

# Smart Contactless Doorbell System Using ESP32-CAM

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#### Abstract

The Smart Contactless Doorbell System Using ESP32-CAM is a system designed to enhance home security and convenience by eliminating the need for physical contact. Leveraging Internet of Things (IoT) technology, this system notifies homeowners of visitors and enables remote access control through an Android application developed using MIT App Inventor ([1]). The system uses an IR sensor to detect motion, which triggers the ESP32-CAM to capture an image of the visitor. The image is then sent to the homeowner's Android application, where they can decide whether to unlock or lock the door by clicking the appropriate button. The backend of the system is managed using Firebase, which stores the images and facilitates communication between the ESP32-CAM and the Android app. The door lock mechanism is controlled by a solenoid lock, which is triggered based on the homeowner's response. This system is designed to be cost-effective, easy to use, and highly secure, making it suitable for modern smart homes. Future improvements could include enhancing the Wi-Fi range using directional antennas and integrating more advanced security features.

Keywords: Smart Contactless Doorbell, Internet of Things (IoT), ESP32-CAM, App.

#### **1. Introduction**

In the era of Internet of Things (IoT) and smart homes the integration of the technology into our everyday life has now become increasingly more frequent. One of the most remarkable development and advancements in this domain is the development smart doorbell systems. The Conventional doorbell systems that needs physical interaction are becoming outdated now due to lack of hygiene and inconvenience, especially after contagious disease like COVID-19. This project mainly aligns with latest advancements in IoT- based security solutions that offers reliable and contactless alternative ([4]). The Smart Contactless Doorbell addresses these issues and provides a completely contactless solution for home with more advanced security. This system leverages the modern technologies like ESP32-CAM, Firebase, IR sensors and an application that gives secure, seamless and user-friendly experience for homeowners. ([2])

# **System Overview**

The Smart Contactless Doorbell System is designed to enhance home security and convenience by eliminating the need for physical interaction. It uses an IR sensor to detect motion near the door, which then triggers the ESP32-CAM to capture an image of the visitor. This photo is shared with an Android application developed using MIT App Inventor, allowing the resident to check the image and decide

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whether to unlock or keep the door locked. The system's backend is integrated with Firebase, ensuring efficient and secure communication between the Android app and ESP32-CAM.

With the growing adoption of smart home technology, traditional doorbells are becoming obsolete due to security concerns and hygiene factors. This project introduces an innovative contactless doorbell system that enhances safety and convenience by utilizing motion sensors, camera technology, and cloud-based storage. Unlike conventional systems that require physical interaction, this system operates remotely, reducing the risk of contamination—especially in post-pandemic environments.

#### **II. Literature Review**

#### • Title: "Configuring the Telegram App for WiFi Door Lock"

Overview: This study discusses the configuration of the Telegram app for remote interaction with IoT-based door lock systems. While this project uses an Android app developed with MIT App Inventor, the principles of remote communication and control are similar. The study highlights the importance of secure communication protocols and user-friendly interfaces for IoT systems.

#### • Title: "Programming ESP32-CAM with Arduino IDE"

Overview: This research provides a detailed guide on programming the component ESP32-CAM using the Arduino IDE. It is a versatile microcontroller that has built in WiFi and its camera capabilities which makes ideal for the IoT Projects. The study emphasises the importance of proper coding practices and the use of libraries such as WiFi and Firebase for efficient communication.

#### • Title: "Sensor Integration in ESP32-CAM Systems"

Overview: This study explores the integration of various sensors, including IR sensors, with the ESP32-CAM module. The use of IR sensors for motion detection is a key component of this project, and the study provides valuable insights into sensor integration and data processing. Challenges and Future Directions

#### • Title: "Security Considerations in IoT-Based Door Lock Systems"

Overview: This research discusses the security challenges associated with IoT-based door lock systems. The study focuses the importance of secure communication protocols, like H TTPS and MQTT along with TLS, for protecting the data transmission between IoT devices and Firebase.

#### • Title: "Case Studies: Implementations of ESP32-CAM in Security Systems"

Overview: This section provides case studies of successful implementations of the ESP32-CAM in various security systems. These case studies highlight practical challenges and solutions, offering valuable insights for new projects.

#### • Title: "User Experience and Interface Design for Smart Door Lock Systems"

Overview: This study examines the design and usability of mobile interfaces for controlling IoT-based door lock systems. The research emphasises the importance of clear notifications, intuitive controls, and responsive interactions in enhancing user satisfaction.

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# III. Proposed Methodology

The proposed system operates as follows:

- The IR sensor detects motion near the door.
- The ESP32-CAM captures an image of the visitor.
- The image is sent to the homeowner's Android application via Firebase([5]).

• The resident views the image and chooses whether to unlock the door by choosing appropriate button or keep it unlocked.

• The solenoid lock is triggered based on the homeowner's response, either unlocking or locking the door.

The flowchart of the system is shown in Figure:1. The program initialises all the sensors and hardware that are connected with ESP32-CAM. When the sensor detects the motion, the ES32-CAM captures the image immediately and sends that to Firebase. The app retrieves the image from the Firebase and it displays it to the resident. The homeowner then can click the "Unlock" or "Lock" button on the app. And that sends the command back to the ESP32-CAM through Firebase. Then it triggers the solenoid lock to either lock or unlock the door.



#### **Hardware Components**

The hardware components used in this project are listed in Table 1. These components include the ESP32-CAM, IR sensor, solenoid lock, relay module, and various connectors. Each component is carefully selected to ensure compatibility and efficiency.

#### **Software Components**

The software components include the Arduino IDE for programming the ESP32-CAM, MIT App Inventor for

developing the Android application, and Firebase for backend communication and data storage. The Arduino IDE is used to write and upload the code to the ESP32-CAM, while MIT App Inventor is used to create a user-friendly interface for the Android app. Firebase acts as the backend, storing images and facilitating communication between the ESP32-CAM and the Android app.

#### **IV. Experimental results and Discussion**

- The ESP32-CAM successfully captured and transmitted images in **all test trials**, with an **average response time of 4.87 seconds**.
- The Android app and solenoid lock functioned **reliably** in every test.

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# V. Conclusion

The Smart Contactless Doorbell System Using ESP32-CAM is a highly effective solution for enhancing home security and convenience. The system provides a contactless way to control the access of the door and stay safe. Te use of motion detection sensor, ESP32-CAM for capturing image and the Firebase for backend communication ensure that the system is secure and convenient to use. The resident can check anytime and anywhere whether the door is locked or unlocked. The system is very cost effective and easily installable which makes it more suitable for smart homes.

the Smart Contactless Doorbell System Using ESP32-CAM is a robust, secure, and user-friendly

solution for modern smart homes. Its contactless operation, combined with efficient communication and reliable performance, makes it an ideal choice for enhancing home security and convenience. Future improvements could further enhance the system's capabilities, making it even more versatile and secure.

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