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Secure Smart Parcel Receiving System

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ABSTRACT: -

The "Secure Smart Parcel Receiving System" is a modern IoT-based solution created to solve problems related to unattended parcel deliveries. As online shopping grows, the need for safe and efficient delivery methods also increases. This project uses advanced embedded systems to provide a smooth and secure way to handle parcels. The system is built around the ESP8266 Wi-Fi microcontroller, which acts as the main controller and manages real-time data sharing between the locker and a cloud database. A fingerprint scanner is added to allow only approved users to collect parcels, boosting security and stopping unauthorized access.

Keywords— Parcel receiver, ESP8266, Secure, E-Commerce.

INTRODUCTION

In today's fast-moving world, people are getting busier with their daily routines, so most prefer online shopping over visiting physical stores. However, many customers face a common problem—they are not available at home to receive parcels. This can lead to missed deliveries, theft, or damage due to weather, which causes dissatisfaction among customers [1]. Re-delivery is also time-consuming and costly.

To overcome these problems, we propose a **Secure Smart Parcel Receiving System**. It is an electronic delivery box with an advanced locking system, a fingerprint sensor, and a mobile application. This system keeps parcels safe until the recipient is available to collect them. It uses the ESP8266 Wi-Fi module, which allows users to receive parcel notifications from anywhere in the world [1].

Earlier, people used to keep simple boxes outside their homes for deliveries, but delivery agents were often hesitant to leave parcels due to lack of proof and security. Our smart parcel box offers a secure and verifiable delivery method. If no one is at home, the delivery person can place the parcel in the box, which can only be opened by the authorized user through the mobile app or fingerprint sensor [4]. This ensures safe, contactless delivery and provides proper proof of delivery [4].

According to a recent report, companies like Amazon handle nearly 3 million deliveries per day, while Flipkart and Myntra manage around 2.5 million each. Other platforms like Meesho and Snapdeal also contribute heavily to daily shipments [8]. With such large numbers, a secure, automated system like this can greatly improve parcel handling and customer satisfaction.

LITERATURE REVIEW

Several smart parcel systems have been developed to solve issues with unattended deliveries. A few key studies are discussed below:

Himalayee Saini et al. designed an **RFID-based mailbox system**, where each courier had an RFID tag. When the courier arrived, the tag was scanned, and if it matched the system, the letterbox opened automatically. A message was then sent to the receiver's mobile, and once the parcel was collected, an acknowledgment was sent back to the courier company [1].

Ahmad Syafiq Bin Masrilhisyam et al. proposed the **Future Parcel Box**, which allowed secure parcel collection from courier agents. Customers could receive parcels through an email link. This system helped save time and reduced missed deliveries. It also lowered the chances of parcel theft [2].

Indrayani Rewatkar et al. presented a **Smart Parcel Receiving System** using a request key and a GSM module. When the delivery driver pressed the key, the system sent a notification to the owner's phone. The owner then sent an OTP to the system, which displayed it to the delivery person. After entering the correct OTP, the box opened, allowing the parcel to be stored safely [3].

Ahmad Anwar Zainuddin et al. developed an **IoT Parcel Alert System** during the COVID-19 pandemic. It sent parcel details to the recipient, who had to verify and scan a QR code. After successful verification, an OTP was sent, which the recipient had to enter to open the locker and collect the parcel [4].

R. ReddiRani worked on an **IoT-based Bank Locker System** using fingerprint and OTP. This project aimed to ensure only authorized users could access lockers, and it can be used in banks, offices, or homes for secure storage [5].

Lee Jia Heng developed a **prototype of a smart parcel box** using a Raspberry Pi. This system solved delivery issues faced by delivery agents and recipients, but the prototype could handle only one parcel at a time and wasn't weatherproof [6].

Mohit Gupta et al. proposed an **Intelligent Parcel Management System** using IoT and machine learning. It used RFID along with QR codes to detect parcels securely. RFID was used to improve accuracy and security over QR alone, as it does not depend on orientation and holds more data [7].

These studies show that the integration of IoT with smart authentication methods like RFID, QR codes, GSM, and biometric systems has greatly improved the way parcels are received. However, most of these systems still have certain limitations such as limited storage capacity, lack of weather protection, or dependency on external validation methods. Our proposed system addresses these gaps by using fingerprint authentication, an ESP8266 Wi-Fi module for cloud access, and a secure locking mechanism, ensuring reliable and contactless parcel delivery.

PROPOSED METHODOLOGY

A. System Architecture:

The box is a smart safety system that uses an Arduino and several parts to control access. It includes an ESP8266 Wi-Fi module that allows users to connect remotely using a mobile app. A fingerprint sensor is the main way to unlock the box, making sure that only the right person can open it. The servo motor, managed by the Arduino, handles the locking part. The ESP8266 helps the app talk to the Arduino, so users can check and control access from anywhere. This design is safe, easy to use, and protects stored items well.

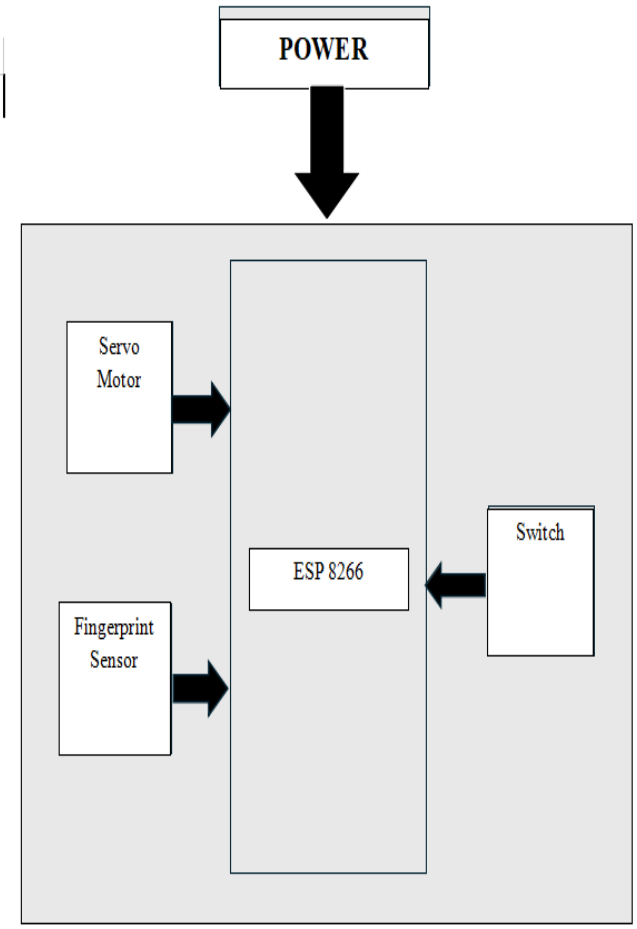

Fig a. Block diagram

- Power Supply:

The entire system is powered by an external source, ensuring stable operation of all components.

- ESP8266 (Microcontroller):

Acts as the central processing unit of the system.

Receives input from the fingerprint sensor and the switch.

Controls the servo motor based on the authentication results.

- Fingerprint Sensor:

Detects and verifies the fingerprint of the user.

Sends the authentication data to the ESP8266.

If the fingerprint matches a stored entry, the ESP8266 sends a command to open the lock.

- Servo Motor:

Operates the locking mechanism of the box.

Upon receiving a signal from the ESP8266, it rotates 90 degrees to unlock the box.

- Switch:

Can act as a manual override or an additional input to control the system.

Sends a signal to the ESP8266 when pressed, which could trigger an action such as locking or unlocking.

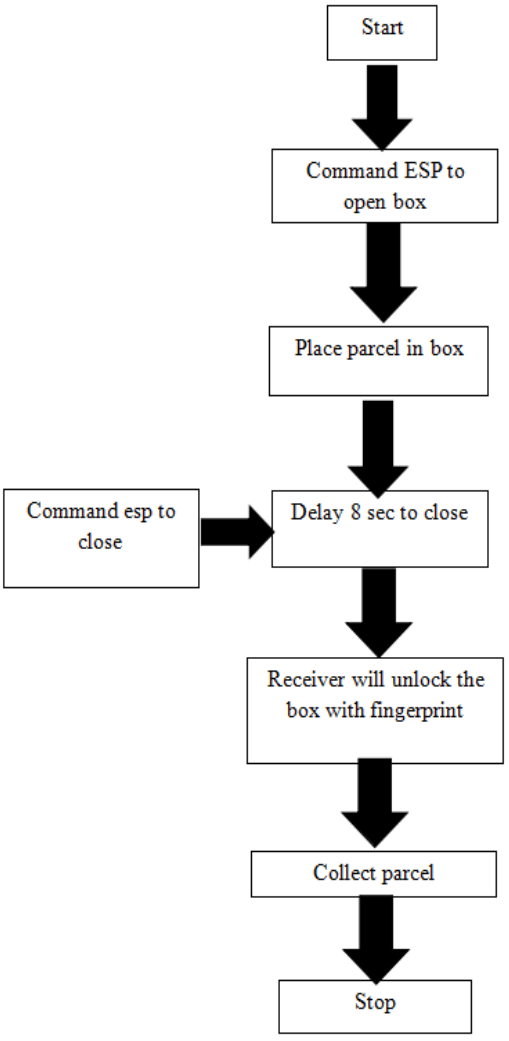

Fig b. Flowchart

B. Description of Components

1. ESP 8266 (Espressif systems)

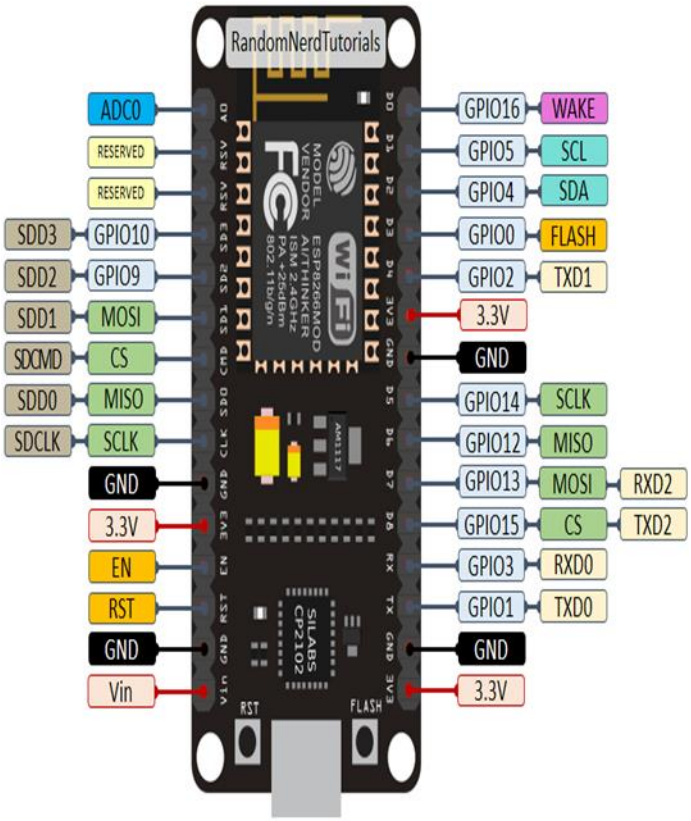

Fig c. ESP 8266 (Espressif systems)

The ESP8266 is a low-cost Wi-Fi microcontroller, with built-in TCP/IP networking software, and microcontroller capability, produced by Espress if Systems.Processor: L106 32-bit RISC microprocessor

Memory:

32 KiB instruction RAM

32 KiB instruction cache RAM

80 KiB user-data RAM

16 KiB ETS system-data RAM

External QSPI flash: up to 16 MiB is supported (512 KiB to 4 MiB typically included)

IEEE 802.11 b/g/n Wi-Fi WEP or WPA/WPA2 authentication, or open networks

17 GPIO pins [7]

Serial Peripheral Interface Bus (SPI)

I²C (software implementation) [8]

I²S interfaces with DMA (sharing pins with GPIO)

2. Servomotor

Fig d. Servomotor

Servomotors are small devices containing embedded mechanics and electronics. There are widely used in modalism, robotics and other applications. Their name comes from the fact that they control their position (or velocity) on their own.

The servo motor in this system is responsible for unlocking and opening the door by rotating 90 degrees upon receiving a valid signal from the Arduino. When an authorized fingerprint is detected, the Arduino sends a command to the servo, causing it to rotate 90 degrees, thereby unlocking the door. Once access is granted, the servo can return to its original position to relock the door. This precise control ensures smooth and reliable door operation, making it an essential component of the security system.

3. Fingerprint Sensor

Fig e. Fingerprint Sensor

This is the fingerprint sensor R307 is used which will detect the owner's fingerprint by scanning and will open the door.

The fingerprint sensor in this system acts as the primary access control mechanism, ensuring that only authorized users can open the box. When a user places their finger on the sensor, it scans and matches the fingerprint against stored data. If a match is found, the Arduino sends a signal to the servo motor to rotate 90 degrees, unlocking the box. This biometric authentication method enhances security, reliability, and ease of access, eliminating the need for traditional keys or passwords.

RESULTS

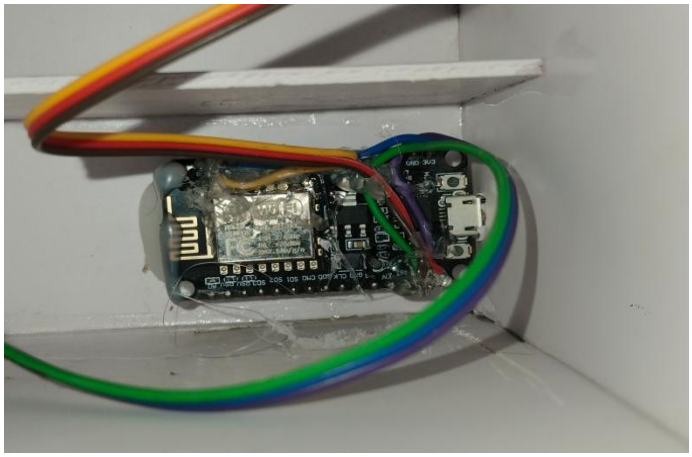

Fig f. ESP Circuit Setup

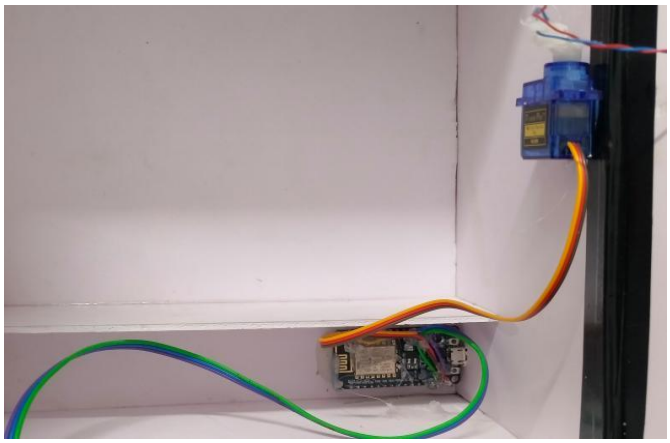

Fig g. Circuit with Servo Motor for Locker Mechanism

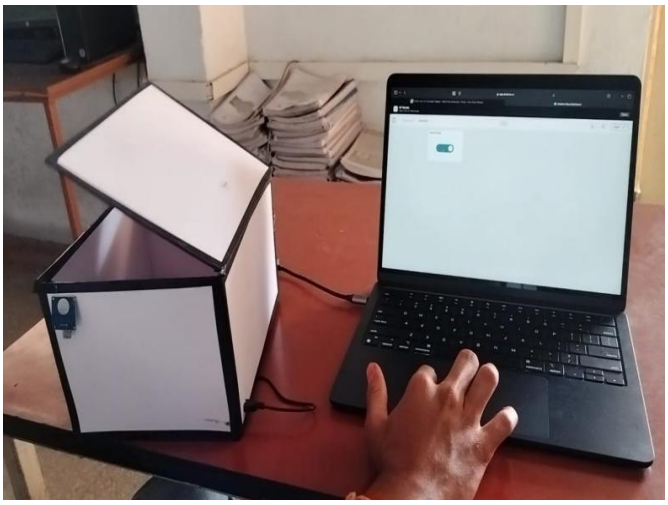

Fig h. Application Interface

CONCLUSIONS

The Secure Smart Parcel Receiving System offers a reliable solution for problems related to unattended deliveries. It ensures that parcels are stored safely until the owner can collect them, reducing missed deliveries and the risk of theft or damage. With features like fingerprint access, a servo-controlled lock, and remote monitoring through the ESP8266 Wi-Fi module, this system provides high security and convenience. It is especially useful in busy urban areas where people are not always home. This smart box supports contactless delivery and improves the overall parcel-handling experience in a safe, efficient, and modern way.

This project shows how simple IoT components can be combined to create a smart and secure system for daily needs. In the future, this system can be improved further by adding features like camera monitoring, GSM alerts, and parcel weight detection to make it even more advanced and user-friendly

Future scopes:

1.Camera Integration

- A high-resolution camera module can capture images or record videos of the person delivering the package.
- Facial recognition can be implemented to verify authorized personnel.
- Motion detection can trigger recording only when activity is detected.

2. GSM Module for Alerts

- A GSM module allows real-time communication via SMS or call alerts.
- When a package is delivered, the system can send an SMS notification to the recipient.
- It can also alert users in case of tampering or unauthorized access attempts.

3. IR Sensors for Detection

- Infrared (IR) sensors can detect human movement near the parcel receiver.
- The system can use IR sensors to verify when a person is standing close to deliver or collect a package.
- IR can be used to detect the parcel is kept inside the box by sensing the shadow.

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