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#### “DESIGN AND IMPLEMENTATION OF AN AUTOMATED DOOR ACCESS CONTROL SYSTEM VIA ESP32-CAM”

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#### ABSTRACT

*This paper presents the design of Smart Door Lock System with Automation and Security - an implementation of IoT (Internet of Things). The system allows the users to monitor and control their homes using the Android device. This system is designed mainly for home door locks; this design can be customized for different kinds of locks as per the need. It uses the ESP32 CAM module as the main device, which has an in built Camera. Different sensors have been interfaced to detect doorbell and knock. It also notifies if any suspicious person is sensed. The system also keeps track of the door status i.e. opened or closed. It notifies the user of the visitor or the suspicious person detected through the mobile application along with the picture. For notification the system has made use of Google Cloud Messaging service. The user, if intended to, can unlock the door for the known visitor or make an emergency call in case of suspicion. The door would be unlocked after the verification. We are using the Blynk Mobile phone application. One Application would be capable of controlling and monitoring different locks.*

**Key Words:** IoT, ESP32-CAM, Facial Recognition, Smart Home Security, Embedded Systems, Remote Monitoring.

#### I. INTRODUCTION

The advancement in technology has brought about the Internet of Things (IoT), which involves connecting everyday objects to the internet for efficient data exchange. In this regard, this report presents a solution for remotely controlling and monitoring door locks using a smart phone application from any part of the world. The proposed system seeks to address the inconvenience of physically attending to someone knocking on the door, particularly when living on higher floors. The system is primarily designed for home door locks but can be customized for other types of locks. It utilizes the ESP32 cam module and various sensors to detect doorbell and knock, as well as notify the user of any suspicious person. The system also keeps track of the door's status and sends a notification to the user's mobile application, including a picture of the visitor or suspicious person. The system uses the internet to keep registered users informed about the visitor at the door and detects any suspicious persons. The user can remotely unlock the door via the application. This system has a vast range of applications, including industrial doors, banking doors, personal lockers, and vehicles.

#### II. LITERATURE REVIEW

Smith et al. (2018), demonstrated that while RFID is efficient, it lacks non-repudiation, as cards can be shared or stolen. To address this, Johnson (2019) proposed fingerprint-based biometrics; however, physical contact sensors were found to be prone to wear and tear and hygiene concerns in high-traffic areas.

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**Kumar and Rose (2020)**, explored the use of the Blynk Application for controlling home appliances via Node MCU. Their work highlighted the advantage of cloud-based notifications but noted a lack of visual verification, leaving users unable to identify visitors before granting access. This established the necessity for integrated camera modules in low-cost IoT setups.

**Chen et al. (2021)** conducted a performance analysis of the OV2640 sensor, concluding that while it lacks the resolution of high-end IP cameras, its low power consumption and built-in Wi-Fi make it ideal for residential entry points.

**Gupta (2022)** successfully implemented a Telegram-based notification system, proving that third-party APIs (like Telegram or WhatsApp) could serve as secure, encrypted gateways for transmitting visitor photos without the need for hosting.

### III. PROBLEM IDENTIFICATION

In India and other countries, most homes have multiple floors, and families often include elderly or disabled individuals who may have difficulty unlocking their doors, especially if they are alone. This can be a challenge for anyone, regardless of their physical condition. To address this issue, we propose a "smart door lock system" that makes life modern, smart, and easy.

People are increasingly concerned with ensuring that their doors are secure, and there are various measures available to prevent unauthorized entry. However, many of these methods are low-grade and can be easily bypassed. To counter this, we aim to employ advanced technology, such as smart door security, which is a significant step forward in ensuring both safety and ease of access.

Our project aims to provide a solution to this problem by allowing individuals to control their door's latch via their Smartphone. The system uses a Bluetooth connection established between the device and the microcontroller, enabling individuals to control their doors from any floor of their home. This technology ensures that everyone, regardless of age or physical condition, can quickly and easily unlock their door, making their lives more comfortable and secure.

### IV. SOLUTION

The main objective of this project was to create a cutting-edge, user-friendly, and intelligent door lock that offers easy access, convenience, and enhanced security to homes. Users can remotely unlock their door through the Smart Lock mobile application or use face recognition technology via a camera mounted on the door for a hands-free experience. The system was composed of three key components, including a cloud-based back-end, an on-board logical unit, and a mobile application.

### V. PROPOSED METHODOLOGY

The development of the Automated Door Access Control System is divided into three primary phases: Hardware Integration, Software Development, and Network Communication Logic.

#### 1. Hardware Architecture

The system is built around the ESP32-CAM module, chosen for its integrated OV2640 camera sensor and Wi-Fi capabilities. The physical locking mechanism is controlled via a 12V Solenoid Door Lock, interfaced through a Relay Module to separate the high-power circuit from the microcontroller's logic pins.

- ESP32-CAM: Acts as the central processing unit and image capture device.
- Relay Module (5V): Switches the 12V power supply to the solenoid.
- Power Supply: A dual-voltage power source (5V for ESP32 and 12V for the solenoid) ensures stable operation.
- Indicator System: LEDs or a buzzer are integrated to provide local feedback for "Access Granted" or "Access Denied."

#### 2. Software Framework and Algorithm

The software is developed using the Arduino IDE (C++ environment). The logic follows a "Trigger-Capture-Validate"

flow:

1. Initialization: The ESP32-CAM connects to a local Wi-Fi network and initializes the camera and GPIO pins.
2. Web Server Hosting: An asynchronous web server is hosted on the ESP32's local IP address.
3. Image Processing:
  - \* Option A (Manual): The user views the live stream via the web dashboard and clicks "Unlock."
  - o Option B (Automatic): The system uses a Haar Cascade or LBPH (Local Binary Patterns Histograms) algorithm for on-device facial recognition to compare the live feed against pre-stored authorized templates.
4. GPIO Actuation: Upon successful validation, a digital high signal is sent to the relay, retracting the solenoid for a predefined duration (e.g., 5 seconds).

**Block Diagram:**

System overview and architecture the entire system consists of an Embedded System and the Mobile Application. The different sub-modules in the embedded system can be understood from the following block diagram:

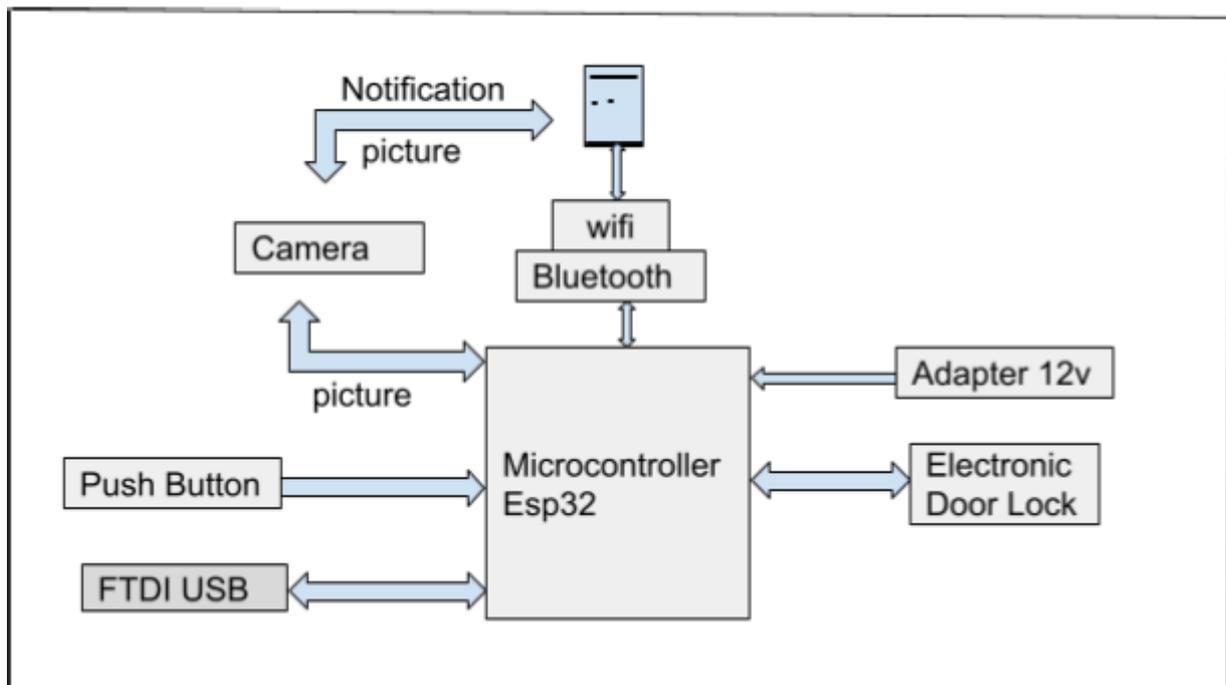


Fig.1 Block Diagram.

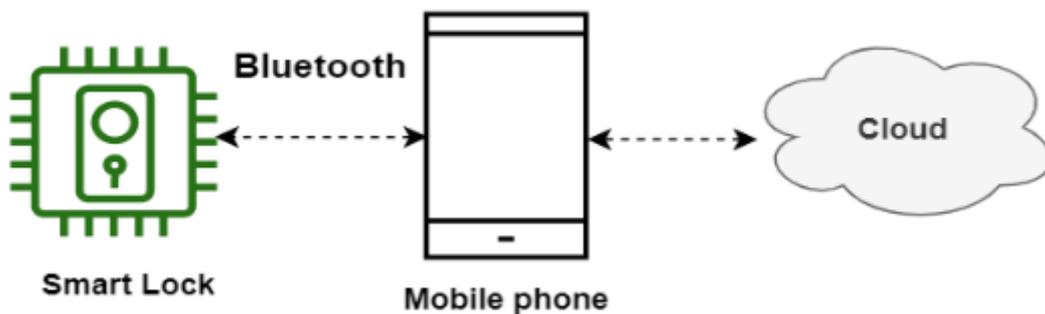


Fig.2 Block Diagram of Cloud System.

**Description:**

The hardware device will be an Embedded System consisting of different modules. The microcontroller from the ESP32 family will be the core of the system. The Bluetooth modem and the camera module will be interfaced to the microcontroller ESP32.

**System Circuit Diagram:**

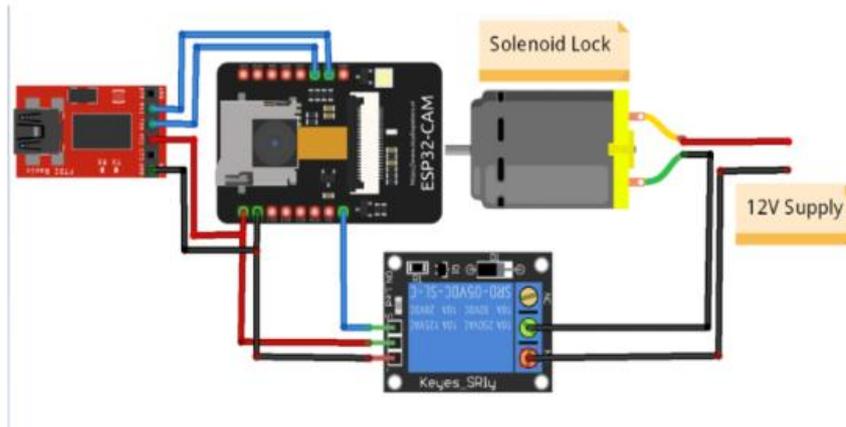


Fig.3 Connection Diagram.

The integration of these modules creates a cohesive security loop. When the Push Button is triggered, the Microcontroller captures a visitor photo via the OV2640 sensor, transmits it through the Wi-Fi module to the Mobile App, and waits for user authentication. Upon receiving an authorized command, the Electronic Lock is actuated, while the Buzzer provides real-time status alerts.

**VI. RESULT**



Fig4: Test Result.

## VII. CONCLUSION

The proposed system allows remote access to lock or unlock the door without physical user interaction. The system fulfills the requirements of supporting autonomous locking devices and easy key distribution compared to physical keys. The system has minimum requirements for hardware and supports customization of keys. The intrusion alert enhances the security of the system. The prototype-built shows that the design consumes minimal power and the locking/unlocking of the door happens in 4 seconds on an average.

Thus, the system proposed is feasible. The aim of this idea is to design a smart door security system using Arduino IDE and Bluetooth application, Wi-Fi connectivity so that people can feel safe about their home whether they are away from home or are in the house. This project is based on Arduino, and the coding is done on Arduino IDE platform using the Arduino application. At the end of this research the aim and objectives of the project was achieved. People can now feel more secure about their doors all the time. Doors can be controlled conveniently to those with access. Thus "Smart Door Locking System using Arduino" is a modern successor of the conventional door locking system. The conclusion of the discussion of smart Lock using ESP32 CAM is the innovation created from the lock system with no more direct contact between the user and the lock.

This system is very cost-effective and easy to install. In conclusion, it was discovered that the project performed according to specification and can be implemented. The use of the ESP32 CAM microcontroller in this project allows for design simplicity, hence, the project can be achieved in lesser time compared to other techniques previously employed. This work proposes a secure locking/unlocking system based on a keypad and Arduino. Adding password to the Arduino side increases the system security. The system also has a feature for locking itself after some delayed time. This system could be used to prevent houses, companies, institutions from stealing or losing the ordinary key.

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