Access Control Using Facial Recognition

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ABSTRACT

The field of smart home technology has grown by leaps and bounds over the last few decades. This development has made several new products available that can add convenience and security to facility. People became aware of smart home devices with the introduction of the smart thermostat, but these thermostats were only the beginning to smart homes. Smart devices helps people manage their sched-ules, grocery lists, home lighting and even the home security. These devices work together to make life a bit easier as well as safer. One group of such smart home security devices that are gaining popularity are smart door locks. Smart door locks are also seeing new innovative features being added recently where some companies are adding the capability of facial recognition to the locks. With nothing but the face, it's now possible for a door lock can be operated. As far back as 2016, manufacturers started talk-ing about smart locks with face recognition. The innovation has continued to grow as several main-stream tech devices with facial recognition like the phones and handheld devices with facial recogni-tion unlock features.

In smart door locks, the device uses facial recognition, leveraging advanced processing and analytics to identify a person's facial attributes at the door.

KEY WORDS

Access control, facial recognition, door locks, security.

1. INTRODUCTION

The field of smart home technology has grown by leaps and bounds over the last few decades. This development has made several new products available that can add convenience and security to facility. People became aware of smart home devices with the introduction of the smart thermostat, but these thermostats are only the beginning to smart homes. Smart helps people manage their schedules, grocery lists, home lighting and even the home security. These devices work together to make life a bit easier as well as safer. One group of such smart home security devices

that are gaining popularity are smart door locks. Smart door locks are also seeing new innovative features being added recently where some companies are adding the capability of facial recognition to the locks. With nothing but the face, it's now possible for a door lock can be operated.

As far back as 2016, manufacturers started talking about smart locks with face recognition. The innovation has continued to grow as several mainstream tech devices with facial recognition like the iPhone®'s latest models have lunched in the market with facial recognition phone unlock features. In smart door locks, the device uses facial recognition, leveraging advanced processing and analytics to identify a person's facial attributes at the door.

With locks such as the FL1000 from ZKTeco, technology now has the capability to allow to unlock doors with nothing but a smile. FL1000 has a dual camera that boasts the ability to recognize faces within a time span of 0.2 seconds. Within the application, the device can register up to 100 faces and can manage to control the locking mechanism within the door. The model also includes a key fob and code for controlling the lock.

Another model currently available is the Corum Security CS-100. The lock claims that the lock can' be fooled by models or images. The traditional mechanical key, code and fob feature is also supporte by the locking mechanism. Infrared technology helps the smart door lock to even work in dim an dark places.

Elecpro is coming to market with another option, the US: E Smart Lock model. The US: E smar lock features facial recognition, fingerprint recognition, smart phone access, password-based entry key fob entry, as well as the traditional physical key access. Elecpro guarantees that the lock can recognize up to 100 faces and cannot be fooled by pictures and even videos.

2. LITERATURE SURVEY

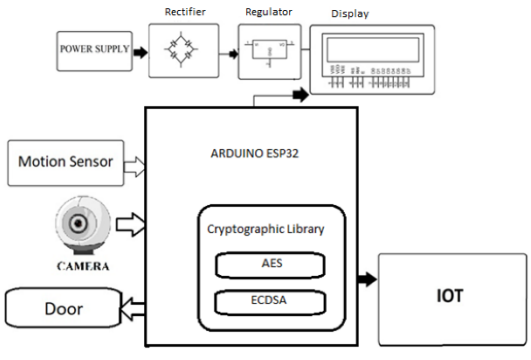
We have discovered various papers identified with the security framework using the fingerprint sensing.

The author in [1] has introduces a new facial expression recognition method based on Gabor filter and a genetic algorithm. Gabor features are extracted from regions of interest of the human face detected using facial landmarks. In addition, a genetic algorithm was designed to optimize SVM hyperparameters and select the best features simultaneously. The experimental results show the outperformance of the method and recognition rates of 96.30%, 94.20%, and 94.26% for JAFFE, CK, and CK+ datasets, respectively. The author in [2] has proposes a novel human face recognition approach in this paper, based on two- dimensional Gabor filtering and supervised classification. The feature extraction technique proposed in this article uses 2D Gabor filter banks and produces robust 3D face feature vectors. A supervised classifier, using minimum average distances, is developed for these vectors. The recognition process is completed by a threshold-based face verification method, also provided. A high facial recognition rate is obtained using our technique. Some experiments, whose satisfactory results prove the effectiveness of this recognition approach, are also described in the paper. The author in [3] addresses the building of face recognition system by using Principal Component Analysis (PCA). PCA is a statistical approach used for reducing the number of variables

in face recognition. In PCA, every image in the training set is represented as a linear combination of weighted eigen-vectors called eigenfaces. These eigenvectors are obtained from covariance matrix of a training image set. The weights are found out after selecting a set of most relevant Eigenfaces. Recognition is performed by projecting a test image onto the subspace spanned by the eigenfaces and then clas-sification is done by measuring minimum Euclidean distance.

The author in [4] proposes a system to ensure security for automobiles. The system is based on an Arduino based system which captures the image of the person trying to start the vehicle. The algorithm used in this case for face recognition is PCA. The authors in [5] used an Embedded platform which was unique and easy to implement. The proposed an image capturing technique in an embedded system based on Raspberry Pi board. The proposed idea is that the Dark and Low contrast images captured by using the Raspberry Pi camera module can be enhanced in order to identify the particular region of image. This concept is used in the real time application of MAV, The MAVs are basically used to capture images and videos through the Raspberry pi camera module. Because of its credit card sized (small) and less weight in the design. However, the image captured by MAVs will consist of unwanted things due to atmospheric conditions; hence it is necessary to remove noise present in the MAVs images. The author in [6] project was "Implementation of Human Face Detection System for Door Security using Raspberry Pi" a great example of how to use the Raspberry Pi and Pi camera with Open CV's computer vision algorithms. By compiling the latest version of Open CV, it can get access to the latest and most interesting computer vision algorithms like face recog-nition. The author in [7] developed a system with an advanced surveillance camera capable of face detection and at the same time recognizing the face detected using OPENCV library, Eigen face methodology and all processing has been done on Raspbian OS on Raspberry Pi. The author in [8] proposes that real time application of Face Recognition concept by generating a MATLAB code using image acquisition toolbox on the basic approach used is PCA using Eigen faces. The authors in [9] had implemented security system where if any person came at the door it was notified to the homeowner via e-mail and twitter then the user could see the person standing at the door using camera from remote location.

3. BLOCK DIAGRAM



3.1. SYSTEM OVERVIEW

A Passive Infrared Sensor senses the infrared radiations emitted by the human beings. This helps the system to detect the presence of the person standing in front of the door and carry out the further process. The detecting angle is 120 degrees and detecting distance is 8m.

The AI-Thinker ESP32-CAM module is a low-cost development board with a very small size, OV2640 camera and a micro-SD card slot. It has an ESP32 S chip with built-in Wi-Fi and Bluetooth connectivity, with 2 high-performance 32-bit LX6 CPUs, 7-stage pipeline architecture. Using the PIR sensor, the ESP32 CAM module captures the image present Infront of it and processes the image to compare it with the image saved. The saved image has to be decrypted using the Software AES Engine and the signature check of the saved data also has to be done before the image is compared. Once the comparison passes, the relay operates a solenoid to open the door. The result is displayed on the LCD and the webpage.

4. HARDWARE USED

Components used are as follows:

4.1 Arduino Uno

An ATmega328 grounded microprocessor is used in the Arduino Uno. It has 14 digital I/O legs, six of which can be used as PWM outputs. The remaining legs include six analogue inputs, a leg for a 16 MHZ demitasse oscillator, a point for a power jack, a port for a USB link, an ISCP title leg, and a restart button. It is capable of being fueled by a battery, an AC-to-DC adapter, or a USB cable. Even though this chip can handle voltages of up to 20 V, its working voltage is only 5 V. An opensource software application called Arduino IDE can be used to configure this board.

4.2 Liquid Crystal Display

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It dis-plays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

4.3 ESP8266 WiFi

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it.

4.4 ESP32 CAM WiFi Module Bluetooth with OV2640

The ESP32 CAM WiFi Module Bluetooth with OV2640 Camera Module 2MP For Face Recognization has a very competitive small-size camera module that can operate independently as a minimum system with a foot-print of only 40 x 27 mm; a deep sleep current of up to 6mA and is widely used in various IoT applications.

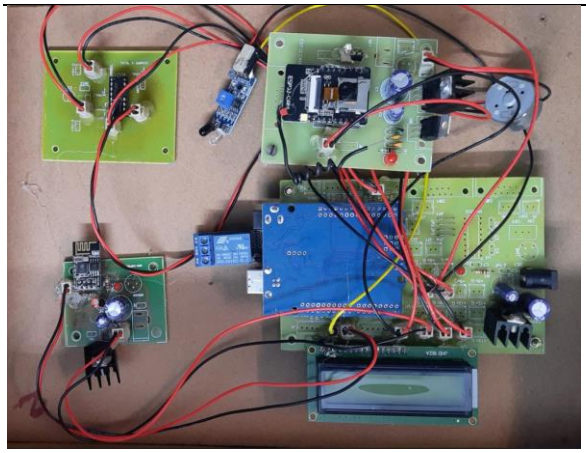
It is suitable for home smart devices, industrial wireless control, wireless monitoring, and other IoT applications.

This module adopts a 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.

ESP integrates WiFi, traditional Bluetooth, and BLE Beacon, with 2 high-performance 32-bit LX6 CPUs, 7-stage pipeline architecture. It has the main frequency adjustment range of 80MHz to 240MHz, on-chip sensor, Hall sensor, temperature sensor, etc.

5. MODEL WORKING

The board of ESP32-CAM and the PIR sensor along with the LCD and the Arduino board are powered using a 5V external power supply. Once the PIR sensor detects a motion, the Arduino gets an interrupt on one of its pins and then the Arduino enables the ESP32 module where the ESP32-CAM module is brought out of sleep and an image is captured which gets processed. The captured image is compared with any of the images saved in encrypted form inside the non-volatile memory of the system and the relay is operated accordingly.



6. CONCLUSION

The project mainly focusses upon developing a Secure Access Control System using Facial Recognition. The system was designed with the help of various type of hardware devices (ESP32 Camera, Relays, PIR Sensor) and Arduino Micro-controller. It is user friendly system. The use of Eigen face recognition technique makes system more secure. This system can be used in several places where high security is required where confiden-tial information and equipment is kept. For example, research institutes, banks, forensic Laboratories. This sys-tem can also be used for domestic purposes. This project helps to reduce problem of thefts and frauds.

There are many objectives focusing towards development of Software and Hardware, firstly integrating the Camera module with the Micro-controller and then capturing the image for processing. Once the image is pro-cessed, we need to take the decision to enable the relay which actually opens the door. For authenticating the user, the image saved in the Non Volatile memory of the system needs to be read, the saved image should be decrypted, its integrity has to be checked using the Digital Signing Algorithm (ECDSA-P256) and then verified saved image will be compared with the captured image.

The complete system is kept in low power mode by shutting down everything except the wake from external interrupt of the micro-controller which is connected to the motion sensor to detect any movement infront of the camera and wake up the system. This increases the lifetime of the battery in the system.

The components has been successfully integrated and tested with different facial characteristics and set points. Expected result were obtained as discussed in the results section. The Access Control Using Facial Recognition system was implemented by using the Arduino module with the help of libraries and coding environment based on the C programming.

6.1 FUTURE SCOPE

1.The system can send updates to a Head End Systems running on cloud server logging the times and the people who tried to access the system.

2.The system can be updated to send updates to a cloud server when an unauthorized person tries to gain access to the secured facility.

3.The data communication can be protected by encrypting the data before sending to any remote device

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