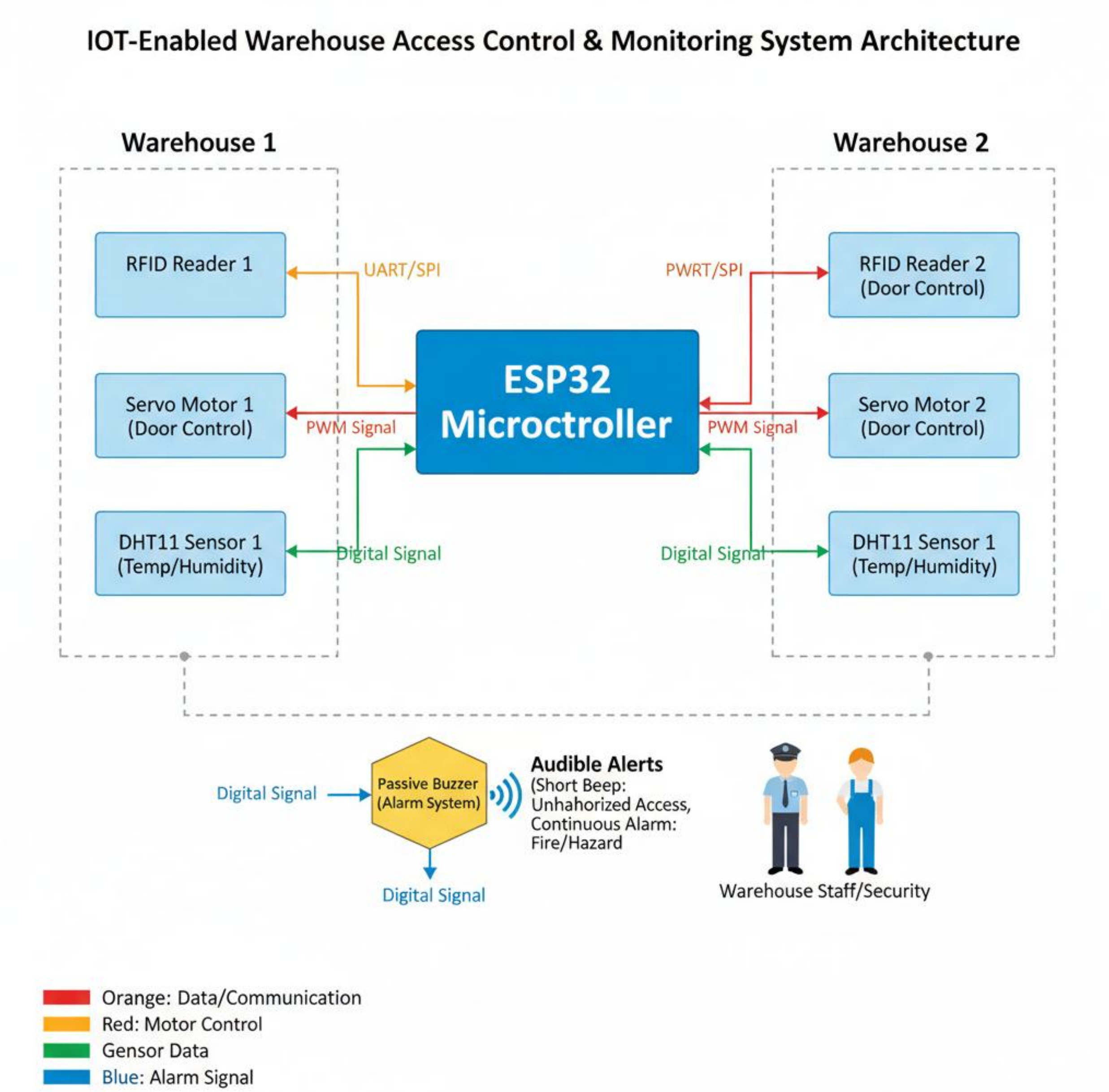
## PROPOSED SYSTEM:

The proposed system introduces an IoT-enabled RFID access control solution powered by an ESP32 microcontroller. Each warehouse is equipped with an RFID reader and a servo motor that automatically opens the door for authorized users. Unauthorized attempts trigger a short buzzer alert, ensuring quick response from staff. The system also includes DHT11 sensors in each warehouse to continuously monitor temperature and humidity. When critical levels are detected, a continuous buzzer alarm is activated to warn of potential fire or spoilage. All components are centrally controlled and scalable, with future-ready features like cloud dashboards and mobile app alerts. This solution ensures enhanced security, real-time monitoring, and efficient protection of agricultural produce.

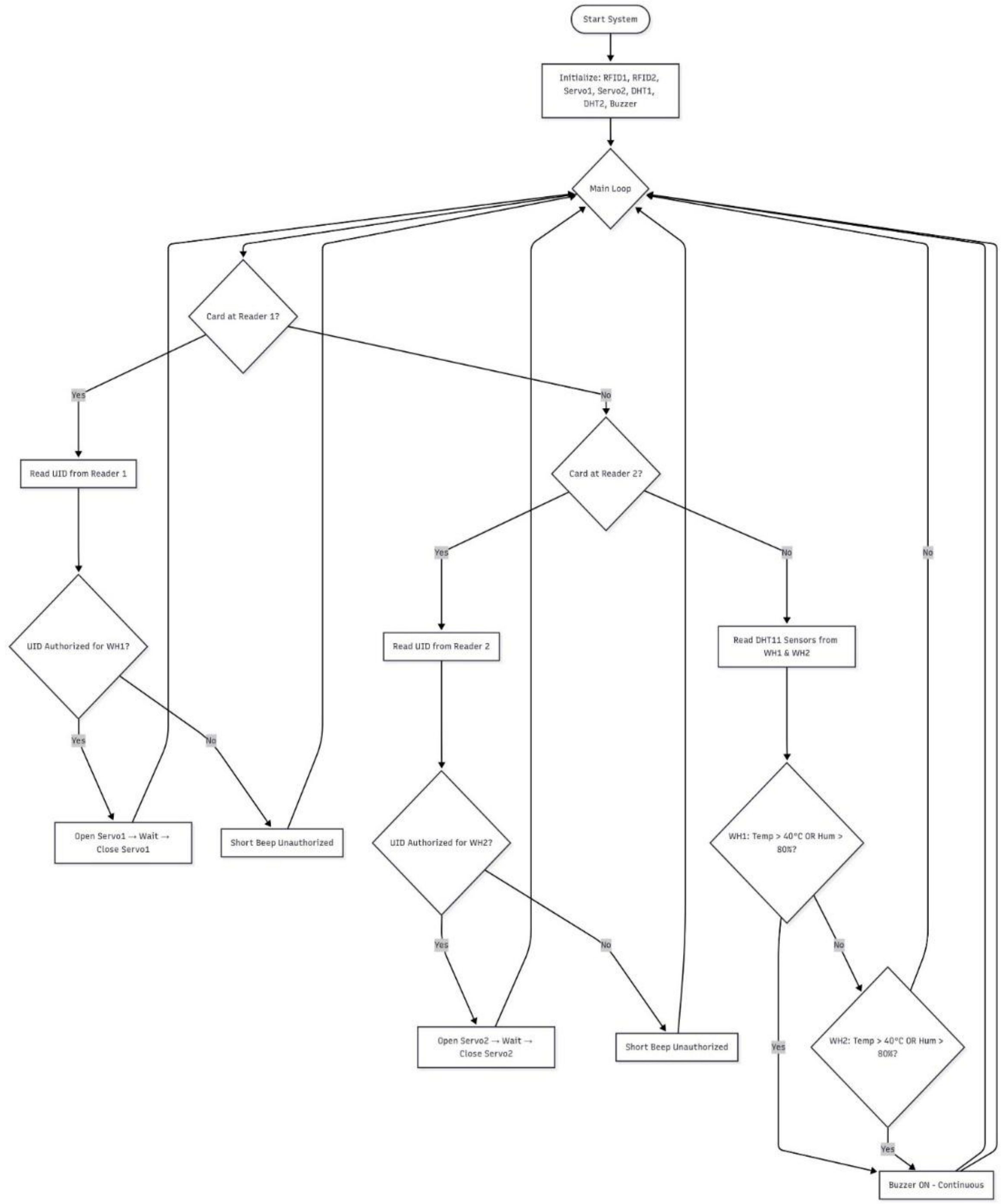
## Complete System Architecture:

The system is built around an ESP32 microcontroller, which acts as the central controller and IoT gateway. All warehouse devices (RFID readers, servos, sensors, and buzzer) are connected to the ESP32, which processes inputs, controls outputs, and coordinates monitoring

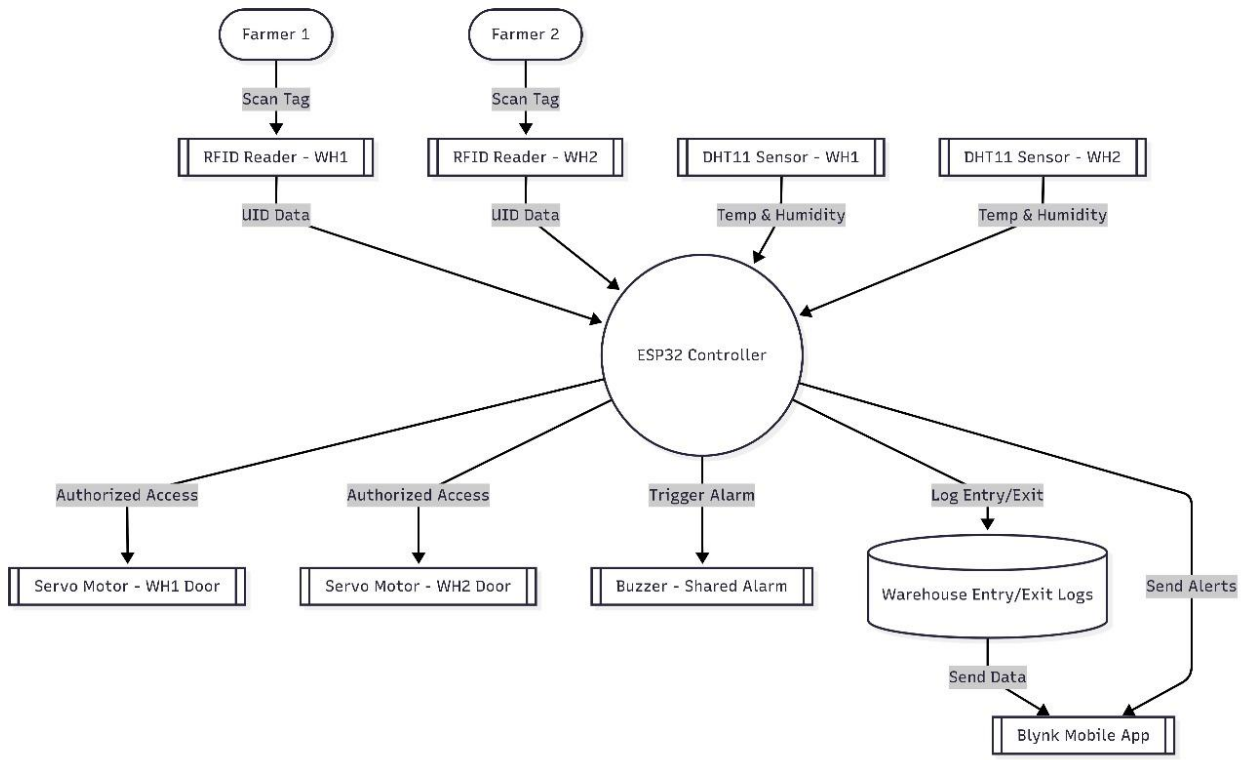
## SYSTEM ARCHITECTURE DIAGRAM:



## **HARDWARE CONTROL FLOW DIAGRAM**:



## DATA FLOW DIAGRAM:




## PSEUDOCODE:

**BEGIN**

**INITIALIZE:**

Setup RFID Reader 1, RFID Reader 2

Setup Servo 1, Servo 2 (doors)

Setup DHT11 Sensor 1, DHT11 Sensor 2

Setup Passive Buzzer

**MAIN LOOP:**

```
RFID Check
IF RFID Reader 1 detects a card:
    Read UID
    IF UID matches authorized list:
        Open Servo 1 (Warehouse 1 Door)
        Wait 5 seconds
        Close Servo 1
    ELSE
        Beep buzzer once (unauthorized access)

ELSE IF RFID Reader 2 detects a card:
    Read UID
    IF UID matches authorized list:
        Open Servo 2 (Warehouse 2 Door)
        Wait 5 seconds
        Close Servo 2
    ELSE
        Beep buzzer once (unauthorized access)

DHT11 Check
Read temperature & humidity from Sensor 1
IF temperature > 40 OR humidity > 80:
```

Turn buzzer ON continuously (fire/water alert for Warehouse 1)

**Read temperature & humidity from Sensor 2**

IF temperature > 40 OR humidity > 80:

Turn buzzer ON continuously (fire/water alert for Warehouse 2)

**Repeat**

Small delay

Go back to start of MAIN LOOP

END

## HARDWARE AND SOFTWARE DETAILS:

## Hardware Components:

### 1. ESP32 (Controller + IoT Hub)

- This is the brain of the system.
- It reads inputs from RFID readers and DHT11 sensors.
- It controls outputs like servo motors (door locks) and the buzzer (alarm).
- Its Wi-Fi capability allows future IoT integration (cloud logging, dashboards).

### 2. RFID Readers (RFID1 & RFID2)

- Each warehouse has its own RFID reader at the entrance.
- Farmers are given RFID tags/cards.
- When a card is scanned:
- ESP32 reads the UID (unique ID).
- If the UID is authorized, the warehouse door opens.

- If unauthorized, the buzzer is activated briefly.

### 3. Servo Motors (Servo1 & Servo2)

- Each warehouse door is controlled by a servo motor.
- When authorized access is granted, the corresponding servo rotates (e.g., 180°) to open the door, then closes after a fixed time.

### 4. DHT11 Sensors (DHT1 & DHT2)

- Each warehouse has one DHT11 sensor installed.
- The sensor monitors temperature and humidity conditions inside the warehouse.
- This is crucial for grain storage:
- High temperature → risk of fire/heat damage.
  - High humidity → risk of water leakage, dampness, or crop spoilage.

### 5. Shared Passive Buzzer

- A single buzzer is shared for both warehouses.
- It has two modes:

**Short Beep→ Unauthorized RFID access attempt.**

**Continuous Alarm → Critical condition detected by any DHT11 sensor.**

### 6. Warehouse Staff / Security

- **They respond to buzzer alarms.**
- **They can monitor the ESP32 output (serial or IoT dashboard in the future).**
- **They manage the list of authorized RFID cards.**

### System Integration (How Components Work Together)

- Each warehouse has a local access control system (RFID + Servo) and a monitoring system (DHT11).

- Both warehouses are independently controlled but connected to the same ESP32.
- The buzzer is a shared alerting mechanism:
- Quick alerts for unauthorized entry.
- Continuous alarm for safety hazards.
- The ESP32 ensures that multiple inputs (RFID or DHT11) are processed **in parallel without conflict.
- The architecture is scalable additional warehouses can be added with new RFID, servo, and DHT11 modules, while still using the same ESP32 if pins allow.

## DATASET LINKS:

**https://1drv.ms/x/c/247912ac9be22363/EarEYkcUkSZKkP-ogDQWZqoBgxBRHnhhbkR0TXaYB-glMw?e=1XPem5**

## REFERENCES:


1)Ali, A. A., Rashid, R. A., Abdikadir, N. M., Mohamed, A. A., & Ahmed, M. M. (2024, September). IoT Based Warehouse Management System Leveraging On RFID and Cloud Platform Technologies. In *2024 IEEE International Conference on Advanced Telecommunication and Networking Technologies (ATNT)* (Vol. 1, pp. 1-4). IEEE.

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3) Ferdousmou, J., Prabha, M., Farouk, M. O., Samiun, M. D., Sozib, H. M., & Zaman, A. M. (2024). IoT-Enabled RFID in Supply Chain Management: A Comprehensive Survey and Future Directions. *Journal of Computer and Communications*, *12*(11), 207-223.

4) Jarašūnienė, A., Čižiūnienė, K., & Čereška, A. (2023). Research on impact of IoT on warehouse management. *Sensors*, *23*(4), 2213.

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6) Borwankar, J., Pandit, S., Patel, V., & Nirmal, J. H. (2023). IOT-based smart warehouse monitoring system. *Available at SSRN 4461490*.