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Smart Home Security Surveillance : An Application of Face Recognition

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ABSTRACT

By emerging the IoT technology, challenging and positioning products it will be much close to instigating smart surroundings by 2020. In the near upcoming, storing and announcement services will be highly universal and disseminated: people, machines, smart substances, neighboring space and stages linked with wireless/wired sensors, M2M devices, RFID tags will generate a highly regionalized resources interrelated by a active network of networks. In this research paper we have utilized face recognition system as an application of smart home security surveillance system with make use of opencv library and python scripting languages.
Keywords : Smart Home Security, Opencv, Haar Feature, Cascade Classifier

I. INTRODUCTION

The Internet of Things (IoT), occasionally referred to as the Internet of Objects, will alteration all including ourselves. The Internet has an influence on education, communication, commercial, discipline, administration, and humankind. Obviously, the Internet is one of the most significant and influential creations in all of humanoid history and now with the perception of the internet of things, internet develops more promising to have a smart life in each aspects. Internet of Things is a novel technology of the Internet retrieving [1].

By the Internet of Things, substances distinguish themselves and achieve intellect behavior by creation or enabling related conclusions thinks to the fact that they can interconnect information around themselves. These objects can admission information that has been combined by other things, or they can additional to other services. The figure 1.1 appraisals that with the internet of things, everything's will able to interconnect to the internet at any period from any residence to deliver any facilities by any network to everyone. this impression will produce a new types of applications can encompass such as smart automobile and the smart home, to provide many services such as announcements, security, energy saving, automation, announcement, processers and entertaining.

II. RELATED WORK

In [5] the authors proposed an efficient facial expression detection system using ensemble learning of algorithms. Facial appearance is the unambiguous transformation of the human face due to the involuntary responses to the demonstrative unpredictability. In most circumstances it is impulsive and irrepressible. The automatic facial expression encompasses the application of a reproduction intelligent system to distinguish the expressions of the

face under any condition. In [6] the authors proposed an efficient face detection system with image variability information. Face recognition schemes usually function in one of two modes: i) Confirmation (FV) and ii) Identification (FI). Face confirmation is a one-to-one matching procedure in which an input (query) face image is associated against the stored template of only one person whose individuality is being demanded. In [8], the authors are investigated the demonstrating of FR system presentation in terms of the signal inconsistency measure resulting from input image datasets. Thus a new erraticism measure (VM) that symbolizes overall image face data inconsistency has been well-defined and used ended a quantity of well-known image datasets. In adding, relationships among such VM values and the presentation of four conservative FR systems have been strong-minded and demonstrated using additional order polynomials. Note that the recommended VM measure takes into account together inter and intra association image dataset physiognomies. Thus computer reproduction results connecting 11 openly available face image datasets demonstration FRSP/VM estimate errors of less than 10%, for completely four FR systems, and Avg. AE ideals crossways FR systems in the range of 3.26% and 5.42%.

III. PROPOSED RESEARCH ARCHITECTURE

The proposed research architecture consists of data gathering which contains different kinds of face images with various persons. Once the images has been composed, the collected images will undergo into analysis phase where the each images of different persons are identified and labeled with identification number. During the second phase the identified images are fed into the recognizer for learning the faces with various features. During the last phase the faces will be detected based on the trained phases. The proposed research background architecture is given in the figure 1. In this research work, the taken images contains various features like different kind of pose, various structure, illumination, emotion and various other characteristics. In this work is mainly focused on the detection of face for smart home. To the best of our information, this is the first research work, which has been focused on security surveillance of smart homes. Nowadays the emergence of IoT of things, and evolvement of new technologies, the smart applications usage are becoming more and more popular.

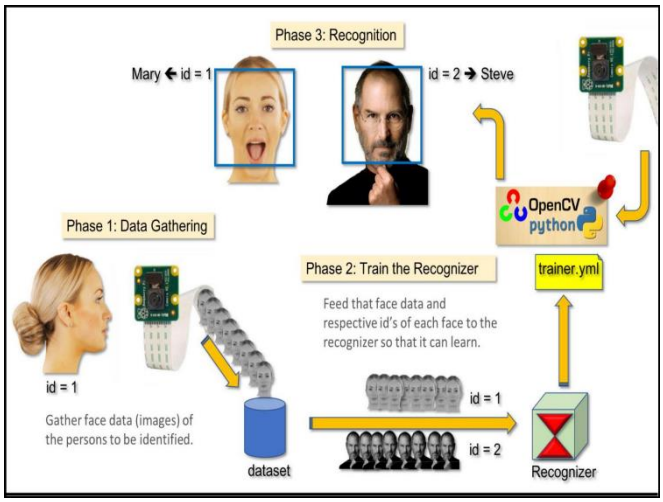

Figure 1. Proposed research architecture

Data gathering

In our research work, we have used UMDFace dataset. It consists of 3, 67,879 faces. In our research we have used 50,500 face images with 100 subjects. The figure 4.2 shows the sample images from the UMDFace dataset. This dataset contains various poses with various illumination and characteristics. I also contains emotion, gender, etc. Once the data has been collected from the online repositories, we need to analyze the collected face images for identification. Face identification process also involved in this phase.

Train the Recognizer

During the training phase, the image dataset along with their corresponding id are fed into the recognizer. The recognizer consists of haar cascade algorithm. It is a machine erudition algorithm used to identify the faces in an images. It is a machine learning based method where a cascade function is accomplished from a lot of positive and negative face images.

Face Recognition

Final phase involves phase recognition, this phase will work combined with previous two phases.

In this research work, we have used opencv library combined with python scripting language. Since python is a platform independent language and also it supports all the languages in its framework. Hence we used these libraries and scripting languages in our proposed research. The ultimate aim of our proposed work is to detect the faces which are trained by the classifier. The following steps shows the experimental evaluation results along with UMDface images.

```
import cv2
import os
import numpy as np

def faceDetection(test_img):
    gray_img=cv2.cvtColor(test_img,cv2.COLOR_BGR2GRAY)
    face_haar_cascade=cv2.CascadeClassifier('/Users/akashmac/Documents/Tutorial_faceRecogniti
    faces=face_haar_cascade.detectMultiScale(gray_img,scaleFactor=1.3,minNeighbors=5)

    return faces,gray_img

def labels_for_training_data(directory):
    faces=[]
    faceID=[]

    for path,subdirnames,filenames in os.walk(directory):
        for filename in filenames:
            if filename.startswith("."):
                print("Skipping system file")
                continue
```

To evaluate the performance of the proposed work we have used accuracy, precision, recall, f-measure and false positive rate measure.

Accuracy is percentage of correctly identified true person images.

$$\text{Accuracy} = \frac{\text{T P+TN}}{\text{T P+FP +FN+T N}}$$

True Positive (TP) =Number of samples correctly predicted as false person

False Positive (FP) = Number of samples incorrectly predicted as false person.

True Negative (TN) = Number of samples correctly predicted as true person.

False Negative (FN) = Number of samples incorrectly predicted as true person.

Precision is a measure of what fraction of test data is detected as false person are actually from the false person classes.

$$\text{Precision (P)} = \frac{\text{TP}}{\text{TP + FP}}$$

Recall measures the fraction of false person class that was correctly detected.

$$\text{Recall (R)} = \frac{TP}{TP + FN}$$

False Positive Rate (FPR) is percentage of wrongly identified true person classes.

$$\text{Positive Rate (FPR)} = \frac{FP}{FP + TN}$$

The experimental results are given in table 4.1.

Table 4.1 Experimental results of the proposed research work

Measures	Values
Precision	0.981
Recall	0.981
Accuracy	98.10
False Positive Rate	0.035

IV. CONCLUSION

Face detection has concerned enormous attention because it has numerous applications in computer visualization communication and involuntary control system. Face recognition is a scheme to identify a face from an image which have numerous attributes in that image. Research into face recognition, appearance recognition, expression tracking, and posture estimation is required. From this results one cane confirm that the proposed face recognition system for smart home security surveillance

applications provides high detection accuracy with low false positive rate.

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