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MOVING OBJECT RECOGNITION AND TRACKING USING BLOB DETECTION ALGORITHM

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Abstract:- Moving object detection and tracking is often the first step in video surveillance. Video surveillance has been a very active research topic in the last little years due to growing importance in security, law enforcement and forces applications. In this work, this system proposes the implementation of an efficient object detection algorithm that can be employed in real time software systems due to its fast processing. This paper proposes an advanced machinery called OpenCV to detect moving object based on Blob matching tracking algorithm. This paper presents a simplified single object detection method such as capture based on image difference and a blob matching tracking algorithm that relies only on blob matching information without having to use algebraic descriptions.

I. INTRODUCTION

Face Recognition has been a major subject of studies in the past few decades. It is something that comes natural to humans. Our brain does complex analysis of faces in order to store useful information about them, which comes handy when trying to recognize a face by simply picking the match (Dakin and Watt in 2009). Scientists still do not fully understand how the brain functions (Marcus in 2012). However, that did not stop scientists from taking some tasks that the brain can do and try to break them down to simple steps to have a general understanding of that task. Computers are becoming as an essential part of our life such as desktop, phones, glasses and many more; their task is to make life easier. Since computers are growing dramatically in terms of performance, teaching a computer how to do brain like tasks become more feasible than ever before. The automatic identification of a person by his/her faces from an image or video stream has wide application is on mobile devices, the use for it can be extended dramatically. It can be companied with other features of mobile devices such as geo location or even the orientation of the device.

Face recognition subject merged in the early 1970s. However, its rapid development began in the 1990s, after the establishment of new technologies in the field of image processing and machine learning. Face recognition is a program that is used to identify faces automatically and verify the identity of a person from a digital image or a video. In general, the face recognition problem is composed of two stages. First, detecting a face, i.e. finding a face in an image frame regardless of who the person is. Second, identifying who the person is in the frame. By comparing the features of the detected face to the image faces database the system can identify the person in the image. To be able to label the person in the image, the machine should have been trained beforehand. The training steps involve detecting a face then use some image processing techniques to insure the clarity of the faces for the machine. After that, applying one of many training algorithms to teach the system who that person is.

Face detection is a process of locating a face inside an image frame, regardless of the identity of that face. It works not only for frontal face view but it can detect faces from side view as well. The basic principles that Viola and Jones method is based on are as follows;

- ➢ Images used in the integral representation that allows a machine to calculate the necessary object features.
- ➢ Using Haar-like features, the desired feature of the face can be found.
- ➢ Adaptive boosting used to select the most suitable characteristics for the desired object to this part of the image.

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All the features are input to the classifier, which gives the result true or false. The basic idea of the Haar-based face detector is that if you look at most frontal faces, the region with the eyes should be darker than the forehead and cheeks, and so on. It typically performs about 20 stages of comparisons like to decide if it is a face improved it in 2002. It works not only for frontal view but it can detect faces from side view as well. According to Baggio, the classifier can be trained using at least 1000 unique faces (positive images) and 10,000 images that do not contain face on them (Negative images). The negative can be anything other than faces. The training of the classifier produces an XML file to be used in the detection process. This file can then be ported into mobile devices to detect faces.

II. PROPOSED SYSTEM

We proposes a general moving object detection and tracking based on vision system for real time application such as attendance, track and monitoring movable objects and face recognition. The proposed approach is based on small sample size for training images and small number of classes, and then it can reach best calculation time, best power consuming and at the same time reach the best performance. All images are taken after detection (In gray scale, each image only contains person's face). This approach evokes pixel wise information of face images to different classes using Fuzzy Pixel Wise Information Extraction (FPIE). Training images are read in column vector form then apply FPIE. One Fuzzy vector is generated for each face image. Discriminative Common Vector (DCV) is then applied to find common vector corresponding to each class. By this way, number of images used for training is reduced. PCA is then applied on generated common vectors.

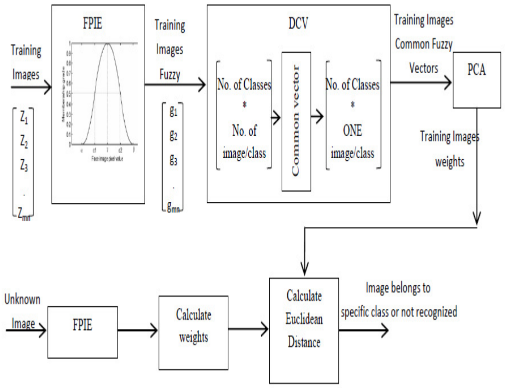


Fig: 1 Block Diagram of Fuzzy Pixel Wise Information Extraction

III. MODULES OF PROPOSED SYSTEM

FPIE module generates pixel wise degree of association of a face image to different classes using Membership Function (MF). This takes a face image as an input and using MF, fuzzifies the pixel values of the image. This generates the membership of individual pixel to different classes. This function can be generalized such that the values assigned to the pixels of the training set fall within a specified range which may be the unit interval [0, 1]. Thus, these values which are real numbers in [0, 1], express the membership grade of the elements of the universal set. Larger values indicate higher degrees of set membership.

A face image can be represented as an mxn dimensional matrix with m number of rows and n number of columns. Compute the non-zero eigenvalues and corresponding eigenvectors of SWby using the matrix ATA, where SW, AAT and A is given by

The eigenface scheme is pursed as a dimensionality reduction approach, more generally known as principal component analysis (PCA), or Karhunen – Loeve method. Such method chooses a dimensionality reducing linear paperion that maximizes the scatter of all papered images. Given a training set of N images Γi (i = 1, 2….N), each of size mxn, it could be turned into a big matrix as

$$A = [\varphi 1\ \varphi 2\ \varphi N]$$

Where φi's are column vectors, each corresponding to an image. Average face is calculated as

$$\mu = \text{mean } \varphi i$$

The total scatter matrix is defined as

$$ST = AAT$$

PCA leads to find the paperion Wopt that maximizes the determinant of the total scatter matrix of the papered images.

$$Wopt = ar\ gw\ max\ WT\ STW$$

Where wi's are eigenvalues of ST corresponding to the p largest eigenvalues. Each of them corresponds to an eigenface. The dimension of the feature space is thus reduced to p. The weights of the training set images and test images could be then calculated and the Euclidean distances are obtained. The test face is recognized as the face of training set with the closest distance, if such distance is below a certain distance. In this approach, the number of samples used for training is reduced, to reduce the time of recognition for mobile environment and at the same time get the best performance. Using FPIE, then find the common vector that represents each class using DCV, to reduce number of samples again. Finally PCA is added for testing. This approach outperforms other traditional techniques as shown in the results.

IV. BLOB DETECTION

A Binary Large Object (BLOB) is a collection of binary data stored as a single entity in a database management system. Blobs are typically images, audio or other multimedia objects, though sometimes binary executable code is stored as a blob. Database support for blobs is not universal. The name "blob" is further borrowed by the deep learning software Caffe to represent multi-dimensional arrays. The term "large" indicates that only object of a certain size are of interest and that "small" binary objects are usually noise. In Computer vision, blob detection methods are aimed at detecting region in a digital image that differs in properties such as brightness or color, compared to surrounding regions. Informally, a blob is a region of an image in which some properties are constant or approximately constant; all the points in a blob can be considered in some sense to be similar to each other. The most common method for blob detection is Convolution. In OpenCV, Blob is a library for computer vision to detect connected regions in binary digital images. Given some property of interest expressed as a function of position on the image. With the more recent terminology used in the field, these detectors can also be referred to as interest point operators, or alternatively interest region operators (see also interest point detection and corner detection). There are several motivations for studying and developing blob detectors. One main reason is to provide complementary information about regions, which are not obtained from edge detectors or corner detectors. In early work in the area, blob detection was used to obtain regions of interest for further processing. These regions could signal the presence of objects in the image domain with application to object recognition and/or object tracking.

WORKING OF BLOB DETECTION

The Blob detection algorithm is controlled by the following parameters;

1. **Thresholding:** Convert the source images to several binary images by Thresholding the source image with thresholds starting at minThreshold. These thresholds are incremented by thresholdStep until maxThreshold. So the first threshold is minThreshold, the second is minThreshold + thresholdStep, the third is minThreshold, and so on.
2. **Grouping:** In each binary image, connected white pixels are grouped together.
3. **Merging:** The centers of the binary blobs in the binary images are computed, and blobs located closer than minDistBetweenBlobs are merged.
4. **Center & radius Calculation:** The centers and radii of the new merged blobs are computed and returned.

V. BLOB FILTERING

The blob detector can be set to filter by the following parameters;

➢ **By Color:** First we need to set filter By Color = 1. Set blob Color = 0 to select darker blobs and blob Color = 255 for lighter blobs.

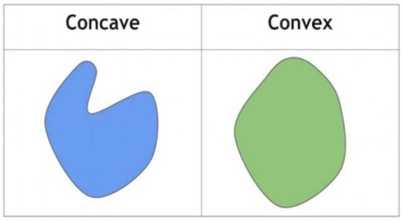
➢ **By Size:** We can filter the blobs based on size by setting the parameters filter By Area = 1 and appropriate values for min Area and max Area. E.g. setting min Area = 100 with filter out all the blobs that have less than 100 pixels.

➢ **By Shape:** Now shape has three different parameters;

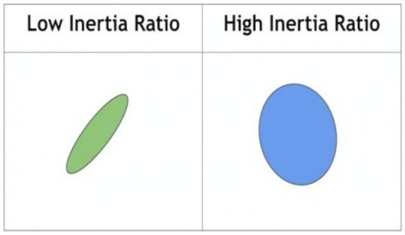
1. **Circularity:** It just measures how close to a circle the blob is. E.g. a regular hexagon has higher circularity than say a square. To filter by circularity, set filter By Circularity = 1. Then set appropriate values for min Circularity and max Circularity. Circularity is defined as

$$\frac{4\pi Area}{(perimeter)^2}$$

2. **Convexity:** A picture is worth a thousand words. Convexity is defined as the (Area of the blob/ Area of its convex hull). Now, Convex Hull of a shape is the tightest convex shape that completely encloses the shape. To find by convexity, set filterByConvexity = 1, followed by setting $0 \leq$ minconvexity ≤ 1 and maxConvexity (≤ 1).



3. **Inertia Ratio:** It measures how elongated a shape is. E.g. for a circle, this value is 1, for an eclipse it is between 0 and 1 and for a line it is 0. To filter by inertia ratio, set filterByInertia = 1, and set 0 ≤ minInertiaRatio ≤ 1 and maxInertiaRatio (≤1) appropriately.



VI. BLOB DETECTION AND TRACKING

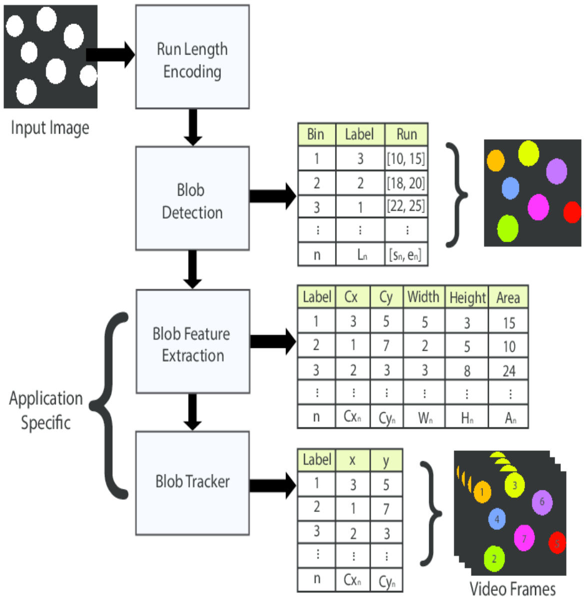


Fig: 2 Diagram of Blob detection and Tracking

BLOB EXTRACTION

The purpose of BLOB extraction is to isolate the BLOBs (objects) in a binary image. A BLOB consists of a group of connected pixels. Whether or not two pixels are connected is defined by the connectivity, that is, which pixels are neighbors and which are not. The two most often applied types of connectivity are 8-connectivity and 4-connectivity. The 8-connectivity is more accurate than the 4-connectivity, but the 4-connectivity is often applied since it requires fewer computations, hence it can process the image faster. A number of different algorithms exist for finding the BLOBs and such algorithms are usually referred to as connected component labelling.

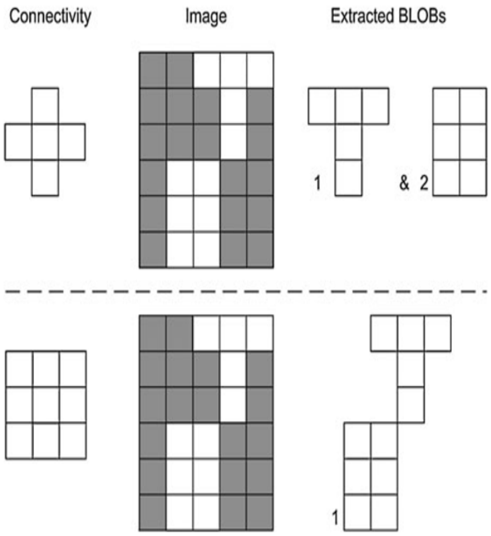


Fig: 3 4- and 8- connectivity. The effect of applying two different types of connectivity

OPENCV TECHNOLOGY

OpenCV (Open Source Computer Vision) is an open source computer vision and machine learning software library. It was built for various purpose such as machine learning, computer vision, algorithm, mathematical operations, video capturing, image processing, etc.,. It was designed by Intel to process images, because it was meant for image processing. It was loaded with many of the algorithms and functions to help computer scientists solve vision related problems. OpenCV offers applications that will help to train cascade classifier. “OpenCV4Android is the official name of the Android port of the OpenCV library”.Being a BSD-licensed product, OpenCV makes it easy for business to utilize and modify the code. Over the years it has become very popular among the researchers and developers as for its support in different platforms (Windows, Linux, Android, ios). Also it has wrapper in various renowned programming languages.

The library contains more than 2500 optimized algorithms, which has excellent accuracy in performance and speed. These algorithm can be used to detect and recognize faces, identify objects, classify human actions in video, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch image together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from image taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc,.. The library is extensively in professional companies, research group and other groups.

VII. IMAGE SEGMENTATION IN OPENCV

The goal of this is to apply to video stream captured from our web cam either a Canny edge detector or a trivial background removal using the following two basic morphological operations: Dilation and Erosion.

Canny Edge Detector

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It was developed by John F. Canny in 1986. Canny edge detection is a four step process. The Canny algorithm contains a number of adjustable parameters, which can affect the computation time and effectiveness of the algorithm.

Dilation and erosion

Dilation: The value of the output pixels is the maximum value of all the pixels in the maximum value of all the pixels in the input pixel's neighbourhood. In a binary image, if any pixels are set to the value 1, then the output pixel is set to 1.

Erosion: The value of the input pixel is the minimum value of all the pixels in the input pixel's neighbourhood. In a binary image, if any of the pixels is set to 0, the output pixel is set to 0.

FACE DETECTION IN OPENCV

OpenCV (Open Source Computer Vision) is a library of programming functions for real-time computer vision. The face detection part of the paper was made using an OpenCV Library for Scala. The reason was that most Face APIs are restricted to doing detection on pictures only, whereas the paper was required to have face detection done on a live video footage tospeed up the process of checking student attendance and prevent queues before lectures. The OpenCV library proved to be flexible enough for the paper as it can accurately detect a face in real time and highlight it by drawing a rectangle around the faces of the students passing by. This all happens in a window separate from the face recognition so the lecturer can keep track of both students passing by while having their faces detected and the feedback from the recognition part of the system. While faces are being detected, the application takes a snapshot of the live footage every second and then sends it to the recognition system.

MERITS USING OPENCV

- Human – Computer Interaction (HCI)
- Object Identification
- Object Recognition
- Face Recognition
- Gesture Recognition
- Motion Tracking
- Image Processing
- Mobile Robotics

VIII. SYSTEM DESIGN

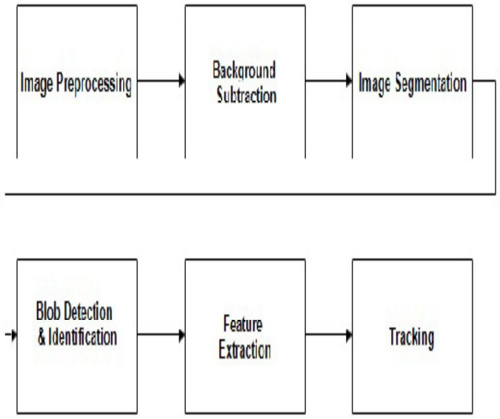


Fig: 4 Block diagram of system design

a) Image Pre-processing

The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. It is a common name for operations with images at the lowest level of abstraction – both input and output are intensity images. This method is based on the size of the pixel neighbourhood that is used for the calculation of new pixel brightness. It uses the considerable redundancy in images. The goal of pre-processing is to enhance the visual appearance of images and improves the manipulation of datasets. Import an image with an optical scanner or directly through digital photography. Manipulate or analyse the image in some way. This stage can include image enhancement and data compression or the image may be analysed to find patterns that aren't visible by the human eye.

b) Background Subtraction

Background subtraction is also known as foreground detection is a technique in the fields of image processing and computer vision wherein an image's foreground is extracted for further processing (object recognition). It is a widely used approach for detecting moving objects from static cameras. Fundamental logic for detecting mobbing objects from the difference between the current frame and a reference frame called "background subtraction" and this method is known as "frame difference method". The background image is not fixed but must adapt to illumination changes, motion changes and changes in the background geometry. It is widely used in traffic monitoring, human action recognition, human-computer interaction, object tracking and in many other cool applications of computer vision such as digital forensics.

c) Image Segmentation

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image is nothing but the replica of object. Segmentation is the process of grouping together pixels that have similar attributes. Image segmentation is the process of partitioning an image into non-intersecting regions such that each region is homogeneous and the union of no two adjacent regions is homogeneous. Segmentation accuracy determines the eventual success or failure of computerized analysis procedure.

d)Blob detection and identification

In Computer vision, blob detection methods are aimed at detecting regions in a digital image that differ in properties, such as brightness or color, compared to surrounding regions. The most common method for blob detection is Convolution.

e) Feature Extraction

Feature extraction is a dimensionality reduction process, where an initial set of raw variables is reduced to more manageable groups (features) for processing, while still accurately and completely describing the original data set. In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some classes lead to better human interpretations.

f) Tracking

It is the retention of information that can be used to connect records of a person's actions or reading habits across space, cyberspace, or time.

How does OpenCV face recognition works?

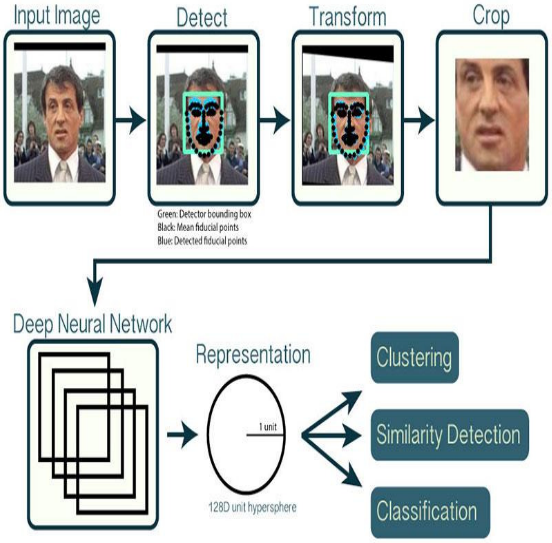


Fig: 5 Working of OpenCV face recognition

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IX. FLOWCHART

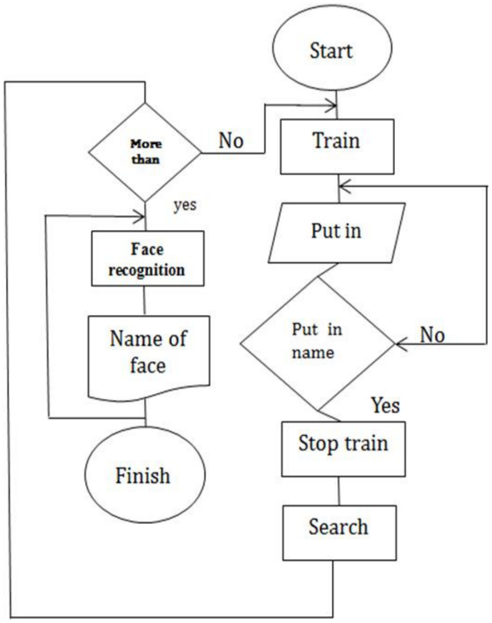
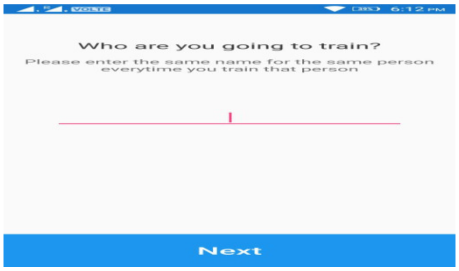


Fig: 6 Overall process of implementation of face recognition application chart

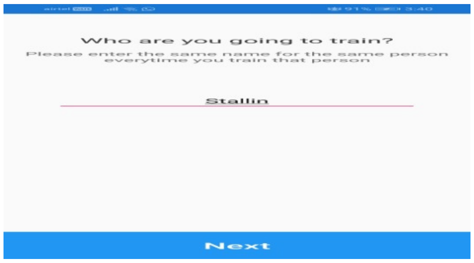
X. RESULT MODULES

Face capturing module


Who are you going to train?

Please enter the same name for the same person everytime you train that person

Fig: 7 Training Tab


Who are you going to train?

Please enter the same name for the same person everytime you train that person

Stallin

Fig: 8 Training Tab with name

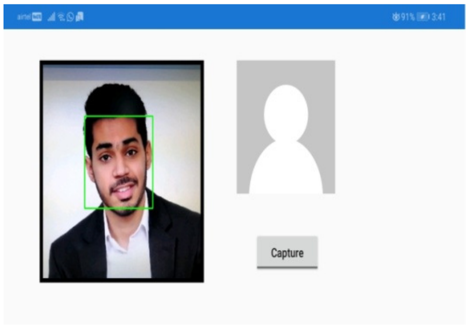


Fig: 9 Capture Tab

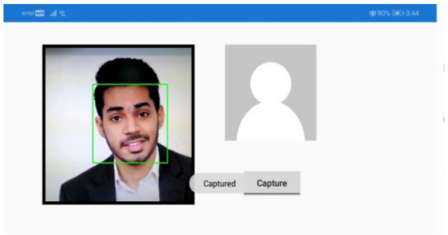


Fig: 10 Captured Tab

Face Recognising module

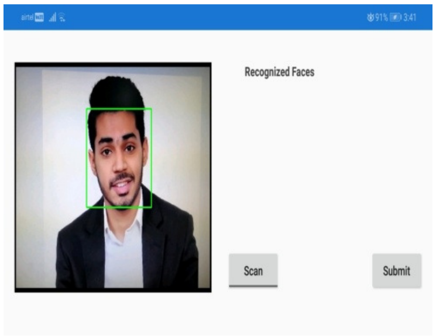


Fig: 11 Scan Tab

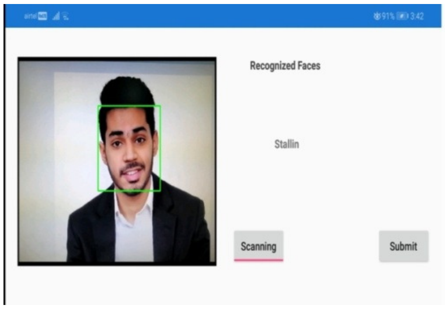


Fig: 12 Scanned Tab

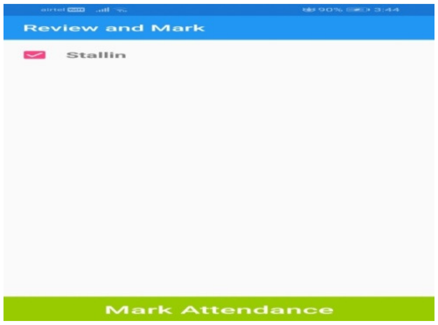


Fig: 13 Review and mark Tab

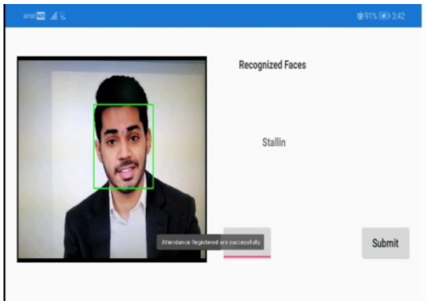
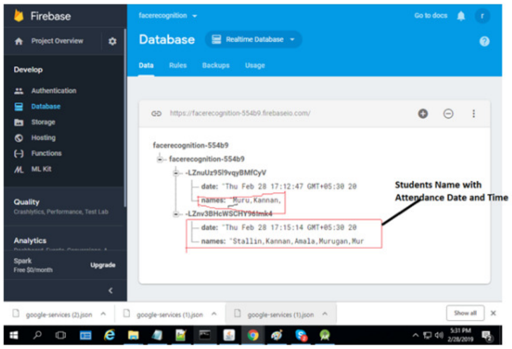


Fig: 14 Attendance Capture Tab



```
https://facerecognition-554b9.firebaseio.com/

facerecognition-554b9
  facerecognition-554b9
    -LZnuUz95l9vqyBMfCyV
      date: "Thu Feb 28 17:12:47 GMT+05:30 20
      names: "Muru,Kannan,
    -LZnv3BHcWSCHY96lmk4
      date: "Thu Feb 28 17:15:14 GMT+05:30 20
      names: "Stallin,Kannan,Amala,Murugan,Mur
```

Students Name with Attendance Date and Time

Fig: 15 Firebase Database

XI. APPLICATIONS

The main applications of face recognition are in table 9.1. For each group, the sample applications are also listed. Our application of recognition system of individual identification recognition background is by using the portable android tools which are similar to mobile.

S.NO	APPLICATIONS	FIELDS
1	Driving ID card, immigration, national code passport, the voter's registration, people recognition and finding their files.	Face ID
2	Car accessibility, ATM and intelligent booth, computer and online accessibility and accessibility of online exams.	Control access
3	Flying security system, stadium fan scanning, computer security, files coding	Surveillance
4	Conserved value security, users	Smart card
5	Suspects warning and preventing crime, prosecution and suspect files survey, recognition and exploitation of crime face	Low Enforcement
6	Faces marking and Images gaining, faces classification automatic labelling	Face data base
7	Researching based on face, video segregating based on face identification	Multimedia management
8	Interaction games, Interaction computation	Human and computer interaction

Table: 1 Main applications of face recognition

XII. CONCLUSION

For this paper, we achieve with an object-tracking program that can track multiple objects. We add intelligence to our program to track moving object recognition. An object tracking algorithm is developed and implemented on Open CV based on background subtraction, BLOB detection using adjacent pixel values. Presence of crisp fuzzier plays a major role in processing pixel data in image segmentation, which solved the salt pepper noise. In this work, we overcome the drawbacks of the object occlusion which are in poor quality. Tracking accuracy is quite good based on the result that moving objects are correctly tracked through the whole sequence.

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