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SMART DOORBELL SYSTEM USING INTERNET OF THINGS

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ABSTRACT

Traditional Doorbell system is commonly wired into electrical system of the house. Security has always been an important issue in house. This paper presents about IOT based Doorbell with security features with less human interaction involved. The smart doorbell will send real time notifications to the mobile. It uses camera sensor to detect the human presence and captures the images. IOT based doorbell is installed near the entrance of the house and it is an internet connected doorbell. This paper has Manual and Automation process. Hardware components such as ESP32 CAM, Solenoid lock, Push button, FTDI232 USB to serial board, DC adaptor, Resistors, Voltage regulator are used. Mobile IOT cloud platform such as Blynk is used. Automation process uses face recognition technology. Tools such as Python 3.9 Version, OpenCV and Sublime text editor is used. It consist of three phases - Data gathering, Face detection and Face recognition.

Keywords: ***Doorbell, ESP32CAM, Solenoid Lock, Blynk- Mobile IOT App, Face recognition technology.***

I. INTRODUCTION

This paper presents about IOT based Doorbell with security features with less human interaction involved. The smart doorbell will send real time notifications to the mobile. It uses camera sensor to detect the human presence and captures the images. The objective of the paper is to send real time notification to mobile when someone press the doorbell using internet of things. The owner of the house can see the image of the person who is standing near the door using Blynk app. Esp32 camera module is used. The owner can control the door lock using Blynk. Blynk is an IOT mobile cloud platform.

The paper consist of two processes - Manual process and Automation process. First process is implemented using hardware components. This system uses ESP32 CAM, Solenoid lock, Push button, FTDI232 USB to serial board, DC adaptor, Resistors, Voltage regulator and Blynk – Mobile IOT App. When doorbell switch is pressed, owner of the house will get notification in his mobile with the captured image of visitor. Owner can check the image of visitor and unlock the door with the help of blynk app. Blynk App is a mobile IOT cloud platform.

Automation process uses face recognition technology. It consist of three phases - Data gathering, Face detection and Face recognition. Tools such as Python Open CV is used. Dataset images are created from the live camera. Dataset images are trained. Haarcascade classifier is used to detect the face and LBPH for recognition purpose. In this automation process, image is not sent to human. Instead image is sent to web cloud platform. When doorbell is pressed, camera module gets triggered and will capture the image. The captured image will be mapped with stored image. If it matches, it unlocks the door automatically.

II. LITERATURE REVIEW

In paper [1] presents how the face is recognized using algorithms such as Eigen face and independent component analysis (ICA). Independent component analysis is written using Matlab R2012b face recognition. This system is based on criteria of low power consumption. Hardware components are used such as Doorbell, camera, Raspberry pi. This project uses Eigen face algorithm using openCV library to perform face recognition. The script can capture the image and convert it to gray scale image and apply Eigen face approach. To decrease the number of images, face pictures are regenerated into two dimensional array with eight bit intensity values.

In paper [2] it is based on real time smart doorbell notification system for home security. It enables the user to monitor visitors in real time via the IOT based doorbell installed near the entrance doors to home. When a visitor rings the doorbell, SMS will be sent to registered mobile number of the house member and response in the form of SMS will be displayed on LCD screen placed beside the door so that visitor can read the SMS and act accordingly. The visitor can leave the voice message that will be sent to house member. The Doorbell will be installed with Arduino chip to transport and receive messages. The system uses main components like Doorbell, wireless transmitter receiver module and LCD response. Arduino and webcam is used to build doorbell and send SMS notification to owner with the picture of the person at door.

In paper [3], involves building a security system using HaarCascade classifier and LBPH face recognizer available in open source computer vision (OpenCv) library. OpenCv uses Haarcascade algorithm to detect facial features of human face. To implement the algorithm lot of positive and negative images are used to train cascade function. Trained cascade function is used to detect human facial features. Hardware modules used are Raspberry, camera module. Haar feature-based cascade classifier is used to detect human faces at real time. Camera detects eyes, nose etc which are used by Haar cascade face detection algorithm. Feed the face data to recognizer so that it can learn. The result will be saved in .yml file. LBPH face recognizer is used.

In paper [4], is based on IOT which uses raspberry pi, Pi camera module and wearable device for the user to know about the person who is standing near the door. Notification will be delivered by vibration from wearable device. It uses facial recognition software which takes the captured face of the person standing near door. Wearable device is used to alert the user about the person on the door by notifying via vibration. Captured Images are processed for feature extraction and face detection process. It finds the match in database then Raspberry pi sends the data which contains name of the matched face to ESP8266 using MQTT protocol. If the face does not match with any face present in database, then raspberry pi will send the data as UNKNOWN to ESP8266.

In paper [5], uses hardware components like camera, Speaker, Fingerprint sensors, scanner which provides features like capturing images of unknown people taking videos, announcing their names after scanning their fingerprints through scanner. Owner will store all the data like fingerprint, message beside the name and other details. Fingerprint of the visitor will be scanned by finger print sensor which will be located on button of the doorbell. The fingerprint will be scanned and sent to raspberry pi. Raspberry pi will extract all known fingerprints stored in database of the system. Fingerprints will be checked for the match of fingerprint scanned with extracted fingerprint stored in database. If match found, then raspberry pi will announce the message through speaker which is stored in database beside visitor's name. If the match is not found, then the default message will be announced through speaker and camera will capture image visitor and send to database.

III. PROBLEM SPECIFICATION

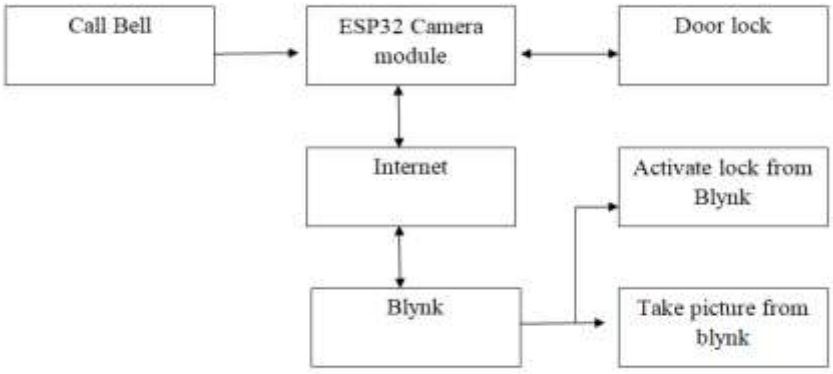
Manual process (Mobile IOT cloud platform): Doorbell switch is pressed by human, it triggers the camera to take the image of human. Notification is sent to mobile of the owner. The owner of the house will open the Blynk IOT mobile app and he clicks on "Unlock" button and the door gets unlock.

Automation process: The same process is automated with the help of dataset images and machine learning techniques. In this image is not sent to human. Instead image is sent to cloud platform. When doorbell is pressed, camera module gets triggered and will capture the image. The captured image will be mapped with stored image. If it matches, it unlocks the door automatically. It consist of three phases - Data gathering, Face detection and Face recognition. Dataset images are created from the live camera. Dataset images are trained. Haarcascade classifier is used to detect the face and LBPH for recognition purpose.

IV. METHODOLOGY

Manual Process: When anyone press the call bell, it sends notification to blynk app installed in the smart phone. We can open blynk app and tap on take picture to take pic of the person who is standing outside. After seeing the person we can open the door by tapping a lock door button on blynk.

Figure 1: Methodology Flowchart



Automation Process: The above process is automated with the help of raspberry pi and face Recognition Technology. Once the Doorbell is pressed, camera module will get triggered and capture the image of the person. The input from the camera will be given to raspberry pi. The Raspberry pi is responsible for face Recognition and carry out further process. It will detect and recognize the faces using Haadcascade classifier and LBPH recognizer.

It involves three steps:

- Data Gathering
- Training The Recognizer
- Face Recognition

V. EXPERIMENTS AND RESULTS

Environmental setup – Manual Process

Hardware components : ESP32-CAM , Solenoid lock , Push button , FTDI232 USB to serial board , DC adaptor , Resistors , Voltage regulator , Blynk app - Mobile IOT platform .

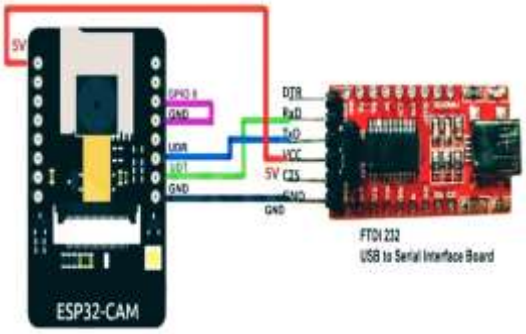


Figure 2

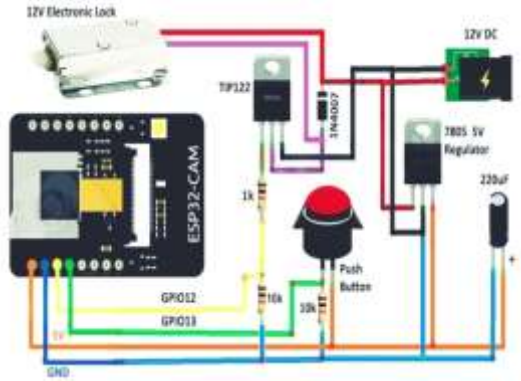


Figure 3

Implementation Steps:

To implement this project, the above hardware components are used.

Programming ESP32 cam module

1: To program ESP32CAM, FTDI232 USB to serial interface board is used. Then connect FTDI 232 with ESP32cam as per the above circuit 1.

Board Settings:

- Board : ESP32 Wrover Module
- Upload Speed : 921600
- Flash frequency : 80 MHz
- Flash mode : Q10
- Partition Scheme : "Hue App(3 MB No OTA/1MB SPIFFS)
- Select the appropriate COM port.

2: Connect GPIO 0 to GND pin and press RESET button in ESP32cam to put the board in flashing mode and then upload the sketch.

Blynk App Setup to control ESP32 cam wifi lock

- Open the project in the Blynk app and click on the "+" icon on the top.
- Select the Image gallery widget from the widget box (Pin-V1 and Function: show image)
- Select the Styled Button from the widget box (Pin-GP14, Mode- push and Function : capture photo)
- Select the Styled Button from the widget box (Pin-GP12,Mode-Switch and Function : Unlock/Lock Door)
- Select the notification from the widget box (Function : get notification)

Connect All the Hardware components on the bread board as per the above circuit diagram 2.

Experimental Results:

After the hardware components and Blynk app setup, Supply 12V DC to wifi door lock and connect the smart phone with the same network. Now Press the push button , we will get notification on the mobile phone.

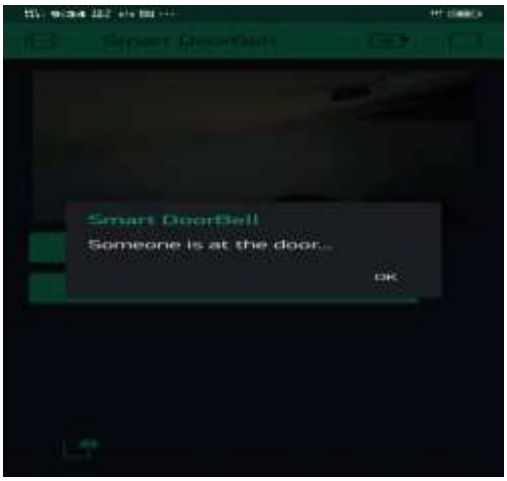


Figure 4

Figure 5

Then click on the "UnlockDoor" button to control the 12V electronic lock.

Environmental setup – Automation Process

Technologies used : Python 3.9 Version **,** Open CV **,** Sublime Text Editor

3 phases in face recognition :

- Data gathering
- Train the recognizer
- Face recognition

1. Face Detection

- Import the libraries such as cv2 and numpy.
- Import Haar Cascade classifier to detect the face.
- Add video capture object and read the image from video capture object.
- Convert the captured image into gray scale for face detection and apply face detector on grayscale image.
- Then extract X, Y, W, H parameters from the image, where X and Y are screen coordinates and W is width and H is the height of the rectangle box.

2. **Creating the Dataset**

- Import the libraries. Next we capture few sample images of the person face from live camera.

- Assign certain ID to capture the captured images.
- Save the samples in the folder called “Dataset”.

3. Training over Dataset

- We created a dataset and now create trainer folder.
- Import pillow library.
- Initialize the recognizer and face detector.
- Load the training images from dataset folder
- Capture the faces and ID from the training images and put in a list of IDs and face samples and return it.
- Save the file and trainner.yml will be generated.

4. Face Recognition

- Import the libraries.
- Load the recognizer and haarcascade file.
- Create a video capture object and convert the image to grayscale.
- Detect the face in object.
- Recognize the ID from the available data in trainer.yml file.
- Create a rectangle over the face and print the ID(name) of the person detected over rectangle.

RESULT

Figure 6 : Dataset

Figure 7 : Face Detection

Figure 8 : Face Recognition

VI. CONCLUSION

The project "**Smart Doorbell System using IOT**" is successfully implemented using ESP32cam module and Blynk app with other hardware components. This project will help the owner of the house to know who is standing near the door through blynk app and also can control the lock by seeing the person. The same process is automated with the help of Dataset images and Machine learning techniques. Face detection and recognition is done by using Python open cv.

VII. REFERENCES

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