

Smartonus - A Home Security Surveillance System

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Abstract

Security has regularly been a pressing issue with our home or workplace. The objective of the work is to aid the user with an easy and custom technology to effectively manage guests flowing to his/her premises. An overseas home security system offers more advantages aside from keeping home homeowners, and their property, safe from intruders. It allows the users to observe guests in real time via the sensible push button put in close to the doorway. The bell is connected to a camera. Once somebody presses the bell, the person's face is captured. The captured faces are cross documented with the database. If the face is recognized a particular OTP would be sent. If there's a confusion within the face recognition then another security possibility pops up. This is where we tend to use voice automation to upgrade the protection level. An exact speech has to be spoken by the person if it matches with any of the info index, then a particular OTP is distributed to the person. If someone rings the bell and fails both the face recognition and voice automation then they're mechanically connected to the house owner. A pic of the person's face would be sent to the house owner and the voice automation would allow them to have oral communication. The house owner will then opt to allow them in if they recognize who it is or they will decline the request to enter the house. This technique is used to benefit the elderly to spot the unauthorized people. The technology rate is always growing and expanding and with that in mind, we need to keep up with the technology and update our home security system to make our life safer.

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1. Introduction

A Doorbell is an object that is placed at the front of door, so that a person can catch the owner's attention when they are at home. Doorbell system has been present since the early 1800's. As civilization increased the complexity and purpose of doorbells also increased. In the era of immense technology we always try to find more ways to make our home safe. The objective of this project is to create a doorbell using the best technology without making it very expensive

A RenesasMc, an embedded application is used in the project. It is used here instead of Raspberry pi as we

would have to add external ROM, RAM and other facilities. Renesas MC provides us with all the features and helps us with easy use. It uses advanced low power technology to give us the best output. It helps the user create energy efficient systems at a very low cost compared to the other embedded applications.

Machine learning is one of the leading interests in the world of technology. It is used in almost all upcoming technology. Machine learning allows the program to self learn and evolve. It learns for itself so it can find patterns which can be used later on such as patterns missed by the human mind. The patterns found could help predicting events or perform higher thinking processes. We use

machine learning to recognise the visitor, which would in turn allow them in if they are known. It helps detect the face and then it co references it with the database created.

GSM is a communication device used to communicate between two or more devices. It can be either a mobile phone or an electronic equipment device which is used to communicate over a network. It can be connected through a USB, serial or Bluetooth connection. AT commands are used to write the code required for communication. AT commands help GSM interact with computers. Communication median has to be present for information to be passed on or to be shared. It helps connect the intruder and the owner. This connection will allow the owner to gather all the information so that they can allow the intruder/outsider to enter their house.

The project tries to exploit the machine learning techniques to achieve a strong home security system. The traditional push button system does not provide much security. In the traditional system an outsider will push the button and it will make noise to gather the owners attention at home. If the owner is not home they wait for a certain amount of time and leave. We are trying to use the latest technology available to create a security system which will create a safer environment and help remove certain drawbacks of the push button.

In the present system, security combines the functions of smartphones and home security systems. This system allows the owner to view the guest without opening the door. It helps verify the outsider by capturing their image and verifying it with the database provided. The face is verified via face recognition and proof of image is sent to the user via email. The user can check the image as per their convenience. It also aids to bifurcate people into familiar and unfamiliar people based on the database provided.

2. Literature Survey

The purpose of a device that calls or notifies someone's presence at the gate or door is quite old. In the olden days, we had the traditional bells or knockers which we used to attach to our main door. Commercial owners such as grocery vendors used to keep bells on top of their door in order to get notified about an entry of a customer. In the early Sars Catalogs, doorbells which can be moved by twisting the wrist to open were used to alert. Only in 1831 did they invent a device which is in the form of an electric signal to alert.

[1] Ayman Ben Thabet et. al presents a paper in which they do not have a backup in case the Face Recognition doesn't work, we have taken that drawback and added that to our advantage by implementing a call option.

[2] Caroline El Fiorenza et. al presents a paper in which a similar plan was used to invent a doorbell using IoT modules. This module speaks about how the home security systems which exist these days try to resolve errors regarding the drawbacks of security, though most

of them were found to be operating on sensors. Hence they have decided to incorporate video mechanization into making smart home security systems.

[3] Nashwan Adnan Othman et. al presents a paper in which in case plan A fails, there was no communication between the house owner and the visitor.

[4] Prashant Balraj Balla et. al presents a paper in which any changes in the appearance would lead to the malfunction of the technology, providing no other option than to take the picture again.

[5] Abhishek Jain et. al presents the paper in which the implementation involves a Microprocessor meaning they don't include RAM, ROM or other peripherals, we would have to add it externally for it to function.

Another research, [7] which is presented by Huseyin Kusetogullari et. al shows the implementation of a related ideology for implementing a smart doorbell. The theory was that the systems which bring up solutions were mostly implemented with a number of devices containing sensors

Smartonus is designed in such a way to keep the user in check if the visitors who enter the premises which in turn maximise the security options. The system could be a sensible buzzer that permits individuals to check, hear, and communicate with the visitor who appears at the front door via their mobile phones to avoid communicating in person..

This work presents 'Smartonus', which focuses on automated doorbell systems. which are designed in such a way that when an unknown visitor arrives at the door, the owner will receive an email and get a phone call alerting that someone is present outside. The owner then has an option to approve the visitor inside the residence or not. The main objective was to provide security and to keep the owner updated about any unauthorized people entering the site.

In this proposed theory, we will have a dataset which will include the images of authorized people which can be done by the process of registering the required images of the faces which will be captured by a camera. An OTP system will be put into place with the aim that the visitor will only be allowed in once the owner accepts. When the visitor approaches the door and presses on the calling bell, it triggers the camera into capturing images of the visitor. Followed by which, it is run through the database to check if the image is existing or not. However, the owner would still be receiving an alert email which will contain the image of the visitor. If in case the image is turned out to be fuzzy and can't be detected, there is a call option which can be used to speak with the owner. If that doesn't work due to technical issues, a message will be displayed on the LCD screen which is used to intimate the visitor.

3. Proposed Methodology

Smartonus allows the Owner to accept or reject the request of unknown visitors into the premises. Overall implementation can be referred from Figure 3.

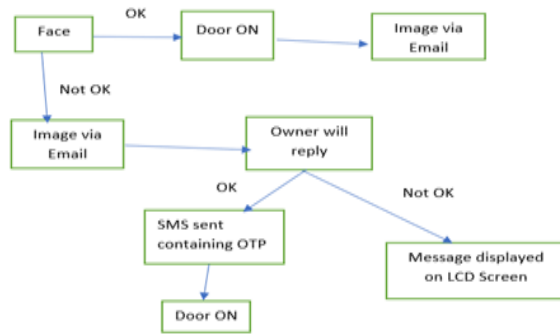


Figure 1: Workflow process

The workflow process as Figure 1 describes will be:

1. The visitor arrives at the door and presses the doorbell, requesting for entry.
2. This triggers the camera and a picture is taken of the visitor, followed by a call which alerts the house owner, if unknown.
3. The image is processed and sent to the database where in the face is checked for a match with the existing faces.
4. If a match is found, the door is unlocked and an email of the image of the face is sent to the house owner (for information purpose)
5. If the face is not verified in the existing database, an image will be sent to the home owner via email and a call is placed so that the owner will be inform that there is someone at the door
6. The owner then decides whether to grant access or not, which will be updated over the server
7. If he grants access, an OTP is generated allowing the visitor to enter into the premises, and if not, a message will be displayed on the LCD screen which will intimate the visitor.

The main connectivity would be as follows:

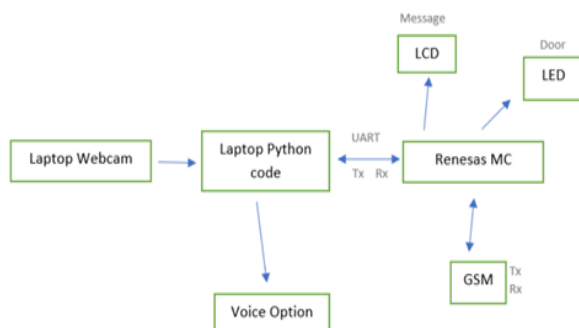


Figure 2: Block diagram of the process.

3.1. Capturing the Face

A webcam will be used as a median in order to do so. Once the doorbell is pressed, it triggers the camera into capturing live images. To invoke this when the visitor pressed on the doorbell, the following pseudo code will be used to trigger the camera to switch on:

```

cam = cv2.VideoCapture(0);
while True:
    ret, img = cam.read();
    cv2.imshow('Face',img)
    if cv2.waitKey(30) & 0xFF == ord('q'): break
    To detect the presence of a face in the image, this
    following code can be further altered, which will give an
    output as shown in figure 4.
    detector= cv2.CascadeClassifier('...path...');
    cap = cv2.VideoCapture(0);
    People_Count = 0
    while(True):
        ret, img = cap.read()
        gray= cv2.cvtColor(img,
        cv2.COLOR_BGR2GRAY)
        faces = detector.detectMultiScale(gray, 1.3, 5);
        for (x,y,w,h) in faces:
            cv2.rectangle(img,(x,y),(x+w,y+h),(2,0,15),5)
            area = (x, y, x+w, y+h)
            People_Count = People_Count + 1
        print (People_Count)
        cv2.imshow('frame',img)
        if cv2.waitKey(1) & 0xFF == ord('q'): break
  
```

3.2 Facial Recognition

Once the camera captures the images, a machine learning algorithm (Haar Cascade) will be deployed which will help in detecting the face in each image received, described by Figure 4.

A python script will be integrated into the IC of the Renesas Microcontroller. The code will make use of OpenCV libraries and the Haar based classifiers to detect and track faces.

Certain measurements and locations have to be specified in the face cascade so that it can detect the face.

The face will first be identified and then checked if it exists in the database.

3.3 Generation of the OTP

A random OTP is generated each time which improves the security of the premises. This blocks the visitor from entering the old OTP in order to gain access inside.

3.4 GSM Modules

This will mainly be used for the purpose of alerting and notifications. AT commands are written and are integrated with the code. Since we give more importance to calls rather than email notifications, a call would be placed via the GSM module so that the house owner will be alerted and the owner can grant or deny access via the same.

4. Result and Discussion

In a modern world like ours, almost everyone carries a smartphone. Our system helps you keep you and your families safe with just a few simple steps. There have also been reports where 60% of convicted burglars said that the installation of security systems influenced their decision to

target a different, less secure home. Hence, we aim for a doorbell system that is as efficient and lesser in price, something that everyone can afford which is what is proposed in this paper. A doorbell system that not only focuses on the needs of the elderly but also is affordable to lesser class individuals. The system would help create a comparatively safer environment for one's family.

In simpler terms, once the visitor has been authorized by the owner, they are allowed to enter the premises. On the other hand the non-authorized person can be communicated via speech and a message will also be displayed on the LCD as an extra option.

Another addition to the system is an LED, it acts as a substitute to the door. It is an indication of when the door is opened and when the access is granted. The authorization process will happen via the OTP (one time password) which can be seen on the LCD. Once the OTP is entered the visitor is allowed inside the residence. The password is unique for each person, as any intruder could copy the same OTP used previously and intrude the residency. This system will provide the user with more security and hence keep their residency safe

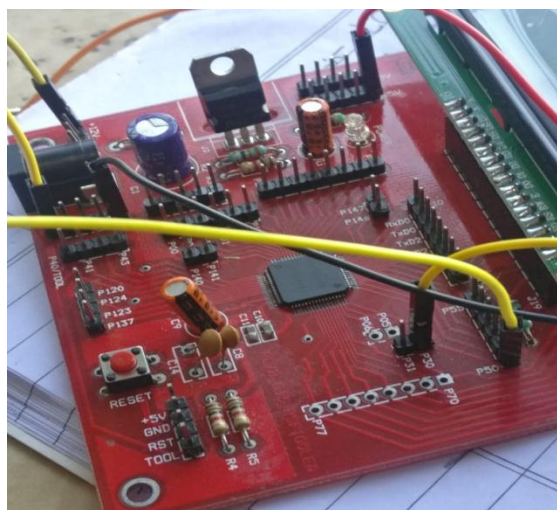


Figure 3: Renesas MC

Fig.3 is an image of a Microcontroller that is used in this work. Renesas is a 16 bit Microcontroller. It consists of 64 port pins and is asynchronous which helps in making the process faster. It mainly has 3 sections

1. Communication
2. Power
3. Controller

It also has 3 UART for Serial Interface Renesas is operated with 5v power supply.

The figure 2 helps you understand the entire process in a diagram. The Process starts with the camera and ends with the system working. The software and the hardware are connected through the Tx and RX. The Tx and Rx indicate transmitting and receiving between the Microcontroller and the python code.

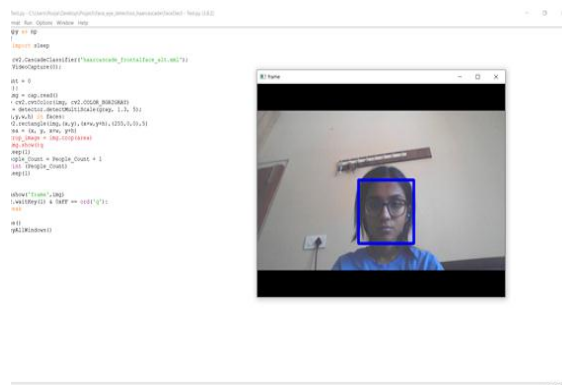


Figure 4: Output received for testing the camera

Finally, after running the code for a live camera which is to be placed outside of the residence is tested. The above image will help you understand how a camera uses face recognition to scan a particular person's face. The blue box around the person's face is how the detection occurs. The image is then searched in the database.

If the face is identified then the person can enter inside the residence or the person whose face is not saved in the database will not be allowed to enter directly.

The Renesas MC is used to combine all the hardware parts together as it is ideal for general purpose small electronic devices. The power consumption is comparatively low, but has a high performance rate.

The software which we would be implementing is the Cube Suite +. We type in the code here and then we would be using Renesas Flash Programmer to dump the code into the IC of the microcontroller, which can be seen in Figure 3.

A LCD screen is used to display the message and is used to enter in the OTP number as the outsider and the owner need a median of communication. This is also where the GSM comes into place. It acts as a median for the owner and the Outsider to talk via call or see the message sent by the owner.

In this proposed system we are using a LED light as a substitute for the door. If the person is part of the database then the LED light will blink on as the person is allowed to enter the premises.

5. Conclusion

A smart doorbell system allows the person inside your residence only if you approve them to, being secure couldn't get any simpler. In a world like today's where homes aren't secure, owning a smart doorbell system could benefit us in many ways. In simple words, a camera captures the image of the person who wants to come inside the residence and the image is sent to the respective owner who then decides if they want to let the person in or not. If the owner approves the guest, an OTP is sent which can be entered by the guest and only then is allowed inside the residence. There are other projects where the owner is notified through a text message or through an app. But this

work intends for a simpler and a cheaper solution. A call option is added where the owner can answer quickly and is also very efficient since it is way more noticeable than an email or a message. In conclusion, a smart doorbell system helps you feel safe in today's time and is also very convenient.

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