DESING OF AUTOMATIC DOOR USING RASPBERRY PI

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Abstract: ***IoT has been a booming technology in recent years because of a wide range of real time applications. One of the applications is smart homes. Our project is about a smart door which comes under home automation. Camera is used to capture the face of the visitor and then it checks with the list of faces and then the door is unlocked accordingly. The system takes images of people, analyse, detect and recognize human faces. If the face doesn't match with the list of faces in the data set then the captured face is sent to the owner via an email. The system can serve as a security system at home. It can detect and recognize a human face in different situations and scenarios.***

Keywords: ***Camera, Face Detection, Face recognition, Comparison.***

I. INTRODUCTION

Face recognition is developing technology and it has been used in mobile phones as a lock. Face recognition is primarily used as security. The first task is to detect if any person is in front of the camera or not. The second one is to capture the face of the person. The third task is to compare the captured face with all the faces in the data set. The fourth task is if any of the faces matches then the door automatically opens, if not buzzer will be activated and after 10 seconds of delay the captured image is sent to mail. For this we referred to a few papers and journals which are mentioned in the reference session.

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.

II. CHARACTERISTICS OF IOT

A. INTELLIGENCE

Together algorithms and computation (i.e. software & hardware) provide the "intelligent spark" that makes a product experience smart. Consider Misfit Shine, a fitness tracker, compared to Nest's intelligent thermostat. The Shine experience distributes compute tasks between a smart phone and the cloud. The Nest
thermostat has more compute horsepower for the AI that makes them smart.

B. CONNECTIVITY

Connectivity in the IoT is more than slapping on a WiFi module and calling it a day. Connectivity enables network accessibility and compatibility. Accessibility is getting on a network while compatibility provides the common ability to consume and produce data. If this sounds familiar, that's because it is Metcalfe's Law and it rings true for IoT.

C. SENSING

We tend to take for granted our senses and ability to understand the physical world and people around us. Sensing technologies provide us with the means to create experiences that reflect a true awareness of the physical world and the people in it. This is simply the analog input from the physical world, but it can provide a rich understanding of our complex world.

D. EXPRESSING

Expressing enables interactivity with people and the physical world. Whether it is a smart home or a farm with smart agriculture technology, expressing provides us with a means to create products that interact intelligently with the real world. This means more than just rendering beautiful UIs to a screen. Expressing allows us to output into the real world and directly

interact with people and the environment.

E. ENERGY

Without energy we can't bring our creations to life. The problem is we can't create billions of things that all run on batteries. Energy harvesting, power efficiency, and charging infrastructure are necessary parts of a power intelligent ecosystem that we must design. Today, it is woefully inadequate and lacks the focus of many product teams.

F. SAFETY:

As we gain efficiencies, novel experiences, and other benefits from the IoT, we must not forget about safety. As both the creators and recipients of the IoT, we must design for safety. This includes the safety of our personal data and the safety of our physical well-being. Securing the endpoints, the networks, and the data moving across all of it means creating a security paradigm that will scale.

III. SMART DOOR

There is never an end to devices that can be made 'smarter' with the help of adequate technology. There are a lot of smart devices but smart doors provide a safety environment. The door provides basic amenities like making a buzzer sound as the indication for in person inside the house. All the computing is done with the help of a raspberry pi. In recent years more and more devices are connected to the internet. The internet has played an important role in connecting more and more people across the world. Devices started to become smarter and smarter, mobile phones became smart phones and most importantly the internet was connected to a variety of devices and the concept came to be known as the ' Internet of Things'. Our project aims at exploring other fields where this technology is used. It aims at including this technology at door, because in general people spend their quality time just for these simple tasks which may also distract one's cooking process or office work and also people who prefer work from home. The smart door would help in developing smart houses by using artificial intelligence. The goal of the smart door is to provide an access point for a person to receive the information about the other person outside at the door. To get information, a person will always have to walk along to open the door which is time consuming. To get rid of these problems, the concept of smart doors is introduced. All the necessary information can be accessed from one location.

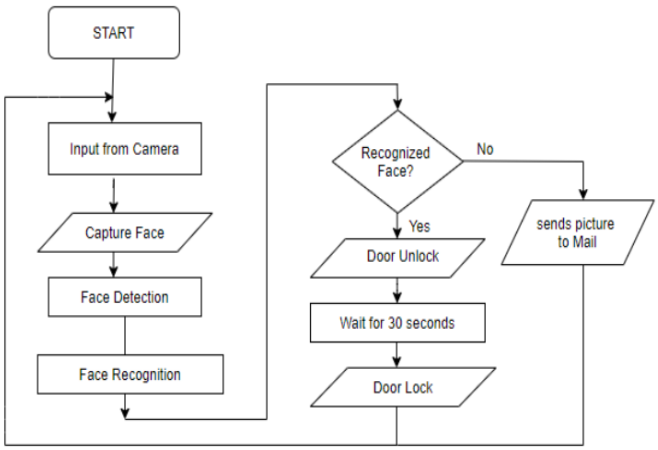
IV. PRINCIPLE AND WORKING OF SMART DOOR

A. Algorithm

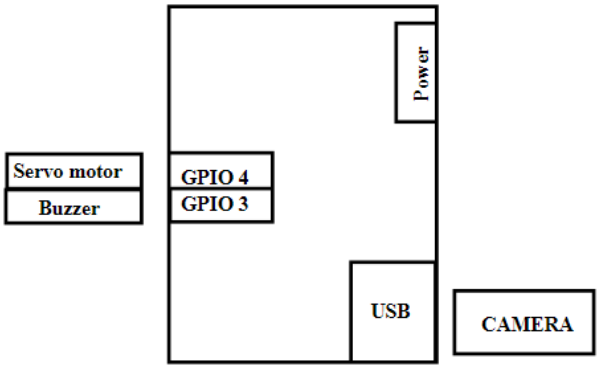
1) Continuously reads input from the camera.
2) If a person is identified, captures an image of the person.
3) Detects the face from the captured image.
4) Converts the captured image into HOG image.
5) Posing and projecting faces.
6) Encoding faces and comparing them with the faces in the data set.

a) If the face matches then display the name of the person and the door opens automatically by the attached motor.
b) If the face doesn't match with the faces in the data set, then the buzzer automatically activates and after 10 seconds of delay the first captured image is sent to the owner via mail.

B. Flowchart



C. Block Diagram:



D. Principle

The convolutional neural network (CNN) is a class of deep learning neural networks. CNNs represent a huge breakthrough in image recognition. They're most commonly used to analyze visual imagery and are frequently working behind the scenes in image classification. They're fast and they're efficient. A CNN convolves learned features with input data and uses 2D convolutional layers.

This means that this type of network is ideal for processing 2D images. Compared to other image classification algorithms, CNNs actually use very little preprocessing, that they can learn the filters that have to be hand-made in other algorithms. CNNs can be used in tons of applications from image and video recognition, image classification, and recommender systems to natural language processing and medical image analysis.

CNN is most popular deep learning architecture. It is computationally efficient. It uses special convolution, pooling

operation and perform parameter sharing.

Convolution layer: It apply a convolution operation to the input. This passes the information on to the next layer.

ReLU layer: It increases the non linearity of image.

Pooling: It combines the outputs of clusters of neurons into a single neuron in the next layer.

Fully connected layers connect every neuron in one layer to every neuron in the next layer.

The image is converted into gray level image and each and every pixel is considered one at a time. For the pixel considered ,its neighbouring pixels are considered. Depending on the darkness of current considered pixel with its neighbouring pixels an arrow is drawn in the direction of darkness.

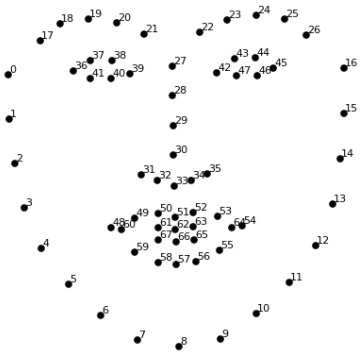
This step is repeated for every single pixel in the image and it will end up with every pixel being replaced by an arrow. These arrows are known as gradients and they show the flow from light to dark across the entire image. Gradients gives much more information when compared to pixels.

The image after representing with gradients it is braked into 16*16 pixels. In each square, the number of gradients points are counted in major directions. By considering the strongest one, the square is replaced with arrow directions.

The part of the image that looks most similar to known HOG pattern was extracted from a bunch of other training faces.

In some conditions the faces are turned in different directions that may look totally different to computer. To account this,the picture is wrapped so that the eyes and lips are always in same position in image by using face landmark algorithm. The basic idea is that 68 specific points (called landmarks) are identified that exists on every face- the top of chin, outside edge of each eye,inner edge of each eyebrow.

By these landmark, the position of eyes, mouth, chin are known, the image is rotated, scale and shear the image so that the eyes, mouth are centered.



The image is trained to get 128 measurements of the image.

The training of image consists of

a) Load a training face image of a known person

b) Load another picture of the same known person

c) Load a picture of a totally different person

Then the algorithm looks at the measurements it is currently generating for each of those three images. It then tweaks the neural network slightly so that it makes sure the measurements it generates for first image and second image are slightly closer while making sure the measurements for second image and third image are slightly further apart.

SVM classifier is used to find the person from the data set of known people. Train the classifier that can take in the measurements from a new test image and tells which known person is the closest match.

E. WORKING

The buzzer and servo motor are connected to raspberry pi to GPIO pins 3 and 4 respectively. Camera is connected to Pi via USB. The power supply is given to raspberry pi. The camera is attached to the door as it covers every person who is approaching the door. Camera runs continuously when a person approaching the door the camera clicks the picture of the person. The captured image is compared with the known faces in data set. If the captured image measurements are closest to the any of the known face in data set the door automatically opens and after a 30 seconds of delay the door closes automatically. If the captured image measurements doesn't match with any of the known faces in data set buzzer is activated automatically. Even after the buzzer activation, response is not noted, the captured image is sent to the owner via mail.

IV. RESULT AND COMPARISON

Captured image:

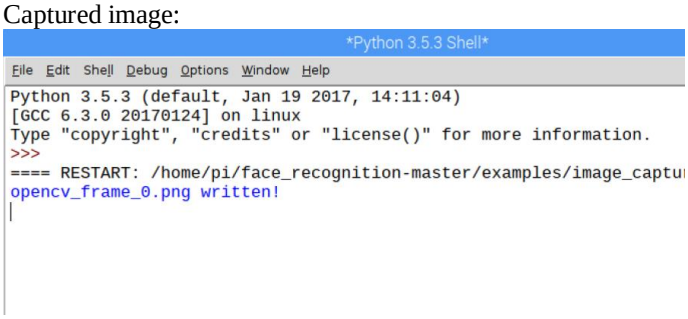
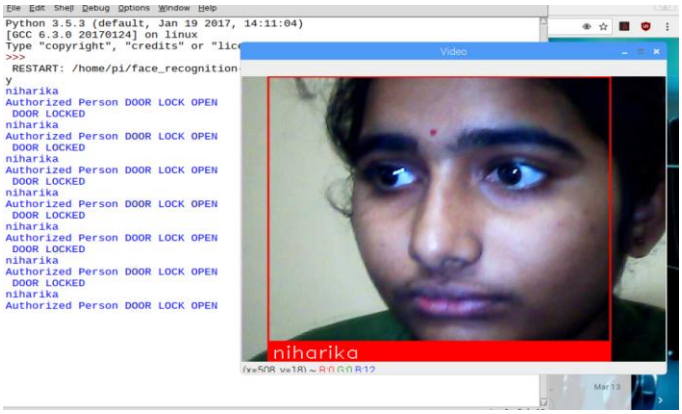
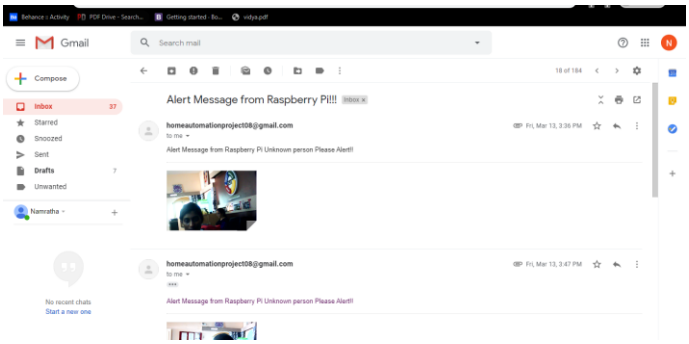


Image capture output



If the face is matched with the known face in data set



If the captured image doesn't match with faces in data set

V. FUTURE SCOPE

The smart doors are evolving technology in current era. It is the most secured doors with is trust worthy. The smart doors are being updated in short periods. The idea of this project is from the smart doors with fingerprint sensor. The future scope of this smart door is the same board may be used for one or more doors. the captured image may be sent to the owner to the owner's mobile/to specified phone number as MMS or to whatsapp. The smart doors can also be used with LPG or fire sensors in indication to any fire or gas leak accidents.

VI. CONCLUSION

The developed automatic door which runs on face recognition. The face recognition algorithm is developed using CNN. The face recognition algorithm is of following steps;

1. First, find all the faces in an image. Encode a picture using the HOG algorithm to create a simplified version of the image. Using this simplified image, a part of the image is found that most looks like a generic HOG encoding of a face.

2. Second, every face is examined and is able to understand that even if a face is turned in a weird direction or in bad lighting, it is still the same person. Figure out the pose of the face by finding the main landmarks in the face. Once the landmarks are found, use them to warp the image so that the eyes and mouth are centered.

3. Third, Pass the centered face image through a neural network that knows how to measure features of the face. Save those 128 measurements.

4. Finally, comparing the present captured face measurements with measurements of faces in the dataset. The closest measurements to the face is a match. The face recognition works with 98% accuracy and is capable of being executed in real-time.

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