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Abstract—Security has always been an important issue in the home or office. A remote home security system offers many more benefits apart from keeping home owners, and their property, safe from intruders. The system is composed of the Doorbell interfaced with Raspberry pi, whoever press the doorbell, the camera gets triggered and capture their face and it checking for their face with its database which already has registered faces, if it is an authorized person door will open, otherwise it sends an OTP with their photograph of the intruder to server mail. Only when non authorized person entered that OTP, that face gets added to the authorized person's database to open the door. Smart doorbells allow home owners to receive alerts when a visitor is at the door, see who the guest is, and communicate with the visitor from a smart device. They greatly improve people's life quality and contribute to the evolution of smart homes

Index Terms—Face Detection,home security,voice recognition,fingerprint.

I. INTRODUCTION

A remote home security system is growing need of the hour to protect our home from intruders. The system is composed of a camera interfaced with Raspberry pi, whenever the doorbell is pressed, the camera gets triggered and capture their face and it verifies its database which already has registered faces.

In this system, security that combines the functions of smart phone and home network system. It enables the users to monitor visitors in real-time, remotely via the IoT-based doorbell camera. These captured visuals are also processed for finding potentially harm causing objects. This system makes security as further autonomous by capturing the image automatically and processing the image for facial matching and uses mail communication to the server to confirm the intruder is known or unknown.

II. EXISTING SYSTEM

In an existing system, there is only facial recognition-based security system and the main drawback in this system is that whoever having the face data in the database it allows that person, whereas it doesn't look for any unknown faces.

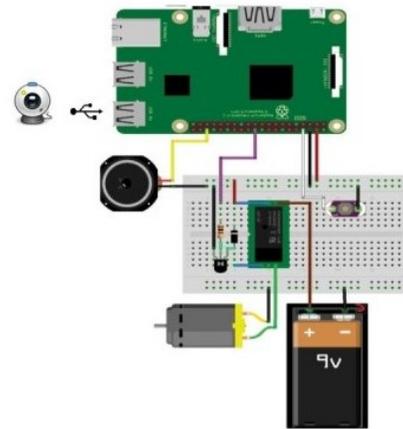


Fig. 1. Existing System.

III. LITERATURE SURVEY

A. ENHANCED SMART DOORBELL SYSTEM BASED ON FACE RECOGNITION

In this paper [1], Face detection is also called as facial detection is an artificial intelligence (AI) based computer technology used to find and identify human faces in digital images. Facial recognition system uses biometrics to map facial features from a photograph or video. It compares the information with a database of known faces to find a match. Facial recognition can help verify personal identity, but it also raises privacy issues. This paper aims to replace costly image processing boards using Raspberry pi board with ARMv7 Cortex-A7 as the core within OpenCV library. This project is mainly based on image processing by porting the OpenCV library to the Raspberry Pi board. Algorithm for face. In this paper, face recognition is initiated by pressing the doorbell button. Indeed, an integrated camera will capture several pictures of the visitor. The face recently scanned will be

verified in the present database. In case of unknown face, a template will be generated then stored. Otherwise, in case of known face, actual template is matched with templates stored in the database. Furthermore, the owner will be notified, through his mobile phone recognition, based on principal component analysis (PCA), is programmed and implemented on the platform. This paper reviews the related work in the field of home automation systems and presents the system design, software algorithm, implementation and results. The main goal of this paper is to create an intelligent doorbell system mainly based on human face identification. To achieve the described functioning, we subdivide the face recognition process into three Extraction and Face Recognition. In this paper, face recognition system has been developed in order to study the potential application for home automation door security with real time response and better recognition rate. The data that is collected during the face detection is a personal data that may be misused. so, it must be secure with good securities practices.

B. RASPBERRY PI BASED SMART DOORBELL SYSTEM WITH ADVANCED ENCRYPTION SCHEME

This paper [2] aims as to discuss the IOT based doorbell with enhanced security features at a small cost with the help of Raspberry pi toolkit. This new concept includes the security concerned issue in an effective manner. Our paper aims as to connect any door system with internet and to make it more secure with help of MAC scheme. When you click the doorbell, the following form of notifications can be sent to the user's mobile appoint is a communication between outside and inside user when a phone call enables. The call will be activated using the GSM module connected to the Raspberry Pi. A speaker and microphone interfaced with the system enables the voice communication between the two persons at both ends. A snapshot of the person at the door. A script written in python is used to capture the image using the compatible webcam interfaced with the pi and to attach and send it to the user through mail. A text message with current time will be sent to the user using the GSM module. Proposed design in this paper is we are using concept of message authentication code. When you send a message from sender to receiver part then as we already discuss about firstly it takes snap from camera module and for motion, we detect it part then it sends a message to receiver. But when we are sending message to receiver then it is not fully authenticated sometime intruder can crash it. So, to overcome this problem we do an encryption technique to make doorbell system more strong and powerful.

C. AN IRIS AND VOICE RECOGNITION SYSTEM FOR A SMART DOORBELL

This paper [3] aims to discuss doorbell system is using both iris and voice recognition to verify the identity of the user who rings at the door. Since there is the involvement of biometric data, this information has to be properly handled. In particular, we designed our system in such a way that

it can avoid to send or store any biometric data to the cloud. Iris Recognition is a biometric method of identifying people based on unique patterns within the ring-shaped region surrounding the pupil of the eye. Every iris is unique to an individual, making it an ideal form of biometric verification. Voice recognition is the ability of a machine or program to receive and interpret dictation or to understand and carry out spoken commands. The doorbell system is using both iris and voice recognition to verify the identity of the user who rings at the door. Since there is the involvement of biometric data, this information has to be properly handled. In particular, system is designed in such a way that it can avoid to send or store any biometric data to the cloud. The major two blocks focused in this paper are speaker identification block and iris recognition block. This paper focuses on the design process related to a Smart Home solution, which involves a system, like the AXIOM platform, capable of performing the extraction and analysis of biometric features of voice, face and iris using as input the recordings of the voice and iris capture. Previous work on smart doorbell has been performed on voice and iris recognition separately but in this paper combination of both voice and iris recognition is seen. In this paper smart doorbell system is thus experienced combining a novel Cyber-Physical Board called the AXIOM board with a standard doorbell system, in order to provide a convenient acceleration of compute intensive recognition functions, such as voice-recognition and iris recognition via machine-learning techniques. We can gain a better performance and also energy reduction. Iris detection is very costly and requires too many datasets, also it is very complicated. the install of the iris detection modules is also not possible handy products. as it requires too much of high-end machines.

D. SMART DOORBELL SYSTEM BASED ON FACE RECOGNITION

This paper [4] aims to discuss how to recognise a face is introduced face recognition system is an intelligent application which can recognise or confirm a man from advanced sources. This project uses the Eigen faces algorithm using OpenCV library to perform face recognition. The main goal of this work is to form an intelligent doorbell system based on human face identification. The primary half involves the face detection with the help of hair like filters then look for likeness within the database entries. A system with the ability to distinguish and recognize faces has numerous potential applications including crowd and airport surveillance, private security and enhanced human-computer interaction. In this paper, how to recognize a face is introduced; for evaluating the proposed system, the author has used two analysis algorithms which are Eigen face and Independent Component Analysis (ICA). Face recognition have various advantages like increase in security and airport surveillance, it also advances the human-computer interaction in a better way. A system proposed here will aid people having hearing impairment or are completely deaf, to intimate about someone on the door. People suffering from loss of hearing face difficulty in knowing the presence of any

visitor at the door using conventional doorbells. This system uses facial recognition to intimate the owner about the person's identity and if the user is unknown to the user, it will ask to add the person to the database or no. The system is based on the criteria of low power consumption, resources optimization, and enhanced operation speed. This paper reviews the related work in the field of home automation systems and presents the system design, software algorithm and implementation. This project is mainly based on image processing by porting the OpenCV library to the Raspberry Pi board. The proposed system mainly consists of two parts, which are pre-processing and image recognition. Face recognition approach offers a great advantage which is user-friendly, easy to build, cheap at cost and effective. Face detection can be further enhanced using voice recognition. We can also develop the same system in 3D using Hadoop we can inculcate call-handling by an IMS-HHNB based interface doorbell.

E. SMART SECURITY SURVEILLANCE USING IOT

This paper [5] aims to discuss a system proposed for development of security surveillance system using Raspberry Pi along with PIR motion sensor and camera module. Smart security surveillance using IOT with PIR sensor and camera module is an interesting idea to involve detection of sensing of the moving object and generate responses for better security. Experimenting with PIR sensor in association with camera module for detail understanding of the motion sensing and thereafter triggering of the camera module and detection of intruders on real time basis. The proposed system is based on PIR sensor and camera module connected to Raspberry Pi along with other system peripherals. In this paper, the work has been done using sensor and camera, the system detects motion in front of the door and captures an image which is then sent to the user's cell phone along with the image in the email inbox and a detection message. A camera module is deployed to capture the picture of the visitor and stream a video on the basis of a passive infra-red PIR sensor. In the future, AI can be added to the system for identification and recognizing the gesture of the visitor using CV. The proposed system using PIR sensor and camera module can be further enhanced for face detection and recognition based on a threshold of changes and using CV. The proposed system using PIR sensor and camera module can be further enhanced for face detection and recognition based on a threshold of changes and using CV.

F. VOICE BASED HOME AUTOMATION SYSTEM USING RASPBERRY PI

This paper [6] aims to discuss a Voice Based Home Automation System, the idea which corresponds to a new era of automation and technology. Voice Using Raspberry Pi, this project is very useful for old age people and disabled people, basically for one's who cannot perform basic activities efficiently. In this paper, the main aim is to control electrical home appliances by android voice commands using Wi-Fi as a communication protocol between Raspberry Pi and an android device. In this paper, work has been done on android

application where a user will provide voice commands for controlling devices such as "Turn light on" which will be connected to Raspberry Pi and according to it the required process will work via Wi-Fi. Technologies used in this paper are Raspberry Pi and Android. Working of the system in the paper is that the voice command is given as input to an android device which is connected to Raspberry Pi and the output from Raspberry Pi is given to a relay switch. The relay switch is connected to an electronic device which does the main function of switching on/off. Further, this paper can be enhanced by giving voice authentication to provide security. The smart Doorbell can be made by implementing voice and video calls with the person standing right outside the door and the owner remotely. We can also add sensors, by using sensors we reduce the effort of declaring each and every device a particular name.

G. SMART BELL NOTIFICATION SYSTEM USING IOT

This paper [7] aims to discuss a Smart Bell Notification System using a microcomputer, Raspberry Pi, camera, PIR sensor, Buzzer. This paper signifies the steps towards the smart home and living. In today's day to day life there is inconvenience in trends if delivery is faced by a customer and a delivery person if the concerned one is not present at his home. It gives the idea about the same doorbell which is helpful for the friends and relatives who visit our place unannounced. Using the microcomputer, 'Raspberry pi', the smart doorbell, it solves the problem of visitors remaining unattended in case the concerned person is not available. This smart doorbell alerts you when the bell is rung and lets you see and speak with visitors from your smartphone, anytime and anywhere. The medium of the course is INTERNET. The doorbell system also includes an inbuilt "Face Recognition" Module which distinguishes between the known persons and unknown persons. It also enables and disables the notifications based on the user's preference. A limitation of the system is that the medium of the course is Internet but sometimes if the internet is not stable in user's smartphone it will fail to alert about notification. So, we will include an SMS system to give notification. The user will be notified when the doorbell rings even though if the user's internet is not stable or the user is not online.

H. FINGERPRINT MODULE BASED DOOR UNLOCKING SYSTEM USING RASPBERRY PI

This paper [8] aims to discuss a Fingerprint Module based Door Unlocking System Using the Raspberry Pi microcontroller. Fingerprint recognition is one of the most popular methods of biometric technology as compared to other biometrics such as face, voice, and retinal scan. Fingerprint recognition can be considered more natural. The hardware components are described which are used for the doorbell system. Raspberry Pi 3 Board, Fingerprint Module, Relay, USB Web camera, Buzzer, Solenoid Lock. The Raspberry Pi considers the input from the fingerprint module and when the details match then the system automatically provides access to the owner by unlocking the door using a solenoid lock. The system also captures the image of the intruders and

subsequently sends an email with intruder alerting message with the face image of the intruder to the owner using the IoT based Wi-Fi technology. Limitations The medium of sending the message with the picture of intruder is Internet. So, if Internet connection is not working well the doorbell system fails to alert So, we can implement the system by adding SMS system, so there is no need to depend on internet only.

I. APPLICATION AND DESIGN OF AUTOMATION COMMUNICATION DEVICES

This paper [9] aims to discuss, Application and Design of Automation Communication Devices. Digital doorbell designed which includes the special features, they are as followed: The digital doorbell can provide some LCD text and voice prompts, which is very useful for the visitors. The digital doorbell can "remember" the information of visitor, then the owner will know when he is not at home. This doorbell plays different music when different visitors will come. Besides a doorbell, it can also be used as a ordinary clock by adding Real-time clock or calendar circuit which provides seconds, minutes, hours, day, week, month, year information. Limitations of the system is we may need to pay for monthly cloud subscriptions to enable you to have a continuous recording of videos recorded.

J. ACCESS CONTROL OF DOOR AND HOME SECURITY BY RASPBERRY PI THROUGH INTERNET

This paper [10] aims to discuss, Access Control of Door and Home Security by Raspberry Pi Through Internet, A new system is design which would control the door through the internet. The raspberry pi micro controller is used to capture all the signals. The mini raspberry pi has different input and output interfaces. The input section consists of calling bell, PI sensor and wireless camera. And the output section contains the led, magnetic lock, emailing and tweeting services. As soon the raspberry pi captures the signal the webcam gets activated and takes a snapshot of the visitor and also activates the alarm buzzer so that the user comes to know about the presence of the visitor. These data of the visitor are then sent to the user by email. If the user wants to give the access to visitor the doors open using the servo motor. The user can see from anywhere that who is visiting the door. The system also keeps the picture of the visitor. The limitations of the system is that it completely depends on the Internet connection to communication with the user and send the details. So, the system can be implemented the using SMS system.

K. DASH BELL: A LOW -COST SMART DOORBELL SYSTEM FOR HOME USE

This paper [11] aims to discuss, A low cost smart doorbell system for the home use. Doorbell are playing an important role in protecting the modern homes. When the user is not a home there is no any medium through which the user will get to know about the visitor visiting the door, or their no such a smart medium to keep the record. Due to these the smart doorbells came into picture. To solve these problems

the doorbell can be simply connected to the user's smart device such as a computer, mobile or a tablet through which the user can communicate with the visitor and also can keep the record. However, such Doorbells are expensive due to technical and manufacturing difficulties. To solve these problem Dash bells was introduced. Dash bell is a low-cost bell which consists amazon dash button to serve the doorbells. It is connected through Internet through which the user can communicate easily with the visitor with any smart device and from anywhere. As Dash bell has several useful features, but it has few limitations there are many security and privacy issues with the Dash bell. Since the device is connected to home Internet network the unauthorised user can still the data. So, there is need to keep the network secured with password. As the system is completely depend on Internet so many issues occur. So we are implementing message system so that the system will not depend on the Internet all time and the unauthorised cannot access it easily.

L. IOT SMART BELL NOTIFICATION SYSTEM: DESIGN AND IMPLEMENTATION

This paper [12] aims to discuss, IOT Smart Bell Notification System, implementing a security system that combines the functions of smartphone and home network systems. It enables the users to monitor visitors in real-time, remotely via the IoT-based doorbell installed near the entrance door to a house. When a visitor is on the door and pressing the doorbell, the device records and sends the CCTV of the visitor to the user. Our system provides a convenient user interface for the user to view the CCTV and take appropriate action accordingly. This is implemented by interlocking with the real-time SMS server that sends a warning message to the user when the doorbell is pressed. Or in case an outsider breaks into the house, the system can help identify the trespasser by acquiring CCTV evidence. Furthermore, this system can be used to report to the police or home security service provider immediately when a trespass occurs. Our smart bell system presented in this paper supports video, saving images, warning notice, GUI features. Existing products use the transmission protocol and use the internet standard protocol. There is an advantage that it is easy to access the system. More features can be implemented like voice recognition and face recognition functionalities can be augmented to strengthen the security system. The limitation of the system is delay in data transfer from the doorbell unit to your smartphone.

IV. PROPOSED SYSTEM

In this proposed system, we are having database of authorized person list by registering their faces by entering OTP, so that non authorized person can't able to enter the home until they entering the OTP. Whenever some person presses calling bell switch, the camera gets triggered and capture the image of the intruder and checks that the image to the database, if that face is not matching with the database, it sends an email containing that intruder image and OTP, when intruder type the OTP by the owners' knowledge then it allows to enter.

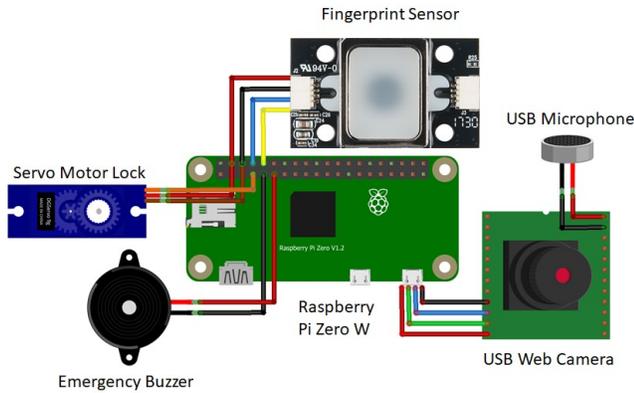


Fig. 2. Proposed System.

With face detection the system will be accompanied with voice recognition method which will add more updated face to the system. Voice recognition will be based on the detection of voice and speech. Also, the system will be equipped with motion detection system.

V. METHODS

1) Image Processing

Image processing, set of computational techniques for analysing, enhancing, compressing, and reconstructing images. Its main components are importing, in which an image is captured through scanning or digital photography; analysis and manipulation of the image, accomplished using various specialized software applications; and output (e.g., to a printer or monitor). Image processing has extensive applications in many areas, including astronomy, medicine, industrial robotics, and remote sensing by satellites.

2) Digital Signal Processing

Digital signal processing (DSP) is the process of analysing and modifying a signal to optimize or improve its efficiency or performance. It involves applying various mathematical and computational algorithms to analog and digital signals to produce a signal that's of higher quality than the original signal.

3) Speech to Text Processing

Speech-to-text technology is a type of technology that effectively takes audio content and transcribes it into written words in a word processor or other display destination. This type of speech recognition technology is extremely valuable to anyone who needs to generate a lot of written content without a lot of manual typing. It is also useful for people with disabilities that make it difficult for them to use a keyboard. Speech-to-text technology may also be known as voice recognition technology.

VI. EXPECTED THEORETICAL RESULTS

The expected theoretical results will be as follows:-

- The face detection would be carried out with at least 97% accuracy.
- The voice recognition module would be working with speech to text and would be working with at most 98% accuracy.
- The whole mechanism would be running on minimum power usage and maximum efficiency.
- The motion detection would be carried out for real time harmful objects.

VII. CONCLUSION

This system can also be reconfigured to detect the intruder who are not pressing the doorbell, whose face get captured and follows the same authorization process to know the intruder who tries to open the door. Which can be very useful to monitor the home remotely. And also, for the owner the system will behave in another manner where it will not perform the same process for the owner i.e. processed for an unknown person it will just recognize the voice and face and the door will be opened.

REFERENCES

- [1] Alvarez et al., "The AXIOM software layers," ELSEVIER Microprocessors and Microsys., vol. 47, Part B, pp. 262–277, 2016.
- [2] R. Giorgi, "Exploring dataflow-based thread level parallelism in cyber-physical systems," in Proc. ACM Int.l Conf. on Computing Frontiers, ser. CF '16. New York, NY, USA: ACM, 2016, pp. 295–300.
- [3] R. Giorgi, F. Khalili, and M. Procaccini, "Axiom: A scalable, efficient and reconfigurable embedded platform," in IEEE Proceedings of Design, Automation and Test in Europe (DATE), Florence, Italy, mar 2019, pp. 1–6.
- [4] R.L. Hyoung, H.L. Chi, "Development of an IOT based visitor detection system," IEEE Trans. 2016.
- [5] S.N. Jyothi, V. Vijaya, "Design and Implementation of real Time security Surveillance system using IOT," IEEE Trans. 2016.
- [6] Alessandro Sforzin, Mouryo Conti, Felix Gomez Marmol and Jens Matthaiahs Bohli, International IEEE conferences on Ubiquities Intelligence and Computing, Advanced and trusted computing, Internet of people, and smart world congress, IEEE 2016.
- [7] M. Virginia, P. Vamsrikrishna, "Surveillance and monitoring System using Raspberry-Pi and simple CV", IEEE 2016.
- [8] Chao-Huang Wei and Shin-An Chen. "Video Door Phone Surveillance System Using power line Communication Channel", International Journal of Computer and Electrical Engineering, Vol. 5, No. 4, August 2013.
- [9] B.P. Priya, M.C. Viraj, "Smart Motion Detection System using Raspberry-PI," International Journal of Applied Information System (IJ AIS) 2016; 10:37-40
- [10] C.Y. Jie, L.L. Chin, "An Automated Door control system based on a smart camera," Sensors 2013; 13:5923-5936.
- [11] R.L. Hyoung, H.L. Chi, "Development of an IOT based visitor detection system," IEEE Trans. 2016. S.N. Jyothi, V. Vijaya, "Design and Implementation of real Time security Surveillance system using IOT," IEEE Trans. 2016.