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The demand for home as well as office security systems is becoming critically important day by day. Accepting that threats to human security differ considerably over and within countries, and at different points in time. So many researches have been taken place in the improvement of the security system. As long as the need for a very remunerative system has arisen and the solution has been found in a camera based security system based on the Raspberry Pi software that is extremely user-friendly and cost-effective. We build a Smart Security Camera for the security purpose by using Raspberry Pi and camera module.

Our purpose is to develop a system that can recognize human faces. In this system at first, the camera needs to capture images of the privileged people whose are allowed to access this specific area, then we need to train the privileged faces and stored it in one XML file where individual face holds different specific Id. During the recognition, the camera starts and if any people come in front of the camera the system verifies whether the face is trained or not, if the face is in the trained dataset the camera shows his name with confidence level otherwise it shows unknown also take a photo of this person's and sends the picture through Gmail notifications as a warnings. The decisions reveal that the proposed system can be applied for face recognition even from poor quality images and shows excellent performance among known and unknown datasets. The face recognition has been done using the OpenCV library. We use the python script to develop the system. Keywords: Raspberry Pi, Local Binary Pattern Histograms, OpenCV, Face recognition, Gmail Notifications.

Introduction

IoT is simply the network of interconnected things/devices which are embedded with sensors, software, network connectivity and necessary electronics that enable them to collect and exchange data making them responsive. By CASAGRAS(2008), IoT is defined as A global network infrastructure, linking physical and virtual objects through the exploitation of data capture and communication capabilities. But By Mark Patel, Jason Shangkuan, and Christopher Thomas explained in an article(2017) Adoption of the Internet of Things is proceeding more slowly than expected. During the past few years, Face Recognition has become very important to have a reliable security system which can secure our assets and property in the safest way possible. Traditional security system has a lot of problems and lackings also, sometimes they are unable to provide real-time data. Face Recognition is the most popular methods of biometric technology when compared to other biometric technologies such as fingerprint, voice recognition etc. however, it is considered to be more natural than other technologies. Many research has been taken place in this field in recent few years.

Ylber Januzaja, Artan Lumaa, Ymer Januzaja and Vehbi Ramajb(2015) presented a system Real-time accessed control based on face recognition using Raspberry Pi and used OpenCV libraries and python language in order to achieve mailto:sana1691@gmail. commailto:ibmcsecu@gmail. comIntegrating Face Recognition Security System with the IoT Chowdhury International Conference on Machine Learning and Data Engineering (iCMLDE

2018) 2 of 6 high effectiveness. Although some researchers used machine learning and deep learning based approach to get much better result likewise Li Xinhua and Yu Qian(2015) addressed a system which focused on face recognition problem and used deep learning method, convolution neural network, to solve the problem along with Sobel operator to improve the accuracy. In 2014 Xiang Xu, Wanquan Liu, Ling Li developed a system Low Resolution Face Recognition in Surveillance Systems that has the ability to detect and recognize known and unknown face in very low resolution. The face recognition can be summed to feature extraction from face images to get the feature vector first, and put it into a trained classifier, at last, get the class and finish the recognition task. More specifically in our system at first, we have to take human faces then we have to train them and lastly, we can recognize known and unknown faces where unknown faces will send via Email. You would never have to worry about the recordings because pi security system will send you an Email and the system is also user-friendly.

SYSTEM ARCHITECHTURE AND WORK FLOW

The main goal is to develop a user-friendly smart security camera using python scripts to recognize known and unknown faces which later sends email alerts for unknown faces. We divided the system architecture into different parts to show the workflow of the system.

Step 1: Raspberry Pi camera is used to take images of people for further use and these images are saved by given specific id in dataset folder. We take 30 pictures of each person.

Step 2: After capturing images there is a pre-processing step where different operations such as image resize, grayscale conversion and image enhancement occur. GrayScale conversion is important because sometimes color information doesn't help us identify important edges or other features. An RGB image consists of 3 layers R, G, B and it's a 3-dimensional matrix so when we convert an RGB picture to grayscale, we need to take the RGB values for every pixel. Face images may suffer from illumination therefore, image enhancement is important to improve the quality of face image which helps face recognition system to perform effectively and accurately.

Step 3: The main purpose of face detection is to locate a human face in an image and it is the process that can apply on stored images or images from a camera. In order to work, face detection applications use machine learning and formulas known as algorithms for detecting human faces within Integrating Face Recognition Security System with the IoT Chowdhury International Conference on Machine Learning and Data Engineering (iCMLDE 2018) 4 of 6 larger images. These larger images might contain numerous objects which are not faces such as landscapes, buildings and other parts of humans. While the process is somewhat complex, face detection algorithms often begin by searching for human eyes. Once eyes are detected, the algorithm might then attempt to detect facial regions including eyebrows, the mouth, nose, nostrils, and the iris.

Step 4: In this phase, we extract various facial features like as mouth, eyes, nose, eyebrows etc. from the detected face. There are three types of feature extraction methods: Generic methods, Feature template-based methods and Appearance-based methods.

Step 5: There are different types of face recognition algorithms, for example, Eigenfaces(1991),

Local Binary Pattern Histograms(LBPH)(1996) and Fisherfaces(1997). Each method has a different approach to extract the image information and perform the matching with the input image. In our system we use LBPH. LBPH uses 4 parameters such as Radius, Neighbours, Grid X and Grid Y. After that, we train the algorithm and applying the LBP operation which marks the pixels of a picture by thresholding the 3-by-3 neighbourhood of every pixel with the focus pixel esteem and considering the outcome as a parallel number. Then extracting the histograms which are followed by Face Recognition.

Step 6: Machine learning algorithms are often categorized as supervised or unsupervised. Supervised algorithms can apply what has been learned in the past to new data. Unsupervised algorithms can draw inferences from datasets. Machine learning is used to detect patterns in data and adjust program actions respectively.

IMPLEMENTATIONS AND EXPERIMENTAL

RESULTS We use Raspberry Pi 3 Model B+ as our IoT core and Raspberry Pi camera module as the system camera also, we installed OpenCV 3 for face recognition process and all scripts in our system are written with Python. The implementation of the proposed system includes the following 4 stages:

We capture 30 images of each person by giving them specific id and applied face detecting process.

On the second stage, We train the images by considering numeric vectors and the final values will be exported to a YML file called trainer. yml.

In the third stage, we will capture a fresh face on our camera and if this person's face trained before, our recognizer will make a prediction returning its id and confidence level of the system. 4. In the final stage, the system will send an email if the system is unable to recognize the face.

After training the images, the system is ready to recognize faces also, if any faces are in the trained database it will show the name of the person as well as show the results with a confident label, but if it is not trained it will display unknown and free it to the unknown directory. Figure 4 shows the result of the above procedure and figure 5 is about security alert via email which is the last feature of the system.

CONCLUSION AND FUTURE WORKS

Face recognition has great potential in improving security operatives to better carry out their duties especially in emerging countries where this technology is not currently extensively used. In this paper, we developed a facial recognition system using a raspberry pi which is littler, lighter and works successfully utilizing lower control power with a security alert message to the authorized person utilities. This system is more convenient than the pc-based face recognition system. This development system is affordable, agile, and highly secure and Raspberry Pi takes limited power and provides enough flexibility to satisfy the requirement of different people. However, there is still a lot of scope for improvement. We can also use this security system by making a required modification to the system in an area like banking sector to provide more security to the lockers, based on their facial authentication and keep a record of account holders

history of data when and who is entered the lockers.