



Smart Home

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Abstract: Smart security system will protect your house, valuables and to keep your family safe. A smart doormat and a smart door is developed to ensure a Smart home. The doormat containing sensors. The camera which is placed in the door will capture the image and send this image as a message to the user. The door will open by scanning face. The face recognition system will store the faces of all the members in the family. If the person is not a member then the door will not be opened and an alert message will send to the users phone that message will contain an OTP number. After entering the OTP the door will be opened. In case if a thief is trying to break the door or trying to enter into the house then a doormat containing sensors is provided along with this. When a person steps into the mat an alert message will be sent to the owner and make an alarm.

Keywords: IoT, PIR Sensor, Ultrasonic Sensor, Local Binary pattern (LBP), Raspberry pi 4

I. INTRODUCTION

A home security system means protect your home and keep safe valuables, and to keep your family safe from potential break-ins by burglars and thief. In the United States, there is a home related burglary that takes place every 13 seconds, 4 burglaries a minute, 240 an hour and nearly 6,000 a day! some of the statistics are 88% of all burglaries are 77% of all crimes are property crimes, 38% of all robberies are committed with guns, identity theft is the fastest growing crime everywhere. 3 out of 4 homes in the U.S. Will be broken within the next 20 years. By using IoT and face recognition, the proposed system delivers a cost and energy efficient solution for home security. IoT will enable sensing and triggers system on motion detection using sensors such as Pir (Passive Infrared) for motion detection and to calculate position of person in front of camera for distance measurement Ultrasonic is used because face detection module has good performance in some conditions which specifies the distance between the person and the camera should be less than 240 cm, person doesn't use accessories that cover part of face. When in case of testing using real time images, LBP based Face recognition system is used which provides 80% of accuracy. Person should stand in front of the camera and then the camera will recognize the face which is then compared with the faces stored in the home member database stored in raspberry pi. If the face found the matches, the door will be automatically unlock else it will remains locked.

II. THEORY

A. Internet of things

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The definition of the Internet of Things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smart phones and smart speakers.

B. PIR Sensor

The PIR (Passive Infrared) sensor used is HCSR-501. the sensor is usually used for human and motion detections. it is a digital sensor that senses the presences of human beings. human body emits thermal emission of the range 0.8- 0.14nm. the PIR sensor captures these thermal emission and gives 1 or 0 for presence or absence of a human being. the range of the sensor is 10-15cm.



C. Ultrasonic Sensor

Ultrasonic sensors are intended to detect nearness or range utilizing ultrasound reflection, to compute the time it takes to reflect ultrasound waves between the sensor and any object. Ultrasound is chiefly utilized on the grounds that it's indistinct to the human ear and is generally precise inside short separations. Here it is used for distance measurement between camera and person because it is essential for better output by face recognition module.

D. Local Binary pattern(LBP)

The captured image will undergo image processing for face recognition, Local Binary Pattern(LBP) has been implemented using Python and OpenCV. face recognition considers both shape and texture information to represent face images based on Local Binary Patterns.

III. RELATED WORK

The aim of this paper [1]most physical exercises done on the grounds using mats which involves coordinated motions of different body parts and are difficult to recognize with a single body worn motion sensors. The focus is monitoring the latter. A characteristic spatio temporal contact and pressure pattern can be identified for each exercise . For tracking exercises such as push-ups, abdominal crunches and squats a sensor matrix is used. A resistive pressure mat as a new sensing modality for ubiquitously recognizing and counting exercises is introduced . The mat is thin, soft and low-cost and can easily replace traditional gym mats. The evaluation is split into two main parts. Firstly, we evaluate calculating rotation and translation from the pressure data for the exercises by using a kNN-classifier for classification. As a next part we describe how the exercises can be robustly detected and counted by utilizing dynamic time warping. To evaluate the counting algorithm templates for each exercise and each subject are calculated. The main advantage of this paper is More accuracy.

This work [2] targets people identification in video based on the way they walk .For learning high-level descriptors from low-level motion features CNN is explored. CNN allows to obtain state-of-the-art results using Spatio-temporal cuboid of optical flow as input data. Gait recognition is used in the context of video surveillance, ranging from control access in restricted areas to early detection of persons of interest. Here an end-to-end approach based on convolutional neural networks maps low-level optical flow, directly extracted from video frames, to learn and extract higher-level features suitable for representing human gait: gait signature. Firstly a preprocessing stage extract, organize and normalize low-level motion features for defining the input data and then a convolutional neural network architecture to extract discriminative gait signatures and after that validate the proposed framework on the standard TUM-GAID dataset for gait identification. Thus the framework address the problem of gait recognition using CNN. So computes optical flow (OF) along the whole sequence, so that build up a data cuboid from consecutive OF maps, then feed the CNN with OF cuboid to extract the gait signature, to decide the subject identity a classifier is applied. Comparatively easier to use is the one of the advantage of this paper.

This paper[3] refers to the infrastructure of connected physical devices which is growing at a rapid rate. The system will inform the owner about an unauthorized entry so whenever the door is opened by sending a notification to the user. Then the user gets the notification, so that he can take the necessary actions. In this uses a microcontroller known as Arduino Uno to interface between the components, a magnetic Reed sensor to monitor the status, a buzzer for sounding the alarm, and a WiFi module, ESP8266 to connect and communicate using the Internet. Home security is a very important feature of home automation. Therefore the main objective of our work is to alert the owner and others of an intruder break-in by sending a notification to their smart phones. The owner will also have the ability to stop or start the alarm using the smart phone. This system will help the users to safeguard their homes by placing the system on the doors or windows. The designed system informs the user as there is a break-in so that the user can take necessary actions. The sensors placed on the door informs the home owner as soon as the door is opened by sending a Push notification. The user will get this notification whether the phone is locked or unlocked or even if any other app is opened at the moment. This was the main objective in which is the user feels safe and not need to worry about any intrusions. The main advantages of such a system includes the ease of setting up, lower costs and low maintenance. it is Less expensive

In recent years, it is important to own a reliable security system [4] that can secure our assets and protect our privacy. The system primarily used openCV based face recognition system using Haar classifiers for face. The main processing element is Raspberry pi. The pi camera is employed to capture the image and send it to the authorized person for security purposes. The Telegram android application is used to control lock and unlock mechanism. The entry log every person thus captured using pi camera and picture is sent to the email address of the prescribed user. When a human is detected, the Pi camera captures the image of the person and sends the image to the remote user through mail. Haar face recognition algorithm is run on the captured image using OpenCV in the Raspbian on the basis of the images saved in the system. If the face is recognized then an authorized person is trying for the door access and hence, the door lock is opened. If the face is not recognized, then the user can check the mail for the image of the person trying to access the door and allow or deny the access of the door. If the user sends "allow" from the Telegram app, the door is opened and if the user sends "deny" from the Telegram app, the person trying to access the door is denied from accessing it. As a result if



a face is recognized the door lock will get open. If any other person comes to the home whose image is not stored in the data base that time the image of the person will get captured and sends the image to the authorized email. If the other person known to the owner then the owner will send a command like "on" through telegram app to unlock the door. One of the advantage is the software is quickly verify a customer 's image.

In this paper[5] The Internet of Things(IoT) has made it possible to set up a smart home security through which you can decide who can enter your home using your smartphone and web application. The web camera is used to connect to the raspberry pi accompanied by sensors such as Passive Infrared(Pir) and Ultrasonic sensor. On motion detection camera captures an image of the person in front of the door then real-time face recognition is done using local binary pattern (LBP). If person's image matches with one of the home members then the door will unlock, else doorbell will ring. if an intruder tries to break door then an alarm will be raised at the same time SMS and Email containing image of the intruder will be sent to the homeowner. Using Android application owner can also add new person's faces into the databases. Person should stand in front of the camera. a camera will recognize the face and compares with the faces stored in the home member database stored in raspberry pi. If the face matches found, the door will be automatically unlock else it will remains lock. After detecting motion, the system will check for the position of person i.e., the distance between person and camera. Here ultrasonic sensor will be used. Image will be captured and face recognition will be performed. If face match found door will open else red color bulb will light up, if the owner is at home then bell will ring else notification will be sent when someone is waiting outside your home. All these activities are stored in the database which is in microSD card in Raspberry. the main advntages are Cheaper and flexible

The problem with traditional door locks is that almost anyone can break into your house which can be easily done by duplicating your key or even breaking the lock[6]. The idea is to develop a smart IOT based face recognition system which recognizes the faces which are stored in the database. On recognition, the door would open and a welcome message is provided for the user. The owner would be alerted on an unknown user entry. An email containing the image of the intruder will be sent to the owner and based on this, the door opens or remain closed. So the owner can control his door from his phone or Personal computer. Here uses a Raspberry Pi 3 microcontroller, a camera installed near the door for facial recognition and a stepper motor to open the door lock. RaspbianStretch, an operating system for Raspberry Pi will be used. For face recognition, Local Binary Pattern Histograms (LBPH) algorithm is used. The system will compare with the local database after recognition. For face detection, Histogram of Oriented Gradients(HOG) is used. For face recognition, the algorithm used is Local BinaryPattern Histogram(LBPH). The main advantage is the system is cost efficient and even provides high security.

Systems capable of recognizing text in images and converting it into characters for editing on a computer are known as optical character recognition (OCR) systems [7]. A character recognition system for commercial advertising images and a text detection and recognition system for natural scenes are used. After the basic character recognition system is completed, integrate an improper words detection system to reduce the number of legal disputes. The main purpose of the text recognition system to be applied to natural scenes. These two systems will be installed on a Raspberry Pi development board. A tool used for character recognition is Tesseract-OCR. Image preprocessing techniques are employed to filter noise or enhance image quality. An image set from the ICDAR Robust Reading Competition and photographs taken were used as test data set. The image preprocessing algorithm was used to test the data set and highlight the text areas in the test data. Tesseract-OCR was employed to recognize text. The accuracy rate was higher when recognition was performed on numbers and English letters. The main advantage of this paper is More accuracy.

The main intent of the paper[8] is that biometric is a unique, measurable parameter of a human being. This can be used to automatically recognize an individual or verify an individual identity. With the help of biometrics the psychological and behavioral characteristics of human beings can be measured. It includes Finger-scan, Facial Recognition, Iris-scan, Retina-scan, Hand-scan etc. Behavioral biometrics include Voice-scan, Signature-scan etc. A biometric system is an integrated hardware and software used to conduct biometric identification or verification. Principal Component Analysis Algorithm with the classifier euclidian distance, normalized correlation and neural networks is used for the face recognition. This system use one physiological biometric (face) parameter for the more security purpose also GSM Module send recognition result in the form of SMS to the authorized person which increases the efficiency of Security. The main advantage is cost effective.

This paper [9] presents a face recognition system developed in Android for robust mobile phone face unlock verification of several users. Image recognition is the most efficient ways to perceive objects in the surrounding environment which is a useful interface. Digital photos or still frame capture from video stream are take as input. The system should recognize where the face is, to extract the facial area from the photo and to perform verification check. For validation checks, uses the features of the human face in quantifiable form. The human face is having around 80 different feature parameters like nose width ratio, distance between eyes, height of the eye sockets, facial bone form, width of the jaw etc. can be used as classification parameters. The main aim is to train a Neural Network, for the purpose of recognizing faces from photos or still frames from video streams. The first is gathering a training dataset in order to train the weight coefficient for the specific task. The input parameters from images are to be the input of the Neural Network and the trained structure is to perform classification based on the input facial feature vector.



In this paper [10] present an approach for person identification using morphing footsteps measured from a fabric-based pressure mapping sensor system. The proposed system detects the user identity by single footsteps without inter-step information while the person is walking as usual without any instrumentation induced distractions. It is covered with standard carpets to be integrated into modern smart living spaces, and can be rolled up for storage and transportation. In pervasive computing, person identification has been identified with various methods from close ranged facial, fingerprint, or barefoot planar pressure to further ranged activity-based vision, pervasive acoustic, planar pressure, etc. If the user step onto a single-point weight scale that is continuously measuring, can detect the person from the dynamic footprint pressure. A medical planar pressure mapping device is used and analyzed dynamic high resolution barefoot footprint. The data is sent to the computer through a USB cable which also powers the system. One of the advantage is flexible.

This paper [11] presents a person identification system based on acoustic and visual features. The system is organized as non-homogeneous classifiers and the outputs are integrated after a normalization step. Two classifiers based on acoustic features, three based on visual ones provide data on performance efficiency for an integration module. The resulting identification system can be used to log personal access and, with minor modifications, as an identity verification system. The speaker and face recognition systems are decomposed into two and three single feature classifiers. Normalizes the score. A mapping from the scores and ranks of the classifiers into the interval (0, 1) using a HyperBF network. The speaker and face recognition systems cannot be further decomposed into classifiers. Each of the previous cues can be identified by specialized sub systems and the resulting outputs can then be combined into a unique decision by some integration process. The main advantage is it is reliable.

This paper [12] presents a method for user tracking and localization based on textile capacitive sensor arrays, under the floor. The sensor array is a commercial product (SensFloorR) can be installed under any standard floor type and is able to detect objects placed on it. Footstep detection is performed online on the devices. This provide the user with context aware assistance and thus user activity can also be recorded. Indoor localization and tracking systems can rely on different sensor setups. Track users by means of Kalman filtering and present a probability based data fusion algorithm, for user identification. Multiple persons can move on the floor simultaneously, in which classified position corresponds to each person are tracked. Sometimes sensor signals from the SensFloor are noisy, making the position of classified persons "jump". A simple constant-acceleration linear model is used for each tracker. The main advantage of this paper is More secure.

The security and remote surveillance system is increasingly prominent feature on the mobile phone [13]. The system is developed to connect any door with the internet, and USB camera will be fixed in front of the door. PIR sensor is used for human detection so it enable and sense the human entry at nearby the door. USB camera will be turn on for 10sec and records the human's face at nearby the door. Then the captured video will be transmitting to the authorized person's system by using 3G dongle. Raspberry pi is equipped with 3G dongle. So after the person see the visitors face through web, if willing to allow the visitor inside the home then can press the pushbutton for open the door. When the system gets wrong password in three times, it signals to the door alarm. Evidence can be given to the security department if any robbery issue occurs. But the system needs to be monitored always. The advantage of this paper is Dramatically reduce the hazard of unauthorized entry.

In this paper [14], a real-time face recognition system for home security service robot is applied to recognize the person's face in front and assure warning when the identity of the person is a stranger. It used Local Binary Patterns (LBP) to detect face and cut out the face region. Then, the target face could be recognized utilizing Support Vector Machine (SVM). It works when multi-face recognition and stranger identification, which meet the demand of robot. Face recognition is a biometric identification technology based on human face feature information. The camera is used to capture the video stream, can automatically detect and track the human face in the image frame, and then recognize the human's identity. The face detection with LBP has good adaptation to the face angle and the face recognition with SVM can accurately recognize family members or strangers. The main advantage of this paper is More accuracy.

Internet of Things (IoT) conceptualizes the idea of connecting and monitoring real world things through the Internet [15]. This IoT project focuses on building a smart wireless home security system with alerts to the owner by using Internet. The microcontroller used is the TI-CC3200 Launchpad board which comes with an embedded micro-controller and an onboard Wi-Fi shield keeping all the electrical appliances inside the home to be controlled and managed. Wireless Home security and Home automation are the dual aspects of this project. The alerts and the status of the IoT system can be accessed by the user from anywhere even where Internet connectivity may not readily available. The owner, who may or may not be present in that building, will be getting a voice call on his mobile stating that 'There is an Intruder in the House'. Moreover if the owner finds that his building is not safe, he can send an SMS. The module will turn OFF the alarm and lights after a fixed time delay. The advantage is This low cost system with minimum requirements takes care of both home security as well as home automation

The main intent of the paper [16] designs face detection and recognition systems for smart home security application. The design is implemented using MyRIO 1900 and programmed using LabVIEW. The connection between myRIO and computer is wifi network. The image of a person is acquired through a Webcam connected to MyRIO using USB cable. The face detection system is built based on the template matching, while the face recognition is based on the



principle component analysis. By using real face, the process of opening the door will be more effective and efficient because it just needs to direct a face on the camera, so the camera can identify whether the person is allowed for coming in or not. By using the face, the level of security becomes higher because the face can not be duplicated. If the matching score is greater than the minimum score, then the face is detected. The image from the webcam is processed first by the face detection module. After that, the face vector is projected onto the principal component, then euclidean distances are calculated. The main advantages is it has more accuracy.

This paper [17] proposes a new method of personal recognition based on footprints. An input pair of raw footprints is normalized. The pressure distribution of the footprint was measured with a pressure-sensing mat. The biometrics features are derived from fingerprints, faces, irises, retinas, a speaker's voice etc. The footprints can be obtained if a sensor is placed on the entrance floor where people step without shoes, so no need for the subject's cooperation. In this paper, footprint-based personal recognition method and test its reliability. So can apply personal recognition for automatic data collection for individuals when many family members live together. The main advantage of this paper is More secure.

This paper [18] deals with the design and implementation of Secure Home Automation using Raspberry Pi for mobile devices. Raspberry Pi operates and controls motion detectors and video cameras for remote sensing and streams live video and records it for future playback, and finally manages operations on home appliances, such as turning ON/OFF a television or microwave. When motion is detected, the cameras automatically initiate recording and the Raspberry Pi device alerts the homeowner of the possible intrusion. If no motion is detected for more than a specific amount of time, then electrical appliances in the room can be set to power down. The process is controlled by a server. A notification will be displayed to the user for the same. Voice control options can also be provided to the system of Raspberry Pi and hence get the efficiency details. This provides a full security support for homes. The advantage of this paper is Easy Implementation and maintenance.

The paper [19] describes the sensor system, the recognition methods. There is a large class of routine physical exercises that are performed on the ground, on dedicated "mats". The exercises are defined by complex motion patterns of different body parts, require more elaborate sensor systems. It propose to use a resistive, textile pressure sensor matrix for tracking exercises such as push-ups, abdominal crunches and squats. The monitoring can be performed without the need to wear any sensors by exchanging a normal gym-mat for a smart one. A resistive pressure mat as a new sensing modality for ubiquitously recognizing and counting exercises. The mat is thin, soft and low-cost and can easily replace traditional gym mats. The core of the gym mat is a resistive pressure sensor matrix. The data frames produced by the sensor mat are calibrated by removing DC and noise. The DC component for each sensor element in the matrix is calculated as the average value during the time the sport mat is not occupied by a person. When a force is applied on the mat the voltage in that position is increasing. The main advantage of this paper is More accuracy.

This paper [20] aims at designing a home security automation using Raspberry Pi. It introduces a system that monitors the house perimeter and notify the owner of the house when there is a visitor or intruder. The owner is informed with an image of visitor at the time of visiting. The system is implemented using Raspberry Pi. The system is capable of notifying the user by Email, SMS, Call and Whatsapp instantly using Python scripting. These systems safeguard homes from intruders and burglars. When a visitor or intruder enter into the house perimeter, then the system should be capable of capturing picture. The presence of a human being is detected by the system using motion sensors and motion detection algorithms. The camera capture the visitor and sends the picture along with visiting time to house owner through an e-mail and SMS. Thus the house owner gets instant notification and can take action. The advantage of this paper is cheaper and userfriendly.

IV. CONCLUSION

In this paper, we have proposed and demonstrated an optimal smart home security with less cost and increased security. With help of IoT and Face Recognition an advanced level of security is provided. The real-time face recognition and face detection used for stranger identification thus gives a warning using a LED display and after that a notification is send via SMS and email to the homeowner. The results shows that system satisfies requirements of the current smart home security system. Use of android application makes it remotely accessible so that a user can keep track of activities happening in the home using a Smartphone

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