

Live Integrated Facial Observation (L.I.F.O.)

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Abstract

A human face is the most influential part of humans that can uniquely identify a person. Using all the facial characteristics as biometric, the LIFO system can be applicable in many different ways. Like in everyday life, the most mandatory task in any organization is attendance marking. Earlier, people used to mark their presence using paperwork but now along with the advancement of technology, this system has also changed and converted into digital form. Talking about this project, face recognition approach has been taken using open CV. In this model, we have integrated a camera that captures an image as an input, an algorithm for detecting a face from an input image, encoding and identifying the face. After that, record will be automatically updated on a CSV file. The system is then trained on the authorized student faces and the dB is created for the trained data. The database for cropped images is then created along with the associated labels. The features are extracted using Harr Cascade classifier. Not only the attendance system but we can also monitor every behavior of students with the help of their face. Like, analyzing the facial expression, the teachers can conclude if the students understanding their lectures or not. This is done with the help of recently evolved technology i.e. Landmark detector, which is trained with large datasets and exhibits excellent robustness against different angles concerning the camera. It is seen that the precision of eye-opening level are evaluated according to the landmarks. The landmark detector algorithm extracts the scaler quantity eyes-aspect-ratio characterizing the opening of eyes in each frame. Finally, the support vector machine detects the blinking of eyes as a pattern of EAR values and displays it on window. After getting this kind of report, teacher can record the behaviors. Emotion analysis is also going to be part of this project which is very helpful for the teachers. The emotions are sorted into six classes namely anger, joy, surprise, disgust, sadness, and fear from face image datasets. To carry out the particular operation, a camera in several areas like college/classroom, offices, movie auditorium, and in front of a car will be equipped that can be able to recognize the emotions of people introducing a potent new form of artificial intelligence into education for monitoring children for classroom compliance. Here in this project, there will be no existing data about the previous behavior of the students and works on real-time expression tracking.

Keywords: Advancement of technology, artificial intelligence, LIFO, open CV, support vector machine

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Received Date: July 08, 2021

Accepted Date: September 17, 2021

Published Date: October 18, 2021

Citation: Anjali Kesarwani, Shubhangi Saxena, Ananmay Sinha, Ayush Yadav, Vaibhav Panwar. Live Integrated Facial Observation (L.I.F.O.). Journal of Advancements in Robotics. 2021; 8(2): 34–43p.

INTRODUCTION

Maintaining attendance is a notable function in all the institutions to monitor the presence of students. Some of these institutes use file-based systems and some have adopted strategies of automatic records maintenance of attendance using some biometric techniques [1]. A facial recognition system is software which is suited for validating someone by performing comparisons on patterns depending up on their facial appearances. This technology is now vastly used for various purposes like security and in commercial operations [2]. It is widely utilized in security systems and it can be compared with other biometrics like fingerprint or

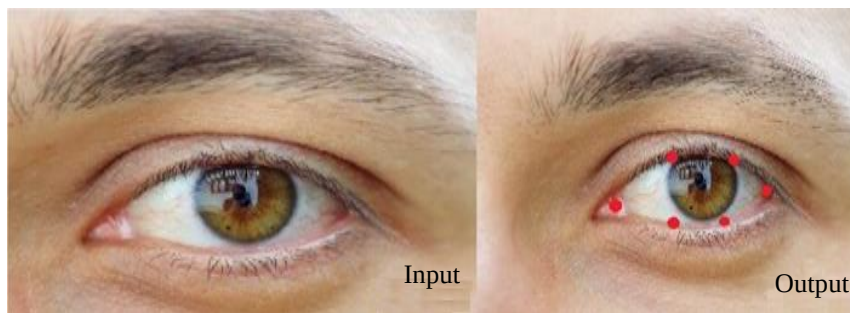


Figure 1. Eyelids point detection.

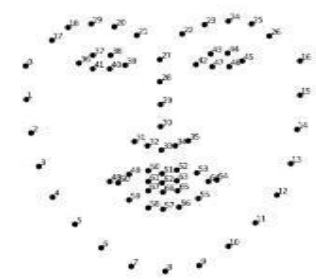


Figure 2. Facial landmarks.

eye blinking landmark detection [3]. As there is an increase in the number of students, lectures or employee, hence an increase in the controlling power of attendance also. Along with this, detecting eye blinks is important, for instance, in systems that monitor human operator vigilance, e.g. driver drowsiness. In this project, we have created the drowsiness system which also monitors the students preventing them from blinking their eyes, to keep concentration on their lectures without any eye movement for longer duration preventing the cause of dry eyes. Meanwhile in human and computer interactive platforms, this makes easier for disables to communicate for protection against anti spoofing when it comes to face detection systems [4]. Detect eye blinks in a video sequence. Motion in the eye area is estimated from optical flow by frame-to-frame intensity differencing and adaptive thresholding. A different approach is to infer the state of the eye-opening from a single image, as e.g. a correlation mapping is done for the eye templates to check if they are closed or open. A heuristic horizontal or vertical image intensity projection over the attention to eye region [5, 6], a parametric model fitting to find out the eyelids is as shown in Figures 1 and 2.

OVERVIEW

Face recognition, a method identifying if the image of the face of any particular person matches with any of the face images that are saved in a database. This difficulty is tough to resolve automatically because the changes of several factors like aging and even lighting, can affect the image. It may not be the most authentic, but it has various advantages over the others. Face recognition is natural and does not require assistance [7].

The expected system engages the face recognition approach for automating the attendance procedure of student or audience without their involvement, and analyzes the blinking of eyes in the discipline area. There is usage of webcam that can be used for image capturing procedure while training system on student or employee data and thereafter stored in database, comparison is done and attendance is added and the concentration of students is also analyzed through this system [8].

IMAGE PROCESSING

In this project, the facial recognition process can be split into three major stages:

Processing occurs before detection involving face detection and alignment, and later recognition is done using feature extraction and matching steps.

(i) Face Detection

The first step is to conclude whether the human faces emerge in a given image, and what is the coordinates of these faces.

(ii) Feature Extraction

After the detection, patches are extracted, and the conversion of the face patch is done into fixed coordinates or a set of landmark points.

(iii) Face Recognition

At last comes face representation procedure so one can easily identify it. There is a need for building a face recognition database that is capable of storing detected faces. Various images are taken for each person and their features are extracted and stored in the database. The process of face detection along with feature extraction is done for every face present in the class. This makes comparison easier; once done, the data gets stored in database [9].

METHODOLOGY

The procedure followed during the project is as follows. The image was acquired with the help of the camera; after that, the color was converted to grey scale, then with the help of cascade classifier, the face was detected (Figure 3). Detailed flowchart of the methodology is given in Figure 5.

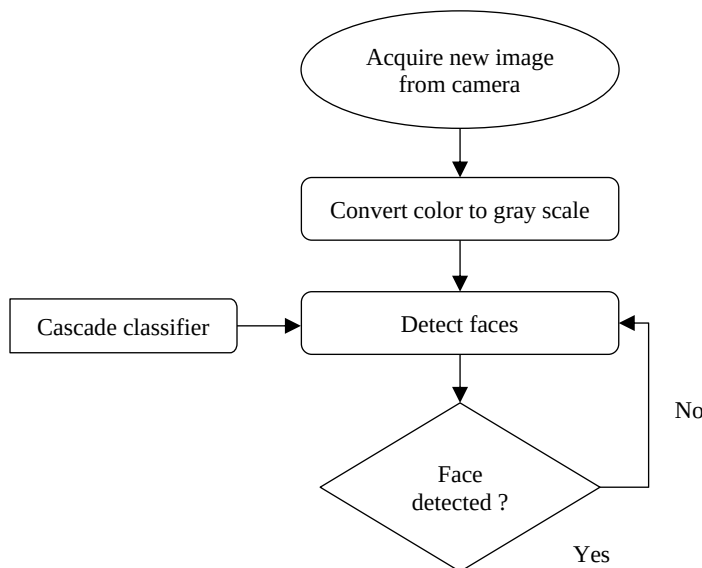


Figure 3. Basic flowchart of methodology.

THE PROJECT CONSISTS OF 4 PARTS

1. Eye blinking detection
2. Attendance system
3. Emotion detection
4. Graphical user interface

Eye Blinking Detection

Real-time facial landmark detectors capture the coordinate points on a human face image including eye corners and eyelids. Most of the state-of-the-art landmark detectors formulate a regression problem where a mapping from an image into landmark positions is learned. These modern landmark detectors are trained on huge datasets and they are thus robust to various varying facial expressions, and moderate non-frontal head rotations. An average error of the landmark localization is usually below five percent of the inter-ocular distance. There exist some amazing recent tactics that can be used to in real time in a significant manner thus offering a simple and efficient solution for detecting eye blinking. This makes use of facial detector as it is the only scalar quantity with help of which, it becomes easier to detect the level of eyes that is opened or closed. At last, all the estimates related to eye-opening frame sequence prediction is extracted and then SVM classifier is used to detect if eye is blinking or not by pattern calculations. However, their system is based on active shape models with the reported processing time of about 5 seconds per frame for the segmentation, and the eye-opening signal is normalized by statistics estimated by observing a longer sequence. The excess cost for SVM and eye-opening is almost negligible and this is the reason why the proposed algorithm can run in real time [10].

This Part of The Paper Includes

The ability to reliably distinguish between the open and closed eye blinks is quantitatively demonstrated in the huge dataset and for various face image resolutions.

Consider the following image for the landmark positions displayed here. The landmarks vary in the speed of closing and opening of the camera as shown in Figure 4 and 5.

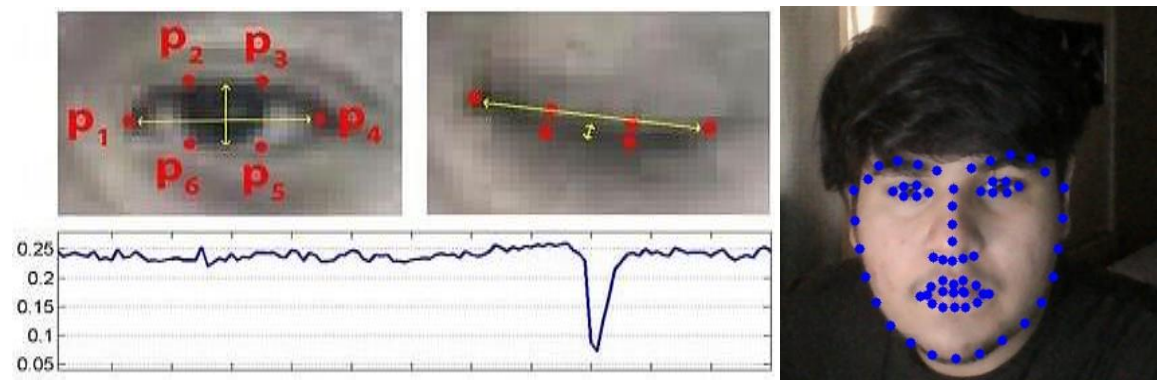


Figure 4. Working of landmark detection.

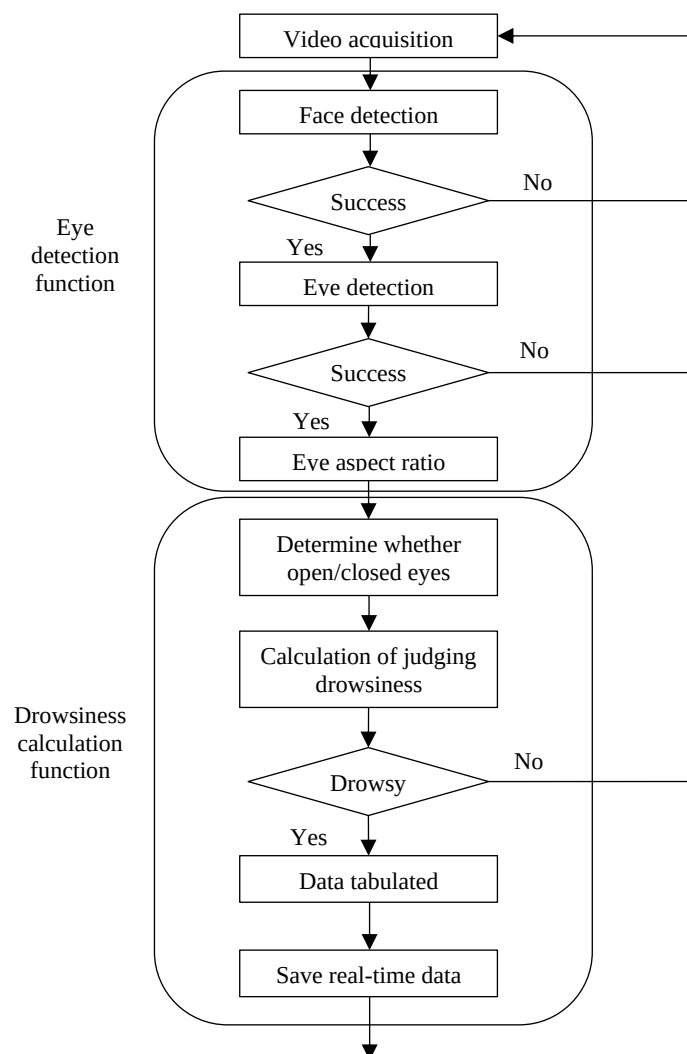


Figure 5. Detailed flowchart of methodology.

Description of Features

- For each frame, the eye landmarks are detected. (EAR) which is also known as eye aspect ratio lies between width of the eye and the height is calculated.
- This function accepts a single required parameter, the (x, y) coordinates of the facial landmarks for an eye.
- For the right eye coordinates are (36, 42)
- For the left eye coordinates are (42, 48)

Formulae of Finding EAR

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Here, $p_1 \dots p_6$ are the landmark.

If the EAR falls below the decided value (0.15), and then rises, it will print “Are you Sleepy” and “Drowsy”. We have taken 0.15 as the threshold value by tuning as this is what has worked best for our applications. The more the EAR, the wider eye is open. We have decided a minimum EAR value to decide whether the eyes are closed or not.

Experiments: There is 1 experiment performed. The experiment that measures the accuracy of the landmark detectors.

Accuracy of Landmark Detectors

Accuracy: To evaluate the accuracy of tested landmark detectors, we used the dlib shape predictor algorithm. It is a pre-trained data model of facial landmarks. The main purpose of conducting this test is to verify that current landmark detectors used for detecting eyes are particularly precise and robust, i.e. corners of the eyes along with the eye contouring. Therefore, we used a prepared dataset, containing sample images with both open and closed eyes. More precisely, having the ground-truth landmark annotation, we sorted the frames for each subject by the EAR and took 10 frames of the highest ratio (eyes wide open), the same for sampled pictures along with pictures with lowest ratio both in 10 frames. Thus, we collected some images. Moreover, all the images were later subsampled to evaluate the accuracy of tested detectors on small face images.

Attendance System

After performing the image processing including face detection, face recognition, and feature extraction, we have moved forward towards the smart attendance system.

Algorithm Used

Face recognition is a python library that is trained by deep learning algorithms. It recognizes faces from python with the simplest form of library which is built using dlib state-of-art face recognition. So, there is an ease to make comparison between live and digital images for storing the faceprint which further verifies the identity of an individual. The model has an accuracy of 99.38%. It lets you do face recognition on a folder of images.

Algorithm Training

For the training purpose of the dataset, the human face is to be recognized along with the unique ID. It is required so that our project would be able to give the correct output based on training as shown in Figure 6.

Computation of the Algorithm

The first step is to create the improved facial characteristics according to original images. To achieve this, firstly it is being converted into gray scale image containing the intensity of each pixel (0–255). Further, we have considered a threshold value that defines a new value from 8 neighbors. For the values

$\geq$ threshold value, output will be one, otherwise 0. The matrix only consists of the bin values which are concatenated at each position resulting in new values for each place. The central value of the matrix is made by converting the binary value into the decimal value represented by the actual image's pixel. As the process is completed, a new image that serves as the better characteristics of the original image.

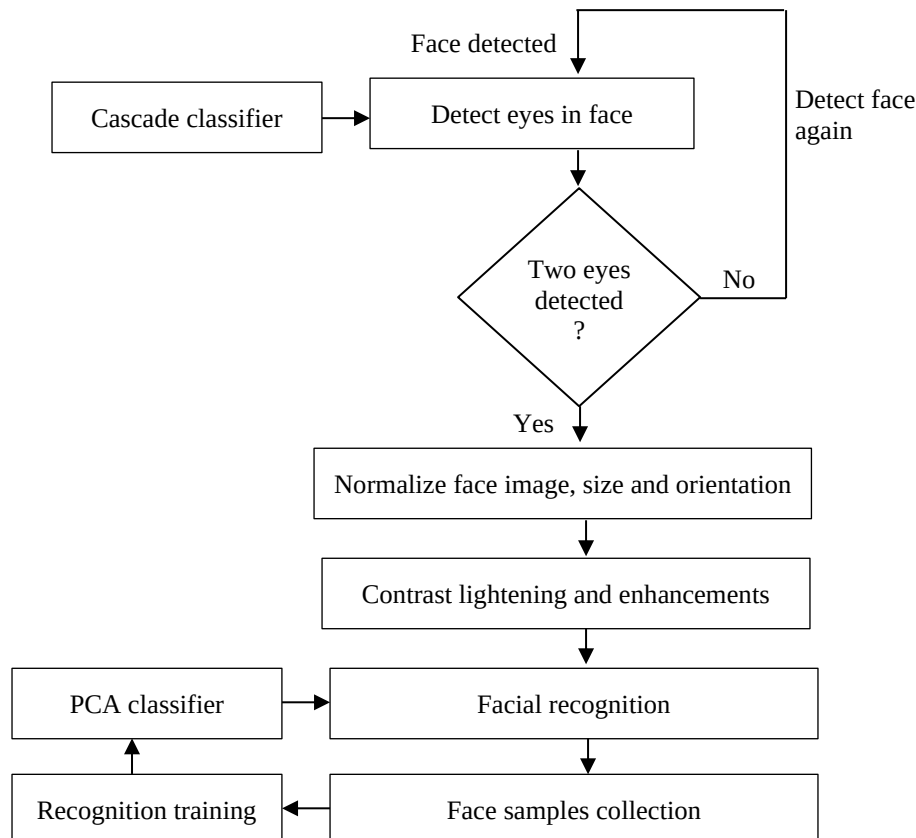


Figure 6. Flowchart for attendance system.

Database Creation

This is the most important part of this system, i.e. creating a database of those images which will be used. For this purpose, a webcam is used that will detect a human face and then store it in a database accordingly with a unique ID as shown in Figure 7.



Figure 7. Database for recognition system.

Software Description

Open CV:

It is open-source software developed basically for ML. It was developed for computer vision applications and to stimulate the usage of machine perception in commercial products. Open CV is a BSD-licensed product that is easy to use and modify code. The library contains so many advanced algorithms including an extensive set of both computer vision and machine learning algorithms. These algorithms can be utilized for the detection and recognition of faces, identification of objects, extraction of 3D models of objects, production of 3 point clouds from web cameras, stitching images together for the production of a high-resolution image of an entire scene, finding similar images from an image database, removing red eyes from images taken through flash, scenery recognition, eye movements and establishment of the markers to intensified reality and overlay with it, etc. The inclusion of languages such as C++, Java, Python, and MATLAB provides supporting interfaces from Windows, Android, Linux, and Mac OS. Open CV is mainly inclusive of real-time vision apps providing benefits of MMX and SSE during its availability. A speedy development of open CL along with completely featured CUDA is taking place. There exist not less than 500 procedures and algorithms that are able to form the same algo.

Microsoft Excel:

It is a spreadsheet used for storing the records. A table which consists of various rows and columns can be mathematically manipulated with the arithmetic operation. Now, advanced Excel is used widely due to its advanced features that are extended to programming Language. It can store data from an external source. Also, having dynamic data exchange and graphing capabilities, Excel spreadsheet is used to store, organize, and manipulate the data. The basic layout of computerized spreadsheets is more or less the same as the paper ones. Tables are used to store relational data that is usually formed by grouping various cells and rectangular boxes in a standardized format of rows and columns.

Result Obtained

Finally, attendance system has been created. Using the webcam, the images of the individual students are being recorded and stored in the training dataset. Simultaneously, their information is automatically recorded in the database i.e. excel sheet. Finally, the presence of the students is being recorded as shown in Figure 8.

1	Name	Date	Time
2	ANANMAY_1	02/Apr/21	13:19
3	ANANMAY_2	02/Apr/21	13:20
4	ANANMAY	02/Apr/21	13:20
5	AYUSH	02/Apr/21	13:26
6	AYUSH_3	02/Apr/21	13:26
7	AYUSH_4	02/Apr/21	13:27

Figure 8. Database created in excel sheet for attendance.

Emotion Detection

Emotion is the most important aspect that can be taken into consideration during interaction or communication between people. Emotion generates some specific feelings which can appear on the human face even if they fail to express it by words. Different human emotions are shown here with Figure 9.

Scope of the Emotion Detection Research Work

It deals with the human facial landmarks. It can be implemented in a chatbot that will identify our emotions and if it captures the sad mood, it can send up some cheerful quotes or play the song, so that student can again cheer up and concentrate on their studies.



Figure 9. Different expressions of face in emotion detection.

The main perspective of this part of our project is to analyze the students' behavior during the entire lecture period and analyze the behavior of each student whether they can concentrate or not. It may help the teachers also for the improvement by changing their way of teaching. This part will be very helpful in other areas also.

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Graphical User Interface (GUI)

There are many graphical user interface (GUI) toolkit that we can use with the python programming language. We use Tkinter library as our GUI toolkit. Tkinter is the standard library for python. In this project, we use Tkinter to make buttons for each program to run them in sequence and according to the user's interest. GUI works as a front end and connects with the backend to perform the task. We use four different programs which are connected with the same GUI and all are able to work separately according to the user's need as shown in Figure 10.

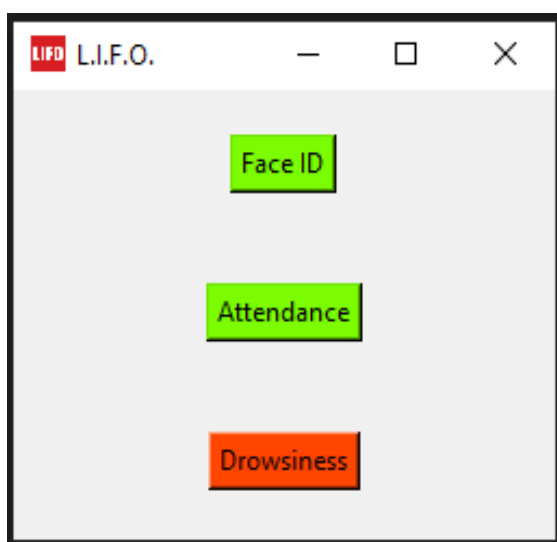


Figure 10. GUI interface to access system.

Main Application of LIFO

LIFO has many applications and advantages which are summarized in the Figure 11.

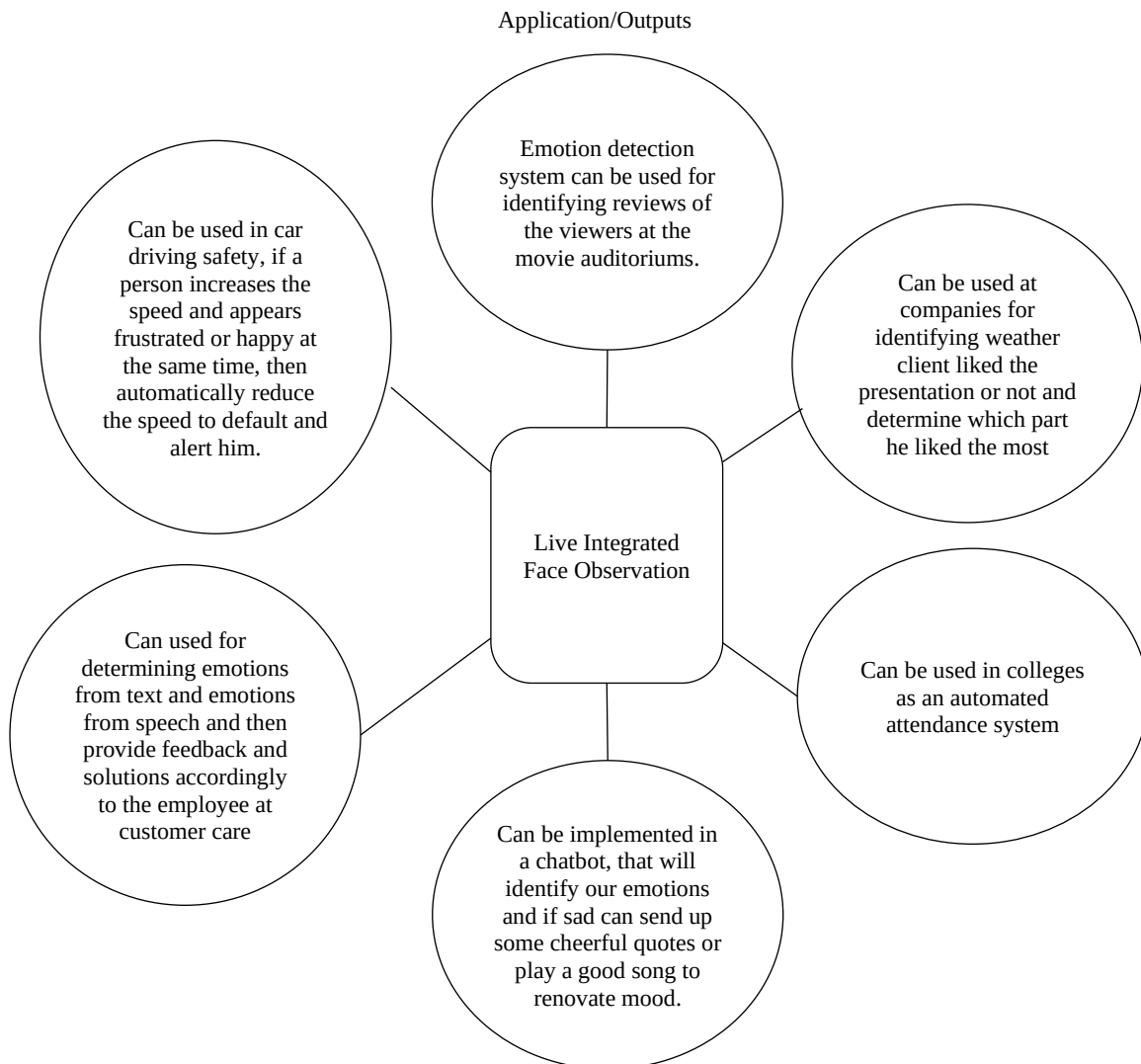


Figure 11. Application of LIFO.

CONCLUSIONS

A real-time eye blink detection algorithm was presented. A demonstration is made whether a regression-based detector for facial landmark is able to estimate the eye openness level? While they are robust to low image quality (low image resolution to a large extent) and in- the-wild.

We have presented an emotion detection by using frontal facial image. The algorithm consists of three stages. Extraction of facial features from the regions of face is done in image processing part. The fuzzy color filter and histogram analysis methods are adopted to extract vector points from facial image. Methods of VFM and analysis through histogram is used for extraction of facial components. Finally, our project is able to recognize 6 types of emotions.

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