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Design of a Feasible Cloud Server based Doorway Security System

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Abstract - *The study being undertaken here in was about checking and validating the feasibility of an IoT system integrated with a cloud server. As security is one of the major concerns for public today they want to ensure security at everyplace possible when they are into their homes or away from their homes. Keeping in view of this problem the idea of a highly reactive, versatile, low cost and real-time responsive security system was formulated here in this study to prevent or deter the unauthorized intrusion or trespassing activity in or around one's premises. The architecture of the system was well planned keeping every minute detail in mind so as to be able to finally realize it into a working prototype.*

Key Words: ESP32-CAM, Security System, IoT, Solenoid Lock, Blynk, Contacless Door Bell, etc.

1. INTRODUCTION

Several security systems are already available in the market to provide the security related solutions but most of them are either expensive or require high storage space for recording surveillance video. Some security systems are static and least versatile but comparably high in cost while others are dynamic but support only half-duplex communication, means the user can only monitor the system output remotely but cannot control it. Now in this era of IoT, cloud computing and machine learning a paradigm shift in the design and development of advanced, smart and intelligent systems has been noticed. Rapid prototyping of IoT devices using certain low cost Wi-Fi enabled development boards like ESP12, ESP32, NodeMCU, Arduino, etc. has now become much easier than ever before. Also it has widened the scope of creativity as the whole process of turning one's idea into a working prototype has now become faster and easier due to lot of support available over the internet.

2. PROBLEM STATEMENT

The research work was mainly concerned with the design and development of an IoT based doorway security system while integrating a cloud server with it for remote access. Specifically, the investigator was directed to answer the following questions:

1. What were the relative strengths and weaknesses identified in the literature with respect to other similar models present?
2. Which computational devices and cloud server platforms were most likely to be used to implement such systems?
3. To what extent does the results obtained by the experimentations performed match the desired results?
4. Whether the system developed was static or dynamic?
5. Whether the system developed responds in real-time or not?
6. Whether the system developed could be accessed remotely or not?
7. Whether the system developed was a cost effective solution or not?

3. PROPOSED WORK

The proposed work was to design, develop and implement a highly effective doorway security system. In this system there were two units: Indoor Unit and Outdoor Unit. Outdoor Unit deployed an infrared proximity sensor and ESP32-CAM board with an LED flashlight over it. Usually a visitor making a visit to someone's place reaches at the doorstep and notifies the owner inside by ringing the door bell available at the doorway. Here the same procedure were to be followed except a minor change that the door bell switch has been replaced here with a contactless sensor based switch. So, here the visitor needs to raise his/ her hand closer to the deployed sensor to trigger the door bell. As soon as the sensor detects someone, the owner inside will be notified by a message on the Blynk project dashboard over the smart-phone followed by a visitor's picture clicked by the ESP32-CAM. The Indoor Unit has a solenoid door lock in control of the user. The system empowered the user with two options to control this door lock electronically via physical access or via remote access. For physical access a tactile push button was provided for the user. To unlock the door, user needs to press that button for few seconds. Similarly, the other option to unlock the door was via the smart-phone by using a virtual button provided in the Blynk application dashboard created for this project. Also user can click multiple pictures of the visitor if required by using another virtual button named 'Take Photo' on the same dashboard screen. The image clicked and the notification appeared on the same dashboard screen via Blynk server. For smooth working of this prototype both the devices i.e. ESP32-CAM and the user's smart-phone must share the same Wi-Fi credentials, otherwise there would be no connectivity between the two.

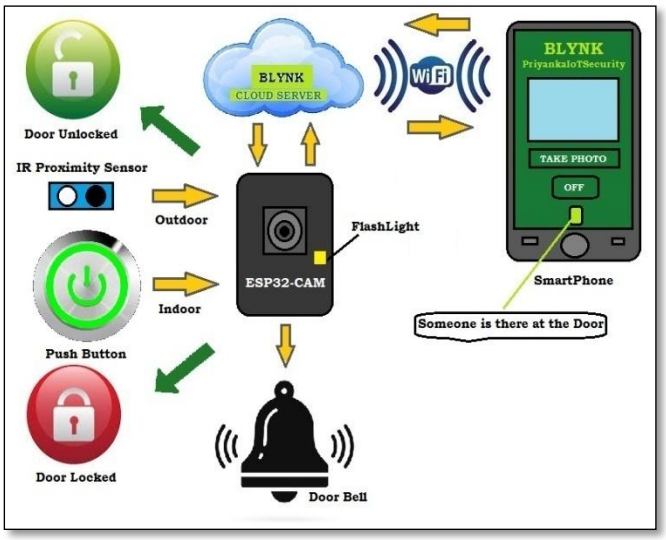

FIG 1: Block Diagram of the Proposed System

4. COMPONENTS REQUIRED

4.1 Computational Platform: ESP32-CAM

The ESP32-CAM has a very competitive small-size camera module that can operate independently as a minimum system with a footprint of only 27*40.5*4.5mm and a deep sleep current of upto 6mA. ESP-32CAM can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications. ESP-32CAM adopts DIP package and can be directly inserted into the backplane to realize rapid production of products, providing customers with high-reliability connection mode, which is convenient for application in various IoT hardware terminals.

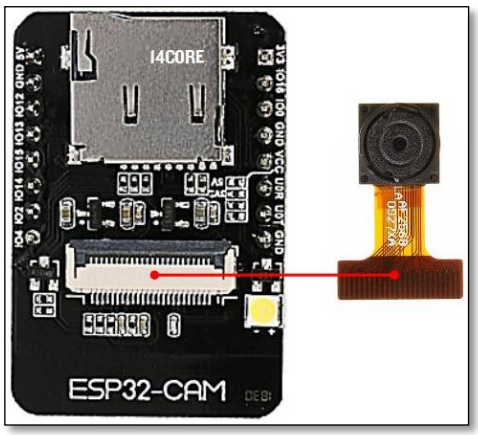

FIG 2: ESP32-CAM Board

4.2 Relay Board

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. Relays are the components which allow a low-power circuit to switch a relatively high current on and off, or to control signals that must be electrically isolated from the controlling circuit itself. To make a relay operate, we have to pass a suitable pull-in and holding current (DC) through its energizing coils. Generally, relay coils are designed to operate on a supply voltage often 12V or 5V.

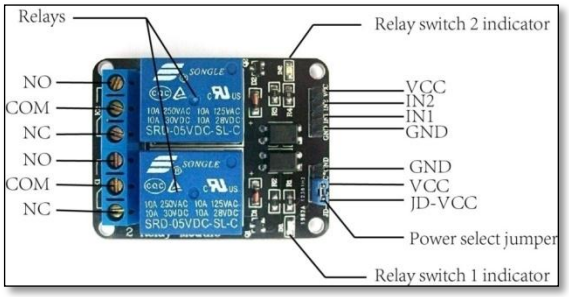

FIG 3: Relay Board

4.3 IR Proximity Sensor Module

Proximity Sensor is used to detect objects and obstacles in front of sensor. Sensor keeps transmitting infrared light and when any object comes near, it is detected by the sensor by monitoring the reflected light from the object. It can be used in robots for obstacle avoidance, for automatic doors, for parking aid devices or for security alarm systems, or contact less tachometer by measuring RPM of rotation objects like fan blades.

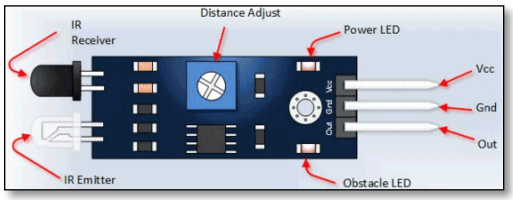

FIG 3: IR Proximity Sensor Module

4.4 Tactile Push Button Module

The tactile push button is the most commonly used mechanical switching device used in electrical and electronic circuits and panels. These small sized switches are placed on Printed Circuit Boards (PCBs) and are used to close an electrical circuit when the button is pressed by a person. When the button is pressed, the switch turns ON and when the button is released, the switch turns OFF. The

switch is used to supply input signal to actuate a device or equipment, to generate an interrupt, to increment or decrement a value manually, to change the mode of operation of a device, as a key in matrix keypad. A pull-up resistor is interfaced to the switch line to prevent detection of false triggers when the line is in high-impedance state or tri-state.

4.5 LED Indicator Module

LED (Light Emitting Diode) is basically a pn-junction diode that emits light when connected to the power source in forward bias mode and doesn't operate in reverse bias mode. The Red colored LED usually consumes 2.2V–2.4V and 10mA–20mA current. A current limiting resistor is required to connect in series with it as per the source voltage.

4.6 Solenoid Door Lock

The solenoid lock denotes a latch for electrical locking and unlocking. It is available in unlocking in the power-on mode type and locking and keeping in the power-on mode type, which can be used selectively for situations. The power-on unlocking type enables unlocking only while the solenoid is powered on. A door with this type is locked and not opened in case of power failure or wire disconnection, ensuring excellent safety. This type is used mainly for places requiring crime prevention. The power-on locking type can lock a door while the solenoid is powered on. If the power is disconnected, the door is unlocked. This type unlocks the door in case of wire disconnection due to a fire or accident, and it is used for emergency exits through which fire-fighting activity or evacuation should preferentially be made rather than safety for crime prevention. The keeping type performs two operations, locking and unlocking by applying a positive or negative pulse voltage to the solenoid, and keeps the no-power state in each position. This type features energy saving because it is unnecessary to always power the solenoid on.

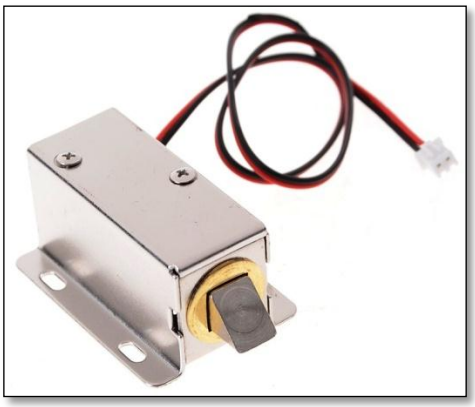

FIG 4: Solenoid Door Lock

5. CONCLUSION

So here in this study a feasible, highly responsive, low cost and versatile solution was introduced to provide doorway security. The purpose to design an IoT system integrated with a cloud server was fulfilled. The system design was properly checked for any failures and recommended for developing a prototype. The security system formulated here in this study was to prevent or deter the unauthorized intrusion or trespassing activity in or around one's premises. The architecture of the system was well planned keeping every minute detail in mind so as to be able to finally realize it into a working prototype.

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