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Face Detection and Facial Feature Points' Detection with the Help of KLT Algorithm

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Abstract: The Goal of this paper is to provide methods for Face Recognition using Different Facial features in Real time face recognition. Some algorithms for face recognition in real time using the webcams to increase the accuracy of face recognition system. To detect the facial features in real time, Haar based algorithms are used and SHI and THOMASI algorithm to track the feature point and Pyramidal Lucas-Kanade algorithm is used to track those detected features. The Main object of this paper is identifying the person by tracking the nose, eyes and face of the person and then detects who the person is.

Keywords: face detection; face recognition; biometrics; real time; image processing.

I. THE FRAMEWORK

Face detection is used in biometrics, often as a part of (or together with) a facial recognition system. It is also used in video surveillance, human computer interface and image database management. After so many decades Robust and Real time face detection is still not complete and there are lot of parameters like light, position etc. that affects the accuracy of the face detection software. However in order to maintain the accuracy and higher level protection to software, a simple method is implemented which further adds a bit more accuracy to the face recognition software. Different people have different facial expression hence to maintain the data becomes quite tedious hence the same software in a different ways can be implemented by tracking their body features, which remains same regardless of their facial expressions. Tracking the eyes, nose and face is beneficial because these features remain constant even if the person is smiling, speaking, weeping or none of these.

II. METHODOLOGY

The **Viola-Jones** algorithm is used for face detection, which is a robust method that describes visual object detection framework, in rapid detection through optical device. Further, it is based on 3-key contribution which are described below:

1. Rich set of image features using integral image.
2. Efficient classifiers provided by "AdaBoost" technology.
3. Combining the classifiers into cascades for the detection purpose.

These techniques help us to focus on the face, eyes and nose while ignoring rest everything the surrounding. So the robust classifiers require at least 3000-5000 positive images and 3000-5000 negative images to train. The images can be obtained by the following calculation. On taking a high quality video (720p or 1080p) for about 3 minutes we can get around 4500 images. The calculation is that the video has 25 frames per second. So 25 x 60 = 1500 images for 1 minute and 1500 x 3= 4500 images of high quality in 3 minutes video and make sure that the video is taken for 360 °.

III. CASCADE OF CLASSIFIERS

The overall form of the detection process is that of a degenerate decision tree, which is known “cascade” .A positive result from the first classifier, triggers the evaluation of a second classifier, which has also been adjusted to achieve very high detection rates. A positive result from the second classifier triggers a third classifier, and so on. A negative outcome at any point leads to the immediate rejection of the sub- window.

A series of classifiers are applied to every sub window. The initial classifier eliminates a large number of negative examples with very little processing. Subsequent layers eliminate additional negatives but require additional computation. After several stages of processing the number of sub windows have been reduced radically. Further processing can take any form such as additional stages of the cascade or an alternative detection system.

IV. LUCAS KANADE METHOD

For More accuracy Lucas Kanade Method for the Optical Tracking is explored. Lucas Kanade (LK) algorithm [1], as originally proposed in 1981, was an attempt to produce dense results. Yet because the method is easily applied to a subset of the points in the input image, it has become an important sparse technique. The LK algorithm can be applied in a sparse context because it relies only on local information that is derived from some small window surrounding each of the points of interest. The disadvantage of using small local windows in Lucas- Kanade is that large motions can move points outside of the local window and thus become impossible for the algorithm to find. This problem led to development of the “pyramidal” Lucas Kanade algorithm [8], which tracks starting from highest level of an image pyramid (lowest detail) and working down to lower levels (finer detail). Tracking over image pyramids allows large motions to be caught by local windows. The basic idea of the LK algorithm rests on three assumptions:!

1. Brightness constancy. A pixel of an object in an image does not change in appearance as it (possibly) moves from frame to frame. For grayscale image, this means we assume that the brightness of a pixel does not change as is tracked from frame to frame.

2. Temporal persistence or small movements. The image motion of a surface patch changes slowly in time. In practice, this means the temporal increments are fast enough relative to the scale of motion in the image that the object does not move much from frame to frame.

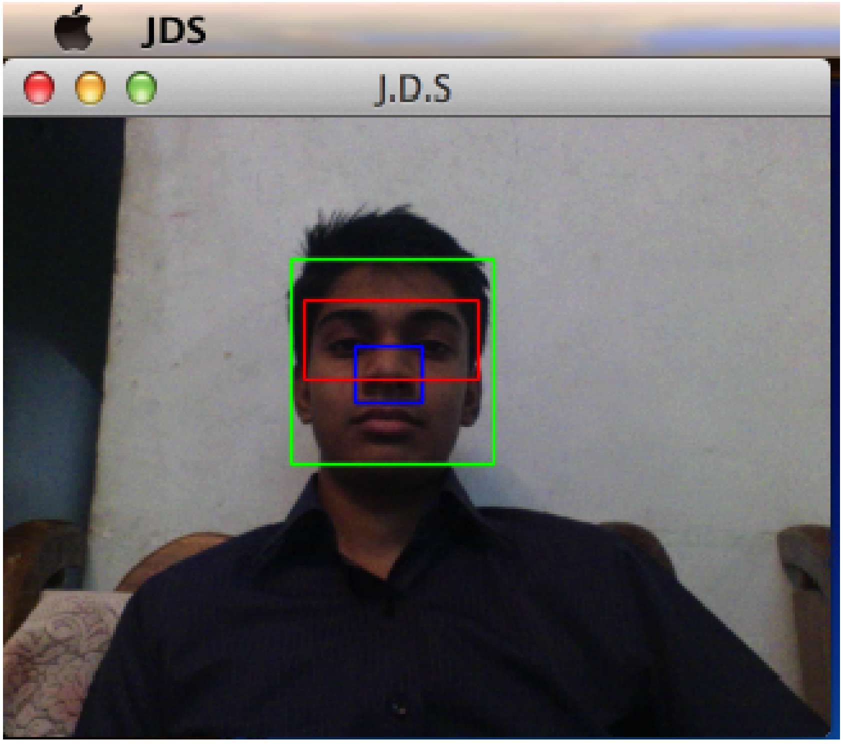
3. Spatial coherence. Neighbouring points in a scene belong to the same surface, have similar motion, and project to nearby points on the image plane.

PYRAMIDAL LUCAS-KANADE FEATURE TRACKER:!

Pyramidal lucas kanade algorithm is the powerful optical flow algorithm used in feature tracking. Consider an image point u = (ux, uy), the goal of feature tracking is to find the location v=u+d in next image J such as I(u) and J(v) are “similar". Displacement vector d is the image velocity at x which also known as optical flow at x [8]. Because of the aperture problem, it is essential to define the notion of similarity in a 2D neighbourhood sense. Let ωx and ωy are two integers. Then *d* the vector that minimizes the residual function defined as follows:

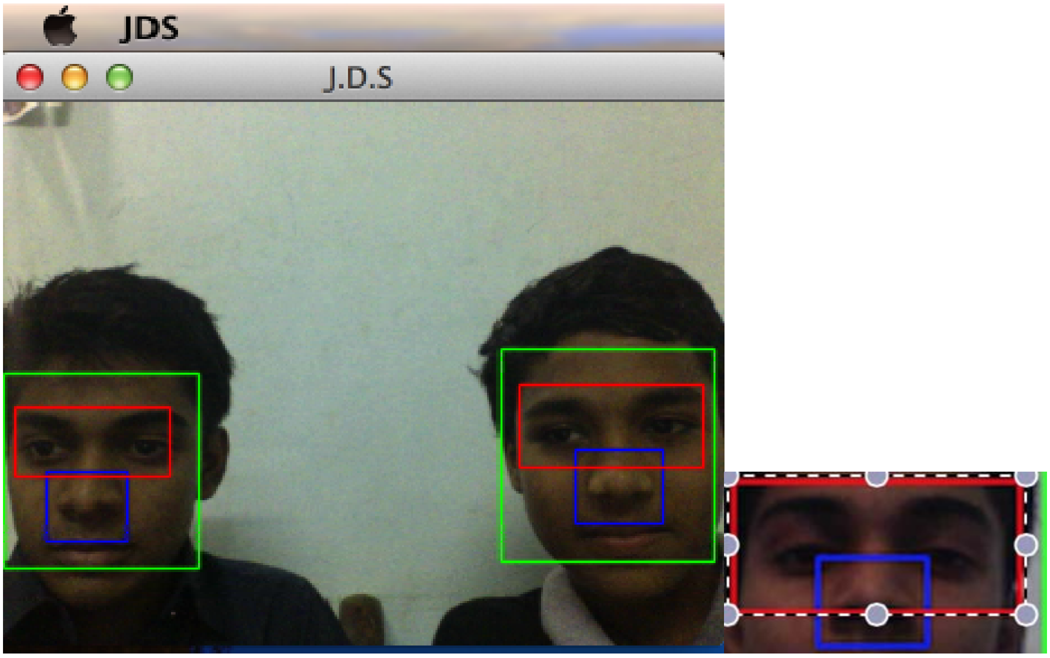
Observe that following that definition, the similarity function is measured on an image neighbourhood of size (2ωx + 1) x (2ωy +1). This neighbourhood will be also called integration window. Typical values for ωx and ωy are 2,3,4,5,6,7 pixels.

V. IMPLEMENTATION



Calculating My Facial Features and Gives A voice OUTPUT "HI VISHANTH".

MULTIPLE FACE TRACKING:



The above right photo is the proof of eyes and nose detection.

VI. LIMITATION

The Person and the camera of the laptop must be at a fixed position and when combined with Eigen Face Method We can get a better result.

Success Case:

Out of 210 test performed we got 205 cases right and the rest was unsuccessful due to 3 reasons!

1. People wearing spectacles.
2. Light becomes dim.
3. People or the camera moved from it's actual position.

The below is the data for first 27 results out of 210 test conducted and the result in 97% with 205 test as correct,

CASE	FACE READINGS	EYES READINGS	NOSE READINGS	SUCCESS CASE
1	200	51	132	Success
2	199	51	133	Success
3	200	53	131	Success
4	207	48	137	Success
5	209	47	135	Success
6	206	48	135	Success
7	195	50	129	Success
8	195	52	130	Success
9	194	51	130	Success
10	200	56	129	Success
11	201	55	129	Success
12	201	55	130	Success
13	188	54	119	Success
14	187	53	118	Success
15	217	59	134	Failure
16	193	54	127	Success
17	195	56	127	Success
18	195	56	125	Success
19	210	52	140	Success
20	211	51	141	Success
21	211	50	138	Success
22	189	48	136	Success
23	189	50	137	Success
24	189	50	137	Success
25	212	58	146	Success
26	214	56	146	Success
27	214	57	145	Success

VII. RECOGNITION METHOD

Here the calculation is based on the feature by using the formula - [(X-Y+H+W)]

X- x co-ordinate of the rectangle.

Y- y co-ordinate of the rectangle.

H- Height of the rectangle.

W- Width of the rectangle.

All these factors depend on person's height and width from the ground when he is standing at perfect lighting conditions. Hence the value of the rectangle on the eyes, nose and the face becomes unique even if the person is smiling, talking or keeping mum because nose, face and eyes are not affected by this method.

Here an error factor is provided by +2 or -2 and identify the person with a high accuracy. Even If twins are present they have an error factor of at least +5 or -5, so it is pertinent to mention that a distinguish between twins can also be established. Hence the same accuracy can be obtained at only 3 data values instead of (4*3=12) values so it decreases the task and provides same computation speed.

Program is Coded In Java Using Javacy.

VIII. Conclusion

In this paper, a face, eyes and nose tracking algorithm in real time camera input environment is presented. To detect the face in the image, a face detector based on the **Haar-like** features is used. This face detector is fast and robust to any illumination condition. For feature points' extraction, the algorithm of Shi and Tomasi is explored. This method gives good results. To track the facial feature points, **Pyramidal Lucas-Kanade** Feature Tracker KLT algorithm is used. Using detected points with the algorithm of **Shi** and **Tomasi** along with the formula to reduce the data level and maintain same accuracy resulting good video sequence and in real time acquisition. The obtained results indicate that the proposed algorithm can accurately extract facial features points. The future work will include extracting feature points with some conditions to limit the number of feature points in bounding box and choose only the points' which describe well the shape of the facial feature. This work will be used for real time facial expression recognition application. Detecting faces at different inclinations or slopes as Haar classifier has its own limitations can extend further the work.

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Bharadwaj Vishanth Thiyagarajan studying third year computer engineering in P.I.C.T of Pune University and is an I.S.O 9001-2000 certified Android Programmer and intends to do PhD in neural networks.