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Eye of Devil: Face Recognition in Real World Surveillance Video with Feature Extraction and Pattern Matching

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Abstract: ***People lost, people missing etc., these are the words we come across whenever there is any mass gathering events going on or in crowded areas. To solve this issue some traditional approaches like announcements are in use. One idea is to identify the person using face recognition and pattern matching techniques. There are several techniques to implement face recognition like extraction of facial features by using the position of eyes, nose, jawbone or skin texture analysis etc., By using these techniques a unique dataset can be created for each human. Here the photograph of the missing person can be used to extract these facial features. After getting the dataset of that individual, by using pattern matching techniques, there is a scope to find the person with same facial features in the crowd images or videos.***
Keywords: Face-Recognition, Image-Processing, Feature extraction, Video-Processing, Pattern-Matching.

I. INTRODUCTION

Humans can't spend time by staying in one place. We tend to move and workout with our daily tasks. For some those tasks could be a part of their job and some would go around places for having fun. Whatever the situation is, there are some places which will get more populated due to daily actions of humans like temples, airports, malls etc., In such areas, there is a chance of people getting separated from their team or family and it would take some time to reunite with them among the crowd.

A traditional way we generally observe in heavily populated areas to reunite lost people with their family is by making announcements using a central operated speaker system and announcing that they will be at some place and the others should be coming there in-order to reunite with them.

A. Motivation

The main motivation of our project is

1) Due to increased population, missing cases became a common thing in human life.
2) Since all places can't be arranged with a control room and speakers like hospitals etc.,
3) We decided to automate this system by using surveillance cameras data.

B. Problem Statement

Now-a-days due to increase in population all over the world, people missing cases are increasing day by day. Though there are few services for finding the lost persons, they are not that effective. There are lots of pending missing cases recorded in police stations. Few areas like temples, malls, pilgrim areas are the places in India where there is higher chance to people getting separated from their families due to heavy crowd.

C. Scope

In this project we will be identifying the location of the person by using surveillance data from surveillance footage.

1) This work can be extended to identify the behavior of a person in a mall or any other places.
2) It can also be implemented in identifying criminals in places like malls or airports etc.,

D. Objective

The objective of this paper is:

1) To provide effective technique for person identification in crowd.
2) To unite missed people with his/her family.

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II. SOFTWARE REQUIREMENTS ANALYSIS

These are the software's we are using in our project.

A. MEAN Stack

The MEAN stack is JavaScript-based framework for developing web applications. MEAN is named after MongoDB, Express, Angular, and Node, the four key technologies that make up the layers of the stack.

1) MongoDB - document database
2) Express(.js) - Node.js web framework
3) Angular(.js) - a client-side JavaScript framework
4) Node(.js) - the premier JavaScript web server

There are variations to the MEAN stack such as MERN (replacing Angular.js with React.js) and MEVN (using Vue.js). The MEAN stack is one of the most popular technology concepts for building web applications.

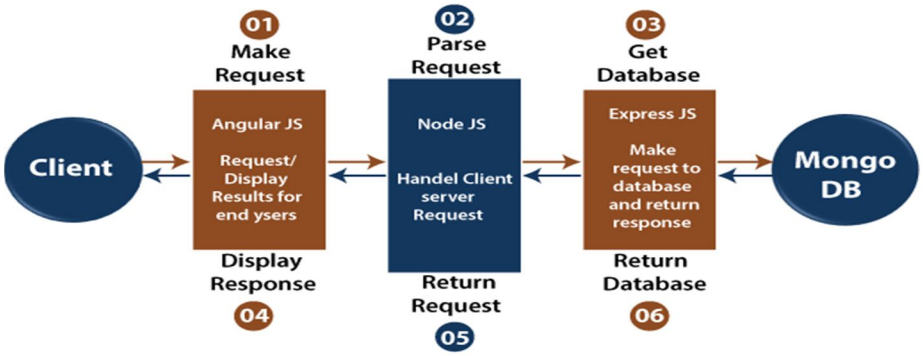


Fig2.1: MEAN stack Architecture flow

B. NPM

Often developing any application, you will need a lot of 3rd party libraries for your project and you need to learn to use a package manager to use these. Package manager for JavaScript gets installed with Node.js, Allows users to consume and distribute JavaScript modules (packages), Packages extend the functionality of your application and promotes reusability.

C. Ionic Framework

Ionic is a complete open-source SDK for hybrid mobile app development, built on top of Angular JS and Apache Cordova. Ionic provides tools and services for developing hybrid mobile apps using Web technologies like CSS, HTML5, and Sass.

D. Python

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. Python provides in-built libraries to do many computer vision operations such as face detection and face recognition. Open CV-Python is a library of Python bindings designed to solve computer vision problems. Open CV is supported by 2.7, 3.4, 3.5, and 3.6versions of python. Anyone of these versions is fine to work with.

III. HARDWARE REQUIREMENTS ANALYSIS

These are the hardware equipment that are required to gather data and process the information and display the result.

A. Surveillance Camera

Surveillance cameras are video cameras used for the purpose of observing an area. They are often connected to a recording device or IP network, and may be watched by a security guard or law enforcement officer. Cameras and recording equipment used to be relatively expensive and required human personnel to monitor camera footage, but analysis of footage has been made easier by automated software that organizes digital video footage into a searchable database, and by video analysis software (such as VIRAT and Human ID). The amount of footage is also drastically reduced by motion sensors which only record when motion is detected. With cheaper production techniques, surveillance cameras are simple and inexpensive enough to be used in home security systems, and for everyday surveillance.

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B. Smartphone

Smart phones are a class of multi-purpose mobile computing device. They are distinguished from feature phones by their stronger hardware capabilities and extensive mobile operating systems, which facilitate wider software, internet (including web browsing over mobile broadband), and multimedia functionality (including music, video, cameras, and gaming), alongside core phone functions such as voice calls and text messaging. Smartphones typically include various sensors that can be leveraged by their software, such as a magnetometer, proximity sensors, barometer, gyroscope and accelerometer and support wireless communications protocols such as Bluetooth, Wi-Fi, and satellite navigation.

IV. PROPOSED METHODOLOGY

Images of the missing person are received from their families via a mobile application. From these images, facial features of that person are collected by using feature set extraction algorithms and that feature set is stored in a database. Now from the surveillance camera either video or image data of the crowd is taken. From those, extraction of faces is done. From those faces, feature set for each face is taken out by using feature set extraction algorithms. Now finding a relative match between the feature set in database and the feature sets extracted is done and identification of person is achieved. Thus, from the data of camera from which the face of the matched person is recorded, location of the person can also be identified.

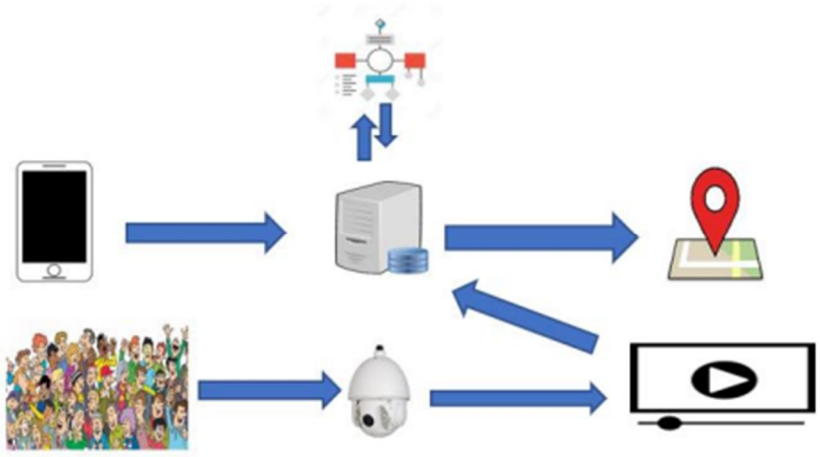


Fig 4.1 Proposed System

A. Mobile Phone

Mobile Phone is the starting point of the process from the user view. Through mobile application developed by our team, from a mobile phone first user needs to have an account in our database. For registration user need to provide some credentials like phone number, email ID, user name etc., After finishing registration, user can register complaints by going into register complaint page. There user can be able to register complaint by giving some 32 details like missed person's photos, name etc., After filling necessary details, mobile application will send those details to the server.

B. Surveillance Camera

Surveillance cameras are eyes of the whole system because they are responsible to collect the surveillance footage and send it to the server in order to process it. Surveillance camera will record the video of the crowd and sends it to the server in any specific format like mp4 or 3gp or AVI or mkv etc.,

C. Server

Server is the heart of the whole system as it is responsible for gathering the complaints from user, collecting surveillance data, maintaining database, processing the data by using specific algorithms. Server upon receiving the images form mobile application, generates a feature set of the lost person by using the images received in the complaint and stores it in it's database. Later from the surveillance footage, feature sets of the people in crowd are also extracted and comparisons are done between these two datasets in order to find any matching for the missing person. Final status will be sent to the mobile application that may contain the location details of the lost person if found or any negative reply like person not found.

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D. Algorithms

Algorithms are the brain part of the system as they are responsible for how to process the data and generate output. Server is responsible to run the algorithms and these algorithms are responsible for generating the outputs. Algorithms includes face detection algorithms, facial feature extraction algorithms, video to frame conversion algorithms, noise removal algorithms feature set matching algorithms etc., In this project we used naïve frame conversion algorithm to convert a video into frames.

V. CODING

Algorithm for mobile application working:

1) *Step 1:* Create a user account or login into eye of devil application.
2) *Step 2:* Go to Register Complaint page to register a complaint.
3) *Step 3:* Eye of Devil takes the input and generates feature set of the missing person.
4) *Step 4:* In parallel, Eye of Devil server receives the surveillance footage from surveillance cameras and generates the feature sets of the people in those videos.
5) *Step 5:* A comparison between the feature sets is done to identify the lost person.
6) *Step 6:* If any matching feature set is found, then location of the person is marked by using the location of the camera from which the video is taken.
7) *Step 7:* Server sends the location details to the mobile application.

VI. TESTING

Testing is a process of detecting errors. It is a process of executing a program with the explicit intention of finding errors.

Checking the working of preview						
TEST_ID: id 1			TEST DESIGNED BY: M.B. Tej			
MODULE_NAME: MobileApplication			TEST DESIGNED DATE: 07-11-2018			
TEST_TITLE: Testingpreview			TEST EXECUTION DATE: 07-11-2018			
PRE CONDITIONS: Android application is needed to be installed into an android mobile						
TEST DESCRIPTION :To test preview						
TEST TYPE : Black box testing						
STAGE	TEST STAGE	TEST DATA	EXPETED RESULT	ACTUAL RESULT	STATUS	REMARKS
1	No preview obtained	---	Mobile phone not compatible	Mobile phone not compatible	pass	Error messageis displayed
2	Obtaining preview	---	App is opened	App is opened	Pass	App layout is displayed

Checking the working of login page						
TEST_ID : id 2			TEST DESIGNED BY : Vamsi			
MODULE_NAME: MobileApplication			TEST DESIGNED DATE : 08-11-2018			
TEST_TITLE :Testing loginpage			TEST EXECUTION DATE: 08-11-2018			
PRE CONDITIONS : Username and Password are needed to be given as input.						
TEST DESCRIPTION : To test login page						
TEST TYPE : Black box testing						
STAGE	TEST STAGE	TEST DATA	EXPETED RESULT	ACTUAL RESULT	STATUS	REMARKS
1	Not yet logged into the account	Invalid usernameand password	Error message should be displayed	Error message is displayed	Pass	Error messageis displayed
2	User's own pageis opened	Valid usernameand password	Log must be successful	Logged in successfully	Pass	User's profilepage is displayed

Table 6.1: Testing Mobile application environment and login page

Checking the working of Complaint registration						
TEST_ID: id 3			TEST DESIGNED BY: Vamsi			
MODULE_NAME: MobileApplication			TEST DESIGNED DATE: 09-11-2018			
TEST_TITLE: Testingpreview			TEST EXECUTION DATE: 09-11-2018			
PRE CONDITIONS: Android application is needed to be installed into an android mobile						
TEST DESCRIPTION :To test complaint registration page						
TEST TYPE : Black box testing						
STAGE	TEST STAGE	TEST DATA	EXPETED RESULT	ACTUAL RESULT	STATUS	REMARKS
1	No mailsare received	Invaliddetails	Failure in registering complaint	Complaint registration failed	Pass	Error messageis displayed
2	Mails describing the complaintare received	Details like name,images, address	Successfulin registering complaint	Complaint registration done successfully	Pass	Mails were received describing the complaint registered

Checking the working of face detection						
TEST_ID: id 4			TEST DESIGNED BY : M.B. Tej			
MODULE_NAME: Face Detection			TEST DESIGNED DATE : 10-11-2018			
TEST_TITLE: Testing facedetection			TEST EXECUTION DATE: 10-11-2018			
PRE CONDITIONS : A system capable of running python programs.						
TEST DESCRIPTION : To test face detection.						
TEST TYPE : Black box testing						
STAGE	TEST STAGE	TEST DATA	EXPETED RESULT	ACTUAL RESULT	STATUS	REMARKS
1	No faces detected	An imagewith no faces	No faces detected	No faceswere detected	Pass	No images offaces were generated
2	Faces are detected	Image with fewpeople's faces	People faces detected from the given image	Few facesfrom the people in image are detected	Pass	Images of faces detectedare generated

Table 6.2: Testing Mobile Application Register Complaint page and Face detection program.

VII. RESULTS

A. *Result of Video to Frame Conversion Module*

This is the result of video to frame conversion code. A video of 40 seconds is used to test it.It generated 1197 frames.

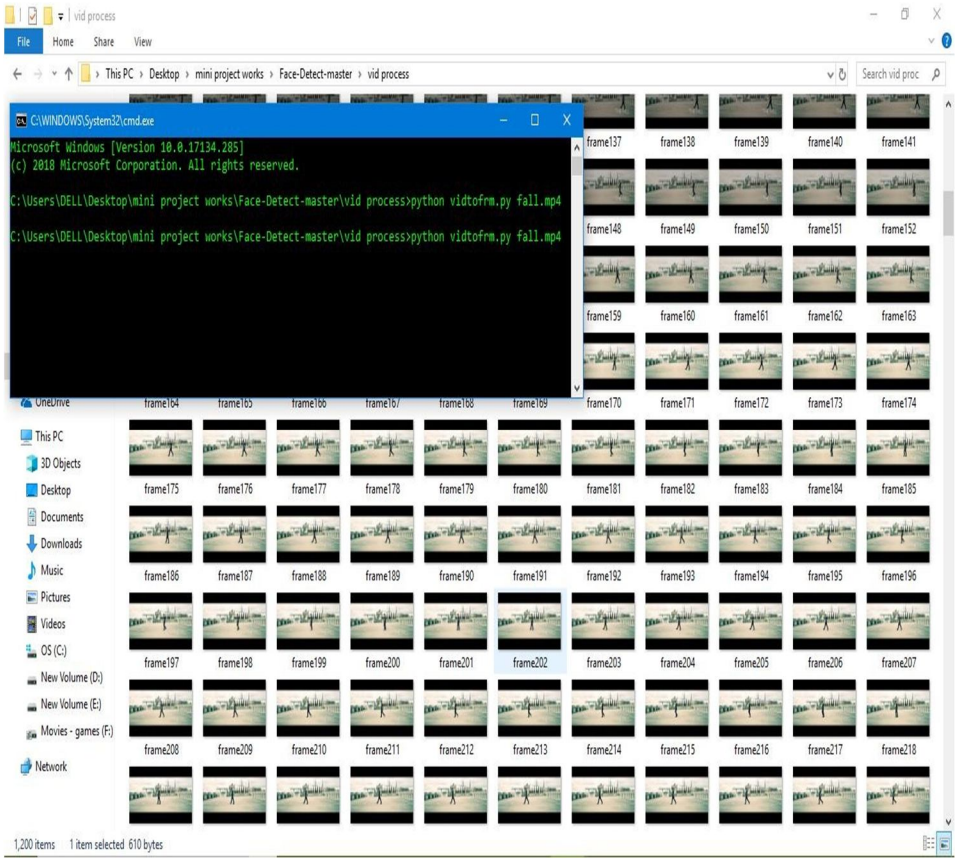


Fig 7.1: Video to frame conversion output.

B. Result of Face Detection Module

This is the output for face detection code. A sample image is given as input and the below shown image is generated as output along with faces cropped collected into a folder.

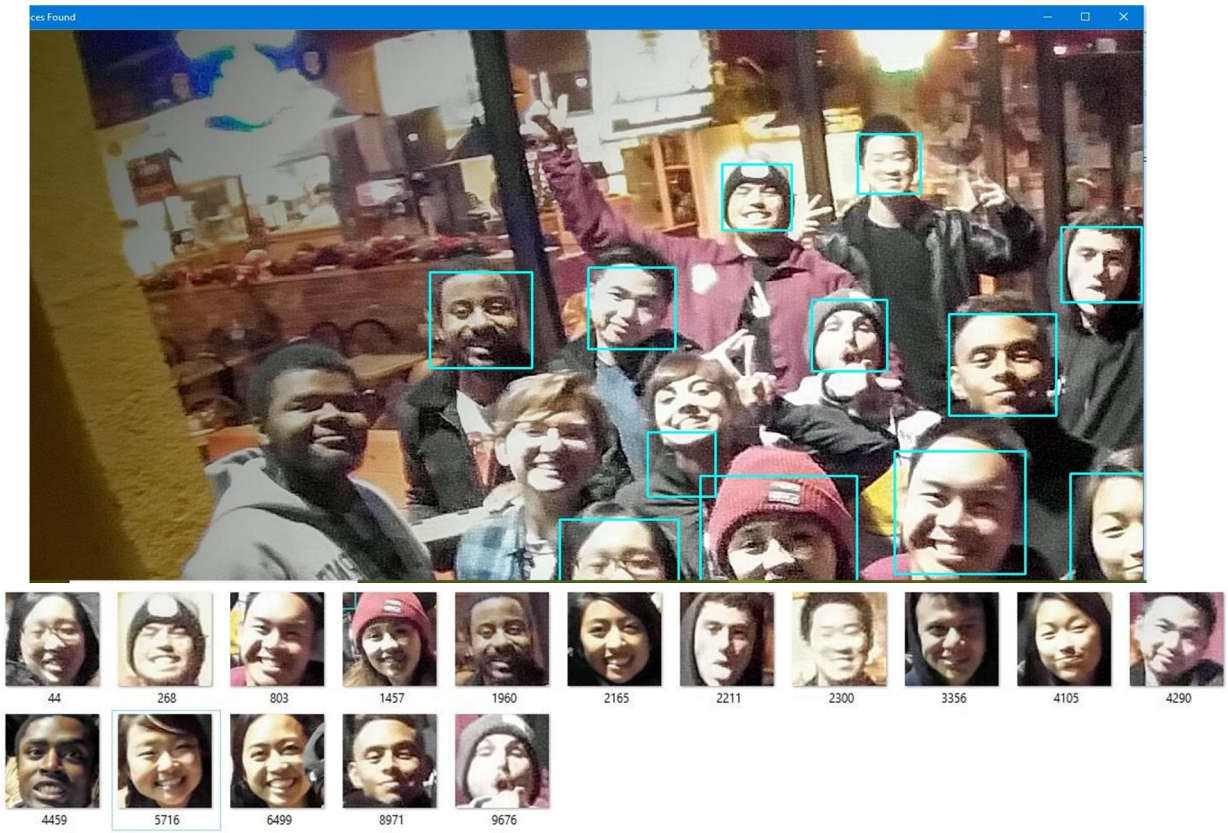


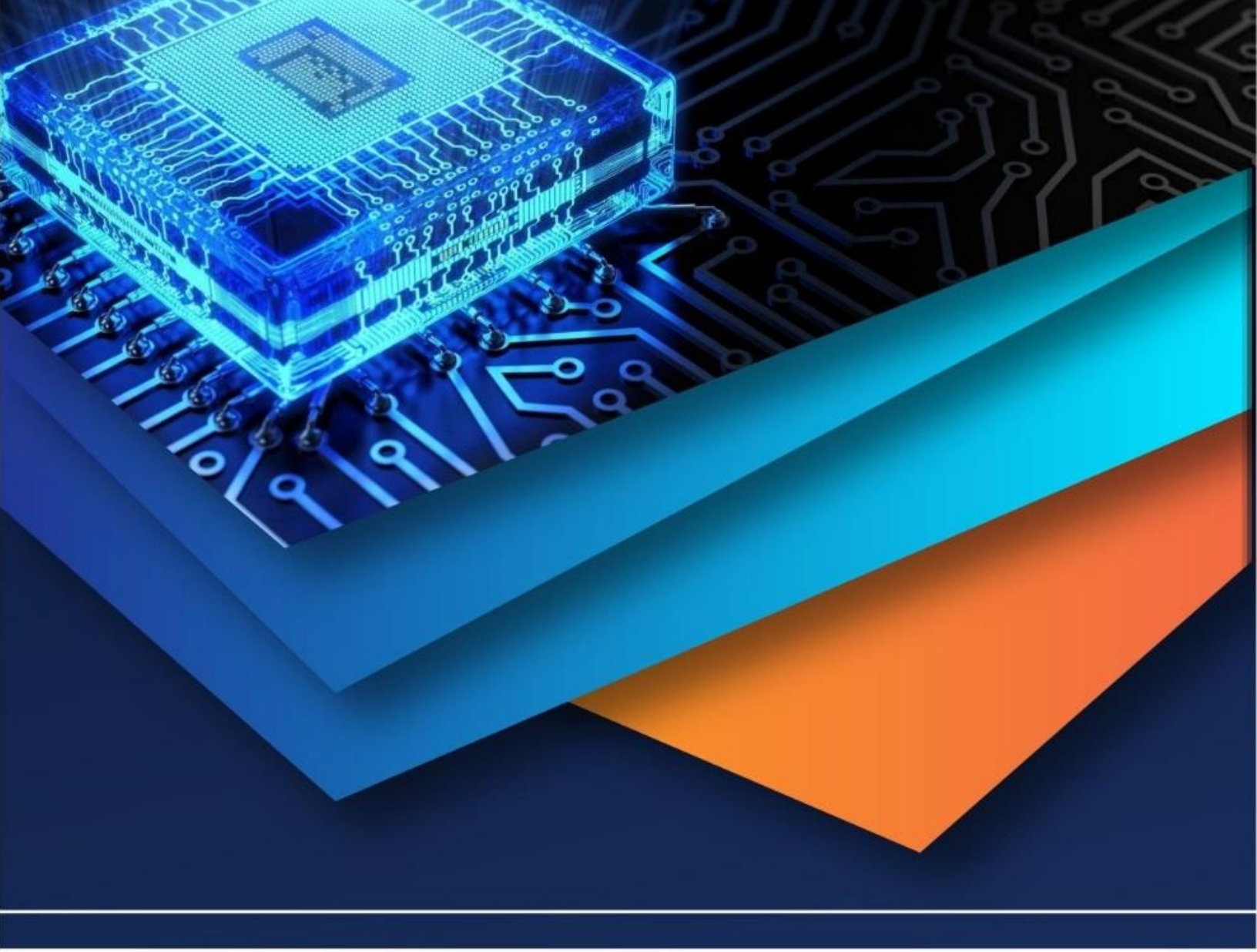
Fig 7.2: Face detection outputs.

VIII. CONCLUSION

Thus, mobile application module is completed and video to frame conversion module is completed and face detection from images is completed successfully. Mobile application is used to register a complaint which will be sent to the server, server takes the surveillance video and performs frame generation operation and face detection from images. The output of the system is based on the images sent while registering complaint and the quality of video sent by surveillance camera. Video processing operations like filtering, masking etc., are yetto be done. Along with it face recognition module is also need to be implemented.

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