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Face Recognition Using Raspberry Pi , Node-Red, IBM Watson and Twilio

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ABSTRACT

Face recognition is termed to be one of the major breakthroughs in the field of security. The main aim of the paper is to design an efficient, feasible, budget-friendly system which can take over the traditional fingerprint recognition, RFID and other technologies. The solution put forward in this paper is a face recognition security system which can identify invaders in restricted or highly secured areas. The device is a combination of both hardware and software functionalities. The hardware part consists of a Pi camera, PIR sensor, Raspberry pi while the software part consists of face-detection and face-recognition algorithms software which includes Node-Red, IBM Watson and Twilio.

Keywords: Raspberry pi, Face recognition, Node-red, IBM Watson, Twilio etc

I. INTRODUCTION

Face Recognition generally takes care of scrutinizing if there are any faces present in the given input image and if yes, it further checks whether the face in the images matches with the ones present in the existing database and if yes, it gives a positive output. As we already know that surveillance and security became a major issue of concern in the present scenario, this face recognition helps in dealing with such situations.

Why do we need to face recognition when we have many other technologies available which can identify and acknowledge a person? The major reason being that Face Recognition is more reliable when compared to other techniques like pin, password, fingerprint recognition. Apart from that, the amount of physical contact with the hardware is very minimal in face recognition when compared to the other techniques which definitely needs the user to interact with the hardware device. Another major reason is that each person has a different set of facial features which makes everyone prefer this technology to others.

The role of the Internet of Things is to sense, actuate and communicate in the system. The given device can be automated easily. So we can extend this to develop a smart home with an advanced surveillance system. In order to design this, a Raspberry Pi board , a Pi camera module and a PIR sensor are used after installing an operating system on the Raspberry Pi along with installing IBM Watson and Node-red once the accounts are created. We should also create a Twilio account and connect it to our paper by using API keys. We can extend this by using it as an automated unlock device for the door by making use of a stepper motor where the motor opens the latch whenever an authorized person is present in front of the camera.

The image Processing technology is applied here in order to authenticate the face of a person by extracting their facial features and comparing the pixels with the images of an already existing database image. For this,the pi camera is connected to the raspberry pi and it captures the face and stores it in the databases. For authentication, a person has to stand in front of the camera, the camera captures the face and if the person is a verified user, the system will grant permission. Using IoT will increase security also helps in accessing the system from a remote area and also gives us the ability to control the system remotely.

II. Novelty of the paper

The novelty of the paper lies in the tools used. The use of Node-red makes it simpler as it allows us to use the predefined nodes which perform the required function without any coding involved in it. We can also include customised nodes which can be defined as per our requirement. The IBM Watson platform has an advanced feature in visual recognition which is used for identification and recognition of the faces. A special messaging platform called Twilio is used which helps us to send messages from our device to a registered number by assigning us with a unique phone number.

III. Scope

The paper aims at building a prototype for face detection that can be controlled using motion detection. This device can be used in a wide range of areas. The system integrated with various other advanced features has widespread real-time applications

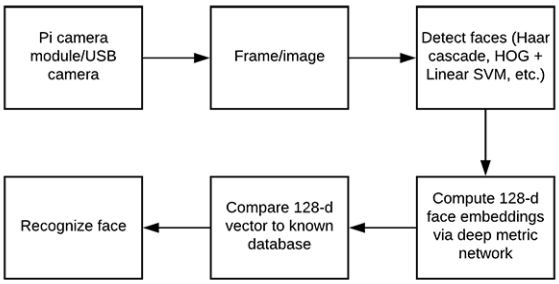
1.The system can be used as a part of automation: The system can be used from homes to offices as an integral part of automation to increase the security aspect.

2.Used in attendance systems: The proposed system can be useful in marking attendance in schools, colleges and universities.

3.Can also be used to restrict people in high-security areas.

4.Can be used in identifying criminals in a crowded place.

IV. Proposed Architecture



Fig(1): Block Diagram

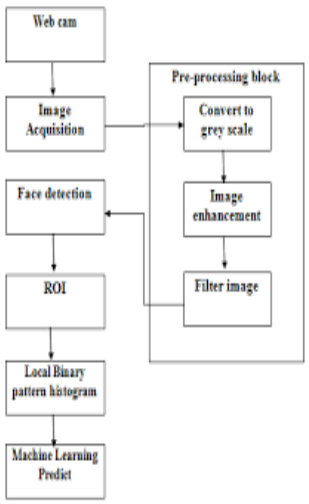
The major models used in this paper are Raspberry Pi, Pi camera and PIR sensor. Whenever there is any movement sensed by the PIR sensor, the camera captures the face of the person who is standing in front of the camera and obtains an image. This image is now set to the raspberry pi and then the pi using the Node-Red and IBM Watson installed in it. The IBM Watson verifies the image to check if the person in the image is a registered person and his face is already present in the database. The detection of faces happens takes place using techniques like HAAR cascade and Linear SVM where Linear SVM is the newest extremely fast machine learning (data mining) algorithm which is used in solving classification of different classes of faces using a relatively larger dataset of images which uses the cutting plane algorithm for designing a linear support vector machine. Haar Cascade classifier is a technique that basically uses the Haar Wavelet technique. The Haar Wavelet extracts the pixels in the image and converts them into squares and analyses them using a specific function. The "integral image" method is used to compute and evaluate the "features" detected. Haar Cascades with the help of the Ada-boost learning algorithm chooses a small number of dominant characteristic features from a large set to obtain a result which is then undergone through cascading techniques so as to identify the person's face from the input image

The model is a deep convolutional neural network trained via a triplet loss function where the vectors having smaller distance between them are considered to be similar and have the same identity and the vectors which have a larger distance between them have different identities (less similar). All these similar vectors are compared to those with the existing 128-d vector (which has the property of splitting up various features) from the known database and then, the face is recognised.

V. Components

1.Raspberry Pi

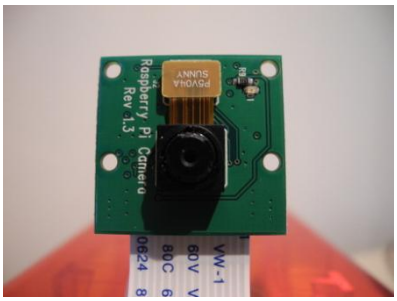
The Raspberry pi board acts as a SoC which is a system on chip that means it comes with an integrated central processing unit (CPU) and on-chip graphics processing unit (GPU).



Fig(3).Raspberry Pi

2.Pi camera

The Pi Camera Module is used to capture the image whenever the sensor senses any motion.



Fig(4): Pi Camera

3. PIR Sensor

The PIR sensor is the passive infrared sensor which is used as a motion detector .It sends infrared waves to detect the motion

Fig(5): PIR Sensor

4.Node-red and IBM Watson

Node-RED is a tool that is used to combine hardware and software devices.
Node-RED is an editor which helps in wiring the required nodes which performs necessary operations.
There are a various number of nodes available to perform various functions that replace the use of coding as the nodes contain code inbuilt in it.
This platform makes it easier for deploying with just a single click.
The IBM Watson Visual Recognition service contains many algorithms which effectively identifies the faces and gives the output.

5.Twilio

Twilio is a platform that gives the users a separate phone number through which the user can manage phone calls, text messages and other services.

VI. Advantages

- It is a cost-efficient device made with very less investment
- As this system uses IoT, the device can be monitored and controlled from even far away places.

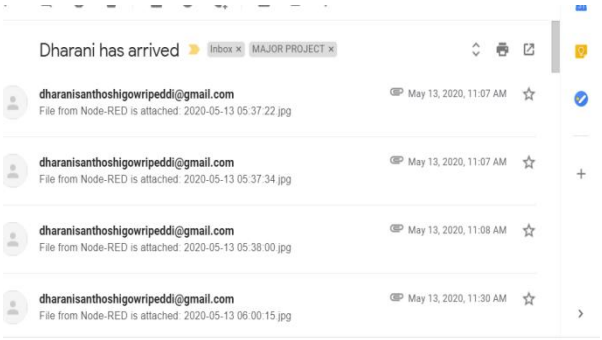
- This device can be automated.
- The device is scalable and flexible because it is based on Raspberry pi.
- Advancements can be easily made to the device without having to demodule the present components in the system in order to have any other features to it.
- This device needs a very little amount of power as Raspberry pi is a low power-consuming device.

VII. Applications

- Helps in Law Enforcement by Minimizing the number of crimes by narrowing mugshot searches, verifying Identity of a person from court records, and comparing the images in surveillance camera images to find the criminals.
- For marking the attendance by verifying the student's identity.
- Restricting access in highly secured zones.
- Applicable in the banking sector where the transactions can take place only after verifying and matching the customer's face.
- Verifying the identity of individuals while picking up the children in schools or daycare centres to avoid child trafficking.
- Can be used in residential areas to alert homeowners of approaching personnel.
- Can be used in Voter verification to ensure safe and secure elections
- Helps in speedy immigration.
- To make a smart home by enabling the locks of the doors only after verifying the face.
- Helps in Security concerned areas

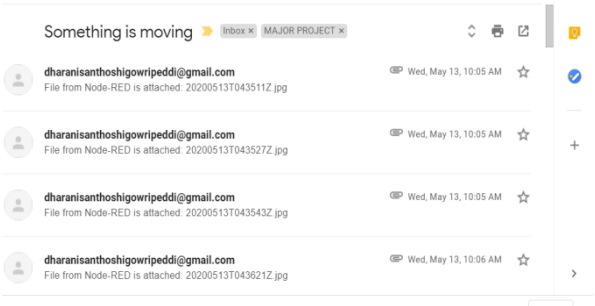
VIII. Results

The output of the above presented module is in terms of a message and a mail to the person whose mail and phone number is registered in the node red flow.
Once the recognised face is detected from the camera, an email is sent to the registered mail id with the name of the recognised person along with the photo of that person attached to it



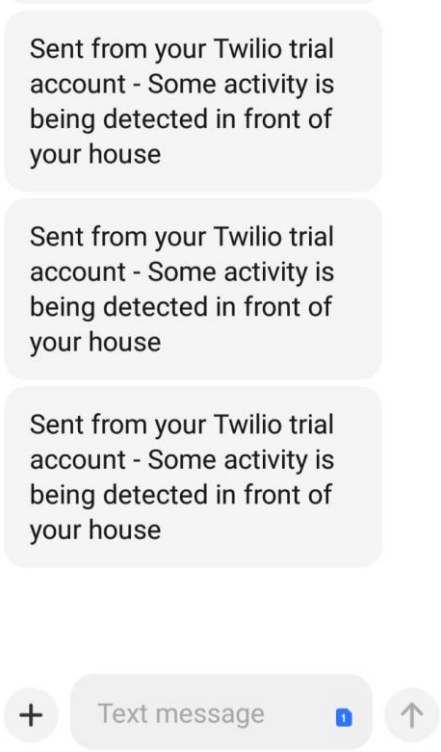
Fig(6): Mail when a recognised person arrives

Else, if an unrecognised person has arrived and the camera captures them, an email is sent to the registered email mentioning that someone has arrived or something is moving along with the photo of the person attached in the mail



Fig(7): Mail when an unrecognised person arrives

The below image shows the message that is sent from the Twilio service to the registered phone number whenever there is a presence of any unauthorized person.



Fig(8): Message when an unrecognised person arrives

IX. Conclusion

The proposed face recognition paper is a cost-efficient and a power-efficient device. This device is a combination of two of the most advanced technologies i.e. Face recognition and IoT which can be further modified to solve many more real-time issues. These are rapidly growing technologies in industries and many advancements are yet to be discovered in these fields which can be applicable to the proposed system too. Therefore this device when putting to use can make a significant impact on security system development. Monitoring the activities of the device from a place farther away is possible because of the use of IoT. This system is very safe and does not encourage hacking or loss of any type of confidential information.

X. Future Scope

There is a wide range of possibilities for extending this paper in future. The paper can be extended in different ways for different fields. In the case of Home Automation, an automatic door lock opening system can be implemented along with directly sending a video call to the house owner whenever a guest arrives at the house. In the case of law enforcement, a high-resolution camera can be used to capture every person's face and check if the person has any criminal records from a far distance itself. Along with marking attendance for a student in schools and colleges, if a video streaming service is integrated, online video lectures can be made accessible to the students, these video lectures can provide more improvement in the field of distance education, course management system and support for faculty development. . Paper can be modernized in the near future as, when an obligation for the same arises, as it is very flexible in terms of development. The above-mentioned areas are the major areas for the future scope of the paper.

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