Automatic Detection of Crimes Captured in CCTV Images for Safety of Senior Citizens

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ABSTRACT

Closed circuit television systems (CCTV) are getting widely popular and are being deployed in many workspaces, housing estates and in most public spaces. Efficiency of CCTV surveillance can be improved by incorporation of image processing and object detection algorithm into monitoring process. In this project, we specialize in the task of automated detection and recognition of dangerous incidents for CCTV systems. We propose solutions that are able to alert the human operator when a weapon is visible in the image through e-mail. We have shown that it's possible to make a system that's capable of an early warning during a dangerous situation, which can cause faster and more effective response times and reduce in the number of potential victims. Face Detection and Face recognition of individuals is an intricate problem which has garnered much attention during recent years because of its ever-increasing applications in numerous fields. In this project the facial detection has been carried out using Viola Jones algorithm.

Keywords : Face Detection, Weapon Detection, E-Mail, Viola Jones Algorithm

I. INTRODUCTION

There is a growing demand in search for automated surveillance algorithms especially in the present situation, the necessity of CCTV cameras has become effective for the home surveillance to prevent the house from any kind of danger [1]. The main aim of automated surveillance is to alert CCTV operator when there's a dangerous situation.[2]. The concept of automated surveillance is possible with the help of incorporation of object detection algorithms. Efficiency of CCTV surveillance are often improved by incorporation of image processing and object detection algorithm into monitoring process.

Face recognition may be a major challenge encountered in multidimensional visual model analysis.[3] The art of recognizing the human face is quite tedious as it displays varying characteristics like

expressions, age, change in hairstyle etc. [3][4] Facial recognition plays crucial role in this project.

The aim of the proposed methodology is to detect the face in a picture and identify the person employing a standard image database with a far better efficiency and accuracy in comparison with the existing methods.

When an individual carries a weapon out in the open, it is a strong indicator of a dangerous situation.[2] The number of algorithms proposed to detect weapons from surveillance cameras is very small. Additionally, these proposed algorithms detect only some kind of weapon. The aim of this project is to find an object detection algorithm that can identify a weapon in surveillance camera image. Though the algorithm cannot stop the occurrence of crime automatically,[2]it could aid to surveillance camera operator that monitoring multiple screens by alerting him through a e-mail when a possible weapon is detected.

II. IMPLEMENTATION

The project uses python programming language to implement the modules. Different libraries and classifiers are imported to obtain the desired functionalities. This project involves implementation of the following modules:

1) Face recognition

Facial detection is the first part of the proposed system. Most face detection systems attempt to extract a section of the whole face, thereby eliminating and removing most of the background and other areas of an individual's face such as hair that are not essential for the process of face recognition. Facial Recognition process verifies if two faces are identical.

Algorithm used : Viola Jones algorithm

Viola-Jones algorithm is an object-recognition framework that enables the detection of image characteristics in real-time. Viola-Jones is quite powerful and its application has proven to be exceptionally notable in real time face detection.[5]

Library used: Face Recognition Library

This library scans the image provided as input and returns the bounding box coordinates of all recognised faces. To compare the package uses one of the most popular machine Learning methods linear SVM classifier. We can use the compare_faces function to determine if the faces are identical.[6]

2) Expression detection

Facial expression recognition is the task of categorizing the expressions on face images into various emotions such as anger, suprise, sadness, fear, disgust, happiness and so on.Facial expressions are the changes occurring on the human face indicating a person's internal emotional states, intentions or societal communications.

Library used: FER [Facial expression recognition]

Facial Expression Recognition is achieved from a deep neural network model using Tensorflow and Keras libraries implemented in python. Dataset used is from Kaggle competition Challenges in Representation Learning: Facial Expression Recognition Challenge.[7]

Weapon detection

Object identification that is dependent on digital image processing on weapons is very important for establishing effective security systems. This project presents a real-time framework for gun detection.

Library used: Haar Cascade Classifier

First, we need to load the Gun haar cascade classifiers. Then load the input image in grayscale mode. Now we find the guns in the image. If guns are detected, it returns the positions of detected guns as Rectangle (x, y, w, h). Once we get these locations, we can establish a ROI (Region of Interest) for the gun.[8]

Email notification

Library used -Simple Mail Transfer Protocol (SMTP)

Simple Mail Transfer Protocol (SMTP) allows users send

mail to another. Users receive email sent from Python applications via Internet Message Access Protocol (IMAP) and Post Office Protocol (POP) . They are the base for standard email interfaces such as Outlook and Gmail. The server can use SMTP to listen for email requests through a TCP connection and then transmit the email on port 587.[9]

A. Working of the System is as follows:

- Import the necessary libraries required for the project.
- Import the haar cascade files.
- Read the images from the registered visitor folder into an array.
- Read each image from the array and encode them.
- Encoded images are checked for the presence of faces. If face is present the encoded image is appended to a list, If no face is detected an error message is displayed.
- For Expression detection the image is passed as an input to the detector library to detect expression.
- For Face recognition, the input image or the image captured through the camera is passed and compared with the encoded list.
- If the index matches with the list the person is identified as a registered user and and the name of the person is displayed.
- Otherwise, the person is identified as a new visitor and the image is added to the Visitor's database folder with the date and time.
- The indexes obtained for different emotions are checked and the expression is evaluated accordingly.
- If the fear or anger emotion index of the image is greater than 20 the person has fear or is said to be angry.

- For weapon detection the image is converted into grayscale and is compared with the cascade file.
- If the gun is detected a box is drawn around the object in the image and weapon detected message is displayed.
- An email is sent from the admin with the results of face recognition, expression detection and weapon detection.

III. ARCHITECTURE AND MODULES

A. Modules

1) Face Recognition:

The python library Face Recognition library scans the image given as input and returns the bounding box coordinates of all recognised faces. Facial Recognition verifies if two faces are same. The use of facial recognition is huge in security, bio-metrics, entertainment, personal safety, etc. It finds face in an image, analyzes facial feature, compares features for the two input faces and returns True if matched or else False.
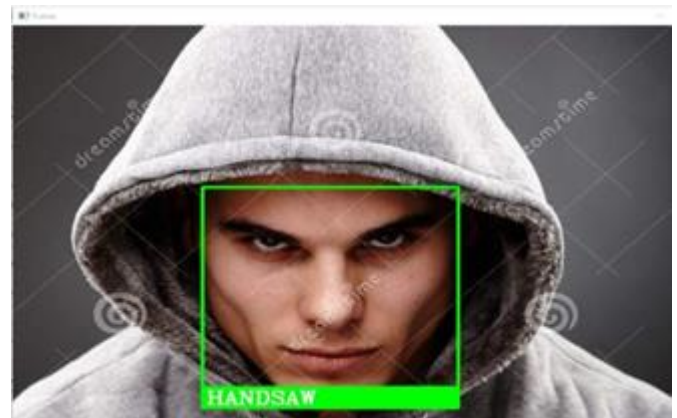

Figure 1. Face Recognition

2) Expression detection:

Face emotion recognizer using 'FER' library from python provides machines a way of sensing emotions that can be considered one of the most commonly used library in artificial intelligence and pattern analysis applications.

When it came to extracting people's expression images using RGB cameras, the majority of the Face emotion recognizer works used principal component analysis (PCA), which was used to recognise facial action units (FAUs) from facial expression images. PCA was also used for FER with the facial action coding system.

Figure 2: Expression detection

3) Weapon detection:

Project presents a real-time framework for gun detection as a part of Object recognition. The method uses image as an input and the library used for this purpose is Haar Cascade Classifier, Open-CV library. When the Weapon is detected, the proposed system prints the message "weapon is detected".

Figure 3 : Weapon detection

4) Email notification:

For each input of image, an image undergoes different modules of classification and the recipient will receive an alert in order ensure security in the premises

Figure 4: Email Notification

B. Architecture

Software architecture of a system of application refers to the fundamental structures of a software system and is an illustration of the system application that helps understand how it works and how it behaves. The project developed in the system refers to the architecture that is presented as a blueprint, defining how the work is to be carried through designing and implementation of the project. Architecture demonstrates three qualities of the system which are performance, modifiability and security. To achieve these qualities, it is important to combine architectural vision of system and team. Architecture is useful and effective way of early analysis where you can find design risks and eliminate them wary in the development process as well as ensure that the design approach taken is effective to produce well designed and acceptable system
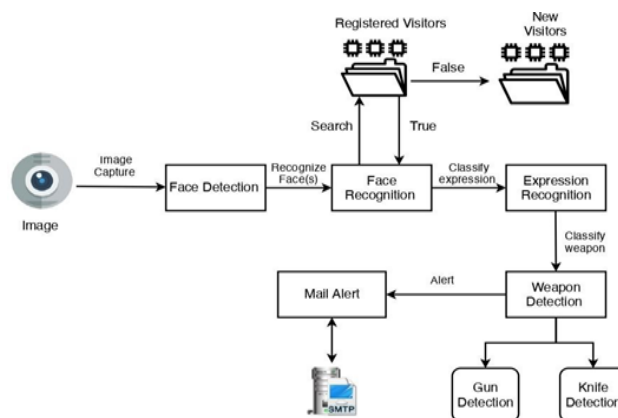

Figure 5: System Architecture

Face Detection: Faces are detected in image capture and are labelled as per the face recognition module.

Face Recognition: It labels face found in image capture by comparing the faces in the 'Registered Visitors 'file system.

Registered Visitor: It keeps a record of the registered faces in the system.

New Visitor: It adds new unregistered person is added to file system.

Expression Recognition: It labels the expression of faces in image capture is using the Python's FER library.

Weapon Detection: Its coverts image into grayscale and detects weapons using the classifiers.

Mail Alert: It is responsible for alerting authorities of suspicious activities by sending the relevant information via the smtp server.

IV. CONCLUSION

In this project, we employ a variety of algorithms to recognise and locate faces in photos. Skin segmentation in grey scaled image was used to detect faces using a variety of Image Processing Techniques. By studying the binary and grey scale variance in distinct regions of the face, the regions of the face were identified. Face recognition was integrated using a broad classification system. Face recognition was implemented using a global classification technique that classifies faces based on the standard deviation and the difference between the faces that were used as input and the faces that were used for training the algorithm. Face detection techniques results will be tested to see if they are satisfactory. The results when are compared to other procedures that have been used previously to check the accuracy. We will implement viola-jones methods for face detection using a variety of strategies in order to achieve accurate results.

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