

“SMART DOORBELL SECURITY SYSTEM”

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Abstract – The door has become an access point to a house where it is used for entering and exiting. Security is one of the crucial factors in a residence. Criminal activities often occur by tampering or breaking the lock system of the house door. Currently, the security of house doors generally still relies on wooden supports, handle locks, and sometimes the use of padlocks. Now, door security systems can be obtained through various methods, one of which is by implementing technology. Therefore, a smart lock door system was created using face recognition technology, specifically utilizing the ESP32-CAM module, integrated into the system, allowing the door to be unlocked using one's face as the password. Additionally, the smart lock door incorporates the assistance of a Telegram application, which serves to store detected images and act as a real-time monitor of the situation in front of the house. The methodology employed was a literature review, utilizing written sources to gather information, and a consultation method involving interactions with advisors and individuals possessing relevant knowledge or experience. The testing results indicate that the ESP32-CAM can be effectively utilized as a detector for the smart lock door system.

Keywords: ESP32-CAM, Microcontroller, Smart Door Lock, face recognition Technology, Telegram Application.

1.INTRODUCTION

In today's society, crime has unfortunately become a ubiquitous aspect of daily life, with house burglary being a significant concern. Burglaries often occur through damaged or bypassed door locking systems, presenting a threat even when residents are at home. Traditional security measures like wooden wedges and padlocks are still prevalent, but technology is increasingly being integrated into home security solutions. Among these innovations is the use of advanced methods such as biometric authentication, including facial recognition powered by devices like the ESP32-CAM module. This technology offers a more robust defense against intruders by allowing only registered faces to unlock the door. Not only does this enhance security, but it also provides real-time notifications to homeowners and security personnel via platforms like Telegram, ensuring peace of mind and prompt action when needed. With such advancements, homeowners can better safeguard their properties and loved ones from the threats of burglary.

This report discusses two distinct projects aimed at revolutionizing conventional door lock systems:

I. Smart Door Lock System using ESP32-CAM and Telegram Application:

The first project focuses on leveraging the ESP32-CAM module and the Telegram application to create a smart door lock system. This innovative system

integrates IoT technology with a user-friendly mobile app to enhance security and convenience. By connecting to the internet, users can remotely monitor and control the door lock system via Telegram. Utilizing MQTT protocol ensures efficient communication between ESP32-CAM and Telegram. The report provides insights into research, hardware setup, software configuration, and deployment, highlighting the significance of IoT integration and its impact on home security. Overall, this project offers users greater control over their premises, real-time notifications, and seamless integration with existing smart home ecosystems.

I. Smart Door Lock System using ESP32-CAM and Face Recognition System:

The second project focuses on integrating ESP32-CAM with a Face Recognition System to develop a smart door lock system. This project aims to enhance security and convenience by allowing real-time recognition of authorized individuals for door access. By establishing an internet connection, users can remotely control the system through a dedicated web application. The report covers research, hardware setup, software configuration, and deployment aspects, emphasizing the robustness of facial recognition algorithms and their contribution to overall security. This project offers users the convenience of secure entry through facial recognition, along with real-time monitoring and integration with existing smart home ecosystems.

Both projects represent significant advancements in home security and automation, providing users with greater control, convenience, and peace of mind in safeguarding their premises.

2. LITERATURE SURVEY.

The [1] "Image-Based Smart Surveillance and Remote Door Lock Switching System for Homes (2019)" is a cutting-edge solution designed to enhance home security and convenience. Leveraging cloud technology, specifically AWS, the system enables users to mark pictures of known individuals, creating a database for comparison. When someone approaches the door, their photo is captured and compared with the known person database. The result of this comparison is promptly sent to the homeowner, allowing them to remotely grant access to recognized individuals. This innovative approach combines image-based surveillance

with remote door lock switching, providing homeowners with peace of mind and efficient control over access to their homes, even when away.

The [2] "Door Security System for Home Monitoring Based on ESP32 (13 September 2019)" represents a sophisticated IoT solution tailored for remote monitoring and control of house doors. Utilizing ESP32 technology, users can seamlessly manage door status through their smartphones via cloud-based MQTT communication. This protocol ensures secure data exchange, guaranteeing reliable control over the door lock system. Enhanced security features include the integration of a PIR sensor to detect nearby movement, triggering appropriate responses. Additionally, a touch sensor on the door handle accurately identifies human touch, further bolstering security and convenience. This comprehensive system not only provides peace of mind to homeowners but also offers efficient and intuitive control over access to their homes, making it a valuable addition to modern home security solutions.

The [3] development of the Smart Door Decision System, based on a PIR sensor, Embedded Face Recognition, and Server Request using TTGO ESP32 (March 2021), represents a significant leap forward in home security technology. At its core, the system utilizes a lightweight Convolutional Neural Network (CNN) algorithm for precise face detection and identification. The integration of WeMo's D1 Mini electronic board facilitates control over input parameters and output actions. Leveraging the ESP8266 microcontroller enables seamless internet connectivity and integration with a Firebase real-time database through a Platform as a Service (PaaS) backend. This connection allows for efficient communication between the system, user's smartphone, and Firebase database. Firebase serves as the storage hub for relevant data, ensuring swift retrieval and seamless functionality. With both TTGO ESP32 cam and WeMo's D1 Mini microcontrollers working in tandem, the Smart Door Decision System provides users with enhanced security and convenience, marking a notable advancement in smart home technology.

The [4] Smart Doorbell Using ESP32 Cam Based on IoT, developed between May and June 2022, represents a significant advancement in home security and convenience. The project's primary aim was to create a door lock system that enables users to unlock doors via face recognition captured by a camera installed on the

door. Leveraging the ESP32-CAM microcontroller alongside a dedicated mobile app, the system seamlessly integrates into existing Wi-Fi networks, transforming traditional doorbells into smart, connected devices. When a visitor rings the doorbell, homeowners receive instant notifications on their mobile devices, complete with a photo of the visitor captured by the door camera. Through the accompanying mobile app, homeowners can review the photo, authenticate the visitor, and remotely unlock the door from their authorized smartphones. Utilizing Blynk as the communication protocol ensures smooth connectivity between the smartphone and the door lock system, facilitating effortless control and interaction. The paper accompanying the project delves into the suitability of the ESP32 microcontroller for powering the functionalities of the Smart Door Lock system, underscoring its reliability and effectiveness in modernizing home security solutions.

3. PROPOSED METHODOLOGY

In the proposed system we used the following hardware and software to meet our requirements.

➤ Hardware Requirements.

1. ESP32-CAM Camera Module

The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, WiFi image upload, QR identification, and so on. The ESP32-CAM suit for IOT applications such as: Smart home devices image upload. Wireless monitoring.



2. Single-Channel Relay 5V.

The 5V relay module can be used to control a load such as a lighting system, motor, or solenoid. It can also be used to switch AC or DC voltages. The maximum voltage and current that the 5V relay module can control is dependent on the specifications of the relay.



3. Regulated IC 7805.

The 7805 voltage regulator IC is widely used to regulate voltage in electrical and electronic circuits. It accepts an unregulated voltage of 7 V to 35 V and outputs a fixed 5 V DC. It is a three-pin IC and belongs to the LM78XX series.



4. Solenoid Lock.

Solenoid lock has a latch and it is used for electrical locking and unlocking. It locks the latch as long as the power is provided and it unlocks when the power is turned off.



5. Push Button Switch.

The main purpose of a push button switch is to control the flow of electricity in a circuit. By pressing a button, you can turn the device on or off, activate specific functions, or trigger specific actions.



6. 12v Adapter.

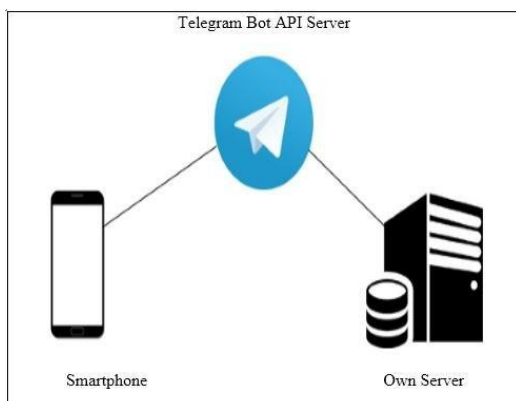
This 12V 1A power supply is mainly used in, chargers, microcontroller, portable amplifiers, audio-video players, Bluetooth/wifi modules, DC motors, led light circuits. Despite being small in size this power supply work effectively.



➤ Software Requirements.

1.Telegram Bot API.

Telegram Bot API is an HTTP interface for developing the bots in the Telegram. Creating a Bot in telegram is easy as it is open source.

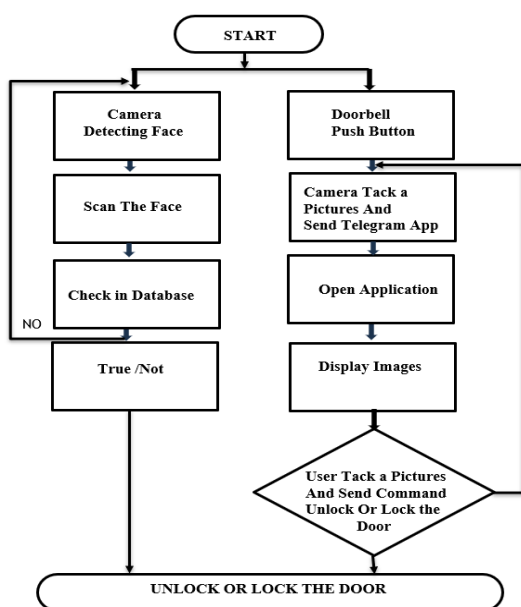


2. Face Recognition.

Face detection software uses machine learning algorithms to identify facial features in a photo or video. It looks for an eye, then identifies other facial features. It compares these features to training data to confirm it has detected a face.

Viola-Jones algorithm. This method is based on training a model to understand what is and isn't a face. Although the framework is still popular for recognizing faces in real-time applications, it has problems identifying faces that are covered or not properly oriented. And it include in a camera server sketch in Arduino IDE.

4. SYSTEM ARCHITECTURE .



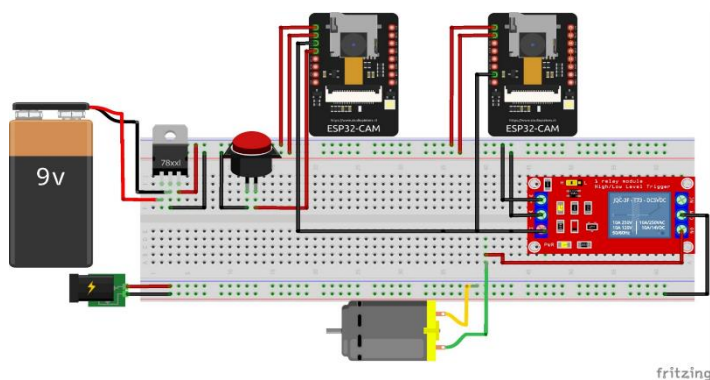
The integration of the ESP32-CAM module within the door system represents a sophisticated approach to home security and access control. As individuals approach the door, the system initiates face detection, leveraging the capabilities of the ESP32-CAM to identify human faces. Subsequently, face recognition algorithms are employed to compare the detected face with a pre-existing database of authorized individuals. If a match is found, indicating that the detected individual is recognized, the ESP32-CAM seamlessly sends a signal to unlock the door, granting access to the authorized person. In the event that no match is identified or no face is detected, the camera remains inactive, ensuring privacy and conserving power.

Simultaneously, the door system is equipped with a doorbell button that, when pressed, triggers the ESP32-CAM to capture a picture of the individual at the door. This image is promptly sent to the owner via the Telegram app, providing real-time visual verification of visitors. The owner, upon receiving the image, has the ability to review it and make an informed decision regarding whether to grant access. If the owner recognizes the visitor and wishes to unlock the door, they can simply respond with the command "/Unlock" through the Telegram app. Alternatively, if the image is unclear or the owner requires further verification, they can request another picture by sending the command "/Image".

This dynamic interaction between the ESP32-CAM-enabled door system and the owner via the Telegram app ensures a high level of security, convenience, and control. By leveraging facial recognition technology, the system enables seamless and secure access for authorized individuals while providing real-time visual verification and control for the owner. Additionally, the integration with the Telegram app facilitates remote access and communication, allowing the owner to manage access to their property from anywhere with an internet connection. Overall, the ESP32-CAM-based door system represents a robust and versatile solution for modern home security and access control needs.

5. THE CIRCUIT DESIGN.

This part covered the essential settings including the ESP32 Camera board manager installation. The system is powered by ESP 32 CAM circuit. The Circuit Diagram for ESP32-CAM Faces Recognition Door Lock System And Telegram Application Door Lock system is combined with an FTDI board, Relay Module, and Solenoid Lock. The FTDI board is employed to flash the code into ESP32-CAM because it doesn't have a USB connector while the relay module is employed to modify the Solenoid lock on or off. Here Arduino IDE is employed to program ESP32-CAM. The Faces Recognition Door Lock System code is split into four parts. One is that the main code for the camera and relay module where the ESP32 locks or unlocks the door consistent with face recognition, and therefore the other three codes are for website, camera index, and camera pins. And Smart door lock system using ESP32-CAM and Telegram Code is Use to communicate the Telegram App and Send photo lock and Unlock the Door. Telegram Application used to provide the Interface to the User. After completing the code, insert the network credentials. To acknowledge the faces with ESP32-CAM, first, we've to enroll the faces. For that, activate the Face recognition and detection features from settings then click on the Enroll Face button. It takes several attempts to save lots of faces. After enrolling the faces, if a face is recognized within the video feed, ESP32 will make the relay module unlock the door. Whenever the person comes ahead of the door, it recognizes the face and if it's registered then it opens the door.



5. RESULTS AND DISCUSSION

The implementation of two distinct modes in the smart door lock system utilizing ESP32-CAM reflects a versatile approach to home security, catering to diverse user preferences and security needs. The integration of Telegram app functionality allows for seamless remote access control, empowering homeowners to manage door security from anywhere. Moreover, the incorporation of facial recognition technology in the second mode enhances security measures, ensuring access is restricted to authorized individuals only.

These advancements signify a significant leap forward in home security technology, with potential for further enhancements to streamline operations and enhance user experience, underscoring the ongoing evolution of IoT-based security solutions in safeguarding homes and occupants.

6. CONCLUSIONS

In conclusion, the development of a sophisticated smart door lock system using ESP32-CAM and Telegram has proven highly successful in enhancing home security and accessibility. Through adept utilization of the ESP32-CAM module and seamless integration with Telegram, the system offers robust authentication protocols and effortless remote management capabilities. Meticulous attention to interoperability ensures smooth communication between components, underscoring the system's effectiveness in simplifying access control procedures. Beyond residential applications, the facial recognition door lock system holds potential for access control in various settings, offering cost-effective and reliable solutions for restricted areas in government agencies, institutions, and beyond.

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