

# A Survey on Various Techniques used in Face Detection & Tracking

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**Abstract**— A solution is classified in this research which addresses detection and tracking aspects and achieves favourable results being compared with the prior arts of detection and tracking. The most challenging problem in various scenarios is real-time face detection and feature tracking. Various robust methods are being implemented time to time which can locate multiple faces simultaneously in different environments and luminous conditions. Many efforts are being made for speeding up the recognition module for the system to run faster & human body detection and recognition are integrated into the system so that the information can be used altogether with detection and tracking. Face detection and tracking is not only about some faces but also need to be integrated for large scale search.

**Key words:** Face recognition, Pre-processing, characteristics match, Image Processing etc

## I. INTRODUCTION

There has been a lot of work on the domain of tracking-by-detection. Those methods rely on an object (people in our case) detector that generates probabilities of a person being on the ground plane at a point of the scene at each frame. Those detections are linked together to form trajectories. When no other information is available and the detections are noisy, the resulting trajectories might be inconsistent and contain identity-switches between the tracked people. By exploiting the facial characteristics we minimize the identity switches and identify the people being tracked. Human face detection and tracking is an important research topic for many applications in computer vision.

However, detecting human face in images or videos is a challenging problem due to high variety of possible configurations of the scenario, such as changes in the point of view, different illumination, and background complexity. There are two different stages of this process firstly; principle component analysis is used for extraction of facial features. Points are extracted by this are used as a base for motion tracking. As the most significant external characteristics of human, face plays a vital role in communication. With human computer interaction technology turning into a newest topic within field of AI, face detection and tracking has become a serious concern analysis direction in computer vision that has broad application prospects within field of human computer interaction, video game so on.

The complexity of the face results in a definite degree of issue for quick the detection and tracking. There are various ways for the face detection, for example: mathematics technique, template matching technique, the strategy of support vector machine, the strategy of active contour model, the strategy of variability template, etc. however the a lot of thought approach for face detection is Ad boost-based, however, the speed of that doesn't meet the time period in high-resolution video sequence detection. Search candidates face by mistreatment the strategy of color

and contour detection, then make sure pattern matching recognition through the algorithmic rule of principal element analysis, the trailing accuracy rate of that is sort of high, however the track result is poor within the event of occlusion. In another thesis, an algorithmic rule, that is combined multiple target hunter with face observe technique, with that is ready to trace the multiple faces at a similar time. This technique has higher time period performance; however the algorithmic rule is a lot of advanced. It takes the Mean-Shift technology to trace moving target that has the quick and economical characteristic. However its trailing window is mounted. Once the target moves at the side of the direction of the camera, it had lost.

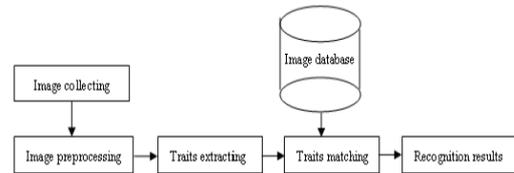


Fig. 1: Process of Face Recognition System

A robust technique on human face for tracking the detected pre determined points. In this the Kanade-Lucas-Tomasi point tracker is extended for achieving robustness and embedding knowledge about the visual characteristics of face and its configuration are used for specialization the work on facial features. The design tracker is designed to recover temporary occlusion and lost points which is caused by tracking drift of tracker. The experiments are performed on set of 30 video sequences in which several facial expressions are tracked.

The Kanade-Lucas-Tomasi if used originally than some points are lost whereas this new method recovers the lost points with minor displacement error. There are different trackers within the framework which are investigated for specific applications. The KLT algorithm initially tracks 12 points of the face, the nostrils are assumed to be the darkest area in the search window, thresholding is applied with local histogram which isolates the two nostrils and other smaller areas which are corresponding to the valleys between nose and cheeks, for searching window simple flood filling is applied and the small darker areas are removed and by averaging all co-ordinates in the region it calculates the centre of nostrils.

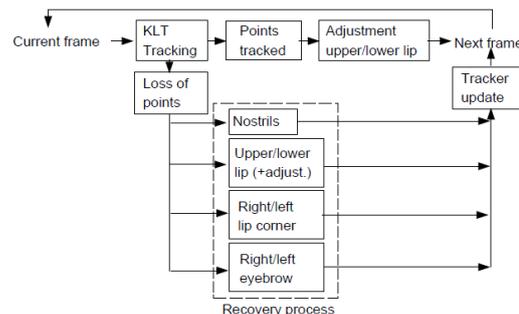


Fig. 2: Facial feature points

Trajectories are determined robustly in the 3D coordinate system. Two datasets are being used in this, i.e. video dataset of outdoor street scene, indoor RGB-D dataset. Camera's estimation can be robustly estimated from the dynamic scenes.

Search and rescue and surveillance are the topics of extensive search for researchers in the past decades in which the detection of images and the tracking of images are done of images which are visible in light. All these leads to the growing availability of the cameras and detecting and tracking devices, however efforts are made on the distinct signatures of humans thermally. The transition of thermal images from visible light images is a challenge as recently trending the thermal cameras which are used on onboard aerial platforms, for example the search and rescue operations. This research paper presents a dataset of thermal images sequence and also proposes a particle filter based framework which will track people in thermal images. The thermal cameras are exclusively used in military applications which make it easier to track people faster.

## II. LITERATURE REVIEW

Petronel and Corneliu (2005) Face detection and recognition can be considered an enabling technology for a range of image enhancements technologies, authentications and advanced UIs in handheld devices. Several modes of implementing a face detection algorithm in hardware are explored and a hybrid approach is found to offer the best trade-off between physical hardware resources and computational software resources.

Sudipta N. Sinha and Jan-Michael Frahm (2007) This paper describes novel implementations of the KLT feature RECOGNITION and SIFT feature extraction algorithms that keep running on the illustrations preparing unit (GPU) and is suitable for feature examination progressively vision frameworks. While huge quickening over standard CPU usage is gotten by abusing parallelism gave by wounding edge programmable design equipment, the CPU is arranged for to run different calculation in parallel. Both SIFT and KLT have been utilized for an extensive variety of PC vision assignments extending from structure from movement, robot route, and stretched reality to face recognition, object detection and video data-mining with quite promising results.

Yohan Dupuis, Xavier Savatier (2013) Bio-roused and non-customary vision frameworks are very scrutinized subjects. Among them, Omni directional vision frameworks have shown their capacity to essentially enhance the geometrical understanding of scenes. In any case, couple of specialist has explored how to perform object location with such frameworks. The current methodologies oblige a geometrical change before the elucidation of the photo. In this paper, we research what must be considered and how to process Omni directional pictures gave by the sensor. We center our examination on face location and highlight the way that specific consideration ought to be paid to the descriptors so as to effectively perform face recognition on Omni directional pictures. We exhibited how image processing is right now performed on catadioptric pictures. At that point we centered the consideration of the pursuer on the theoretical and commonsense issues included in picture unwrapping. We likewise exhibited that unwrapped picture

handling would take additional time than preparing the catadioptric picture as it seems to be. Handling time being an imperative variable, we construct our last commitment with respect to procedures that have been turned out to be exceptionally effective.

Muhammet Baykara and Resul Das(2013) security comes into more prominence every day. It is vital for individuals to keep more passwords in their brain and convey more cards with themselves. Such usage in any case, are turning out to be less secure and useful, in this manner prompting an expanding enthusiasm for strategies identified with biometrics frameworks. Biometrics frameworks are the frameworks which store physical properties of individuals in electronic environment and empower them to be perceived by the put away electronic data when required. Biometrics is the recognizable proof of human. Biometric frameworks are structures that have been regularly utilized as a part of late years. This biometric framework is taking into account the utilization of some physiological elements of the individual for security. It is anticipated that biometric frameworks will be a crucial piece of the data security frameworks in the nearing years.

Tong Zhang(2014) This paper presents the pervasiveness of checking cameras introduced out in the open spots, schools, clinics and homes, feature examination advancements for translating the created feature substance are turning out to be more significant to individuals' lives. Along this setting, we add to a human-driven feature observation framework that distinguishes and tracks individuals in a given scene. In this paper, a parallel preparing pipeline is recommended that coordinates picture handling modules in the framework, for example, face location, individual acknowledgment and following, proficiently and easily, so numerous individuals can be at the same time followed continuously. a human distinguishing proof and following framework for feature security utilization cases was displayed. Particularly, a parallel processing pipeline for feature preparing was proposed and developments were made to picture investigation modules for both productivity and heartiness .

Jatin Chatrath, Pankaj Gupta (2014) This paper describes the technique for real time human face detection and recognition utilizing an altered variant of the calculation recommended by Paul viola and Michael Jones. The paper begins with the prologue to human face discovery and following, trailed by misgiving of the Vila Jones calculation and after that talking about the execution in genuine feature applications. Its calculation was in view of article location by removing some particular components from the picture. This paper introduces an arrangement of itemized trials on troublesome face recognition and following information set which has been generally concentrated on. This information set incorporates confronts under an extensive variety of conditions including: brightening, scale, posture and camera variety.

Cheng-Yuan Ko, and Liang-Gee Chen(2014) In this paper, we propose an algorithm using just two thing webcams without adjustment to recognize separation in the middle of client and show by face location. Face recognition based stereo coordinating calculation to identify the client's separation just by face location. Due to conventional stereo framework utilizing stereo coordinating to discover the

client's profundity by aligned info picture, the upside of this calculation is that we can get great results with low complexity and calibration free.

V. Belagiannis, F. Schubert(2009) Face tracking is a process in which we track even the smallest part or portion of the face. On average human beings there are very small differentiations among the colour, texture & skin. For tracking a face we need its different parts to be recognised first, the skull face can give us an idea to a dummy face. Like that we can recognize a face on basis of some points that have been discovered earlier. There are 12 points on basis of what we are tracking the human face.

T. Zhang, D. Wen, X. Ding(2012) This gives information about the size of the face and its orientation in a reliable way. Nowadays there are cameras installed everywhere for mainly security reasons. And sometimes we have to detect faces or match them in order to re check faces. Face detection and tracking is very important aspect for security purpose. This can also be used in solving robbery cases if we are having cameras installed. Facial feature initialization can also be done automatically. 12 facial feature points can be tracked exactly as a test set having KLT. There are various limitations also in case of detecting and tracking a face. The main problem arises when we have rotation face from a video clip, or there is a luminous object in front of the face which is to be detected. There are always problems in detecting the faces due to difference in pose, lightening, facial orientation and expressions. Facial hair and glasses can also make a huge difference in the appearance of any face. There are various iterative methods that uses the alternative methods in real time face recognition having varying to some extent of features i.e. rotation, lightening, and different expressions used by the humans.

B. Wu, S. Lyu(2013) Scaling and translation are also some of the major problems. There are various advantages and disadvantages dealing with these difficulties. Some papers have considered the effect of some small off-the-plane rotations on detection and tracking of mainly eyes and nostrils. Nose always reflects more light because it emerges from the face. Extraction and matching of various 2D feature points in video is important in many computer vision tasks like detection tracking and supervision. Face detection is an expected feature in image acquisition devices. AHFD (advanced hardware face detector) is designed to combine the speed and low computational requirements of hardware.

H. Bhaskar(2012) Recently 3D displays have come into vogue nowadays. But for any display 3D effect optimization should be under a certain distance from the image in order to get the exact 3D capture. For enjoying the 3D effect completely we need to find and maintain the proper pose. Using this game designers can provide enhanced representation of characters (recent example is animated Avatar). The very first practical real time algorithm to provide the real time object detection was described by viola and jones in 2001. The work is mainly based on the statistical representation of object appearance which is being tracked or detected. It is complex to track and detect multiple people in real time simultaneously. There are aspects of issues that needed to be solved, firstly to build the image analysis modules, secondly parallel

computing pipeline should be designed to integrate the images. There could be possibility of head rotation and pose changing.

Sudipta N. Sinha, Jan-Michael Frahm(2012) This research paper describes SIFT feature extension algorithm that run on the graphic processing unit and novel implementations of KLT feature tracking. The modern programmable graphic hardware provides significant acceleration over standard CPU implementations. All the computations are done in parallel and for this purpose CPU s freed. Up to a thousand features in real time can be tracked with GPU-based KLT implementation. The GPU-based SIFT implementation is approximately ten times faster than an optimized CPU implementation. In computer vision tasks like object recognition, detection is important in extracting and matching of 2D feature points in video. In this research paper GPU-KLT, GPU-based implementation for KLT feature tracker, GPU-SIFT are presented.

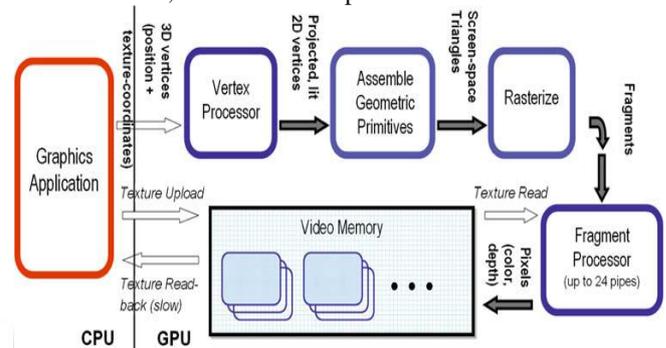


Fig. 3: Overview of the 3D Graphics Pipeline

Cheng-Yuan Ko, and Liang-Gee Chen(2011) In this research paper two webcams are used as a commodity, webcams are without calibration which detects the distance between the display and the user by face detection. The correlation coefficient of distance and the reciprocal of disparity is up to 0.998 according to the experimental results. With the use of high accuracy from calibration free stereo capture image pair for any of the application i.e user-aware, interactive 3 DTV, auto-stereoscopic display can provide depth information of the user captured. In this research paper haar-like feature classifier in OPENCV to detect users face is used to solve the problem of false detection while detecting a face. There are only two kinds of systems that are popular, one is sensor based and another is stereo camera.

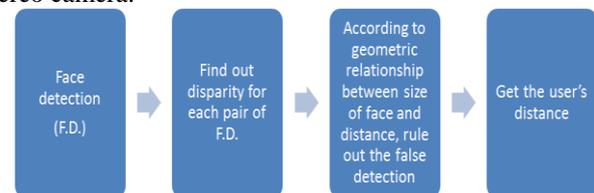


Fig. 4: The overall system flow of proposed algorithm

Petronel BIGIOI, Corneliu ZAHARIA and Peter CORCORAN(2009) In handheld devices the enabling technology for a range of image enhancements technology, advanced UIs and authentication face detection and tracking are considered. Various modes of implementation in hardware for face detection algorithm are explored and found a hybrid approach which offers the best trade-off between computational software resources and physical hardware resources. Eventually complex set of classifiers are applied

by the software engine using simple and weak classifier templates in hardware. In this research paper the face detection technology presented is specifically designed to retain the advantages of hardware and software implementations. Now days, the topic of vogue is 3D display for hand held devices.

Muhammet BAYKARA1 and Resul DAS(2013) For the purpose of security it is unnecessary for people to have more passwords in their mind and carry more cards perhaps, all these are becoming less practical and less secure and interest in biometric systems techniques has been increased. Biometric system uses an electronic environment that stores physical properties of people whenever needed. It can also be termed as human identification as it identifies those physical properties which are distinctive in nature and the person can never alter them and are in the person's possession. There are several biometric techniques developed i.e fingerprints, hands, retina, face, iris and voice recognition. These biometric systems are important for security purpose and are being widely developed and used in many countries. This research paper aims for recognizing a face successfully in real time based upon principle component analysis algorithm (PCA) and the results are compared with the samples that are recorded previously. Some problems may include in these systems depending upon their field of practice.

Tong Zhang(2009) Videos analytical technologies for the interpretation of generated content of video are becoming relevant in today's world with the pervasiveness of monitoring camera installed in various places. In this research paper a human-centric video surveillance system which identifies interacts the people in given seen are developed. A parallel processor pipelining is also proposed which is used for integration of image processing modules in the system i.e. person recognition, face detection and tracking, which is done smoothly and efficiently so that we can track multiple people simultaneously in real time. Various significant innovations are involved in making each major image analysis module fast and robust to variations in occlusion, pose, illumination etc. implementation of a demonstration software is done in this research paper which supports identifying, tagging, finding and tracking people in recorded or live videos having uncontrolled conditions of capturing. In this research paper various recent approaches are introduced based on face recognition and tracking, video processing pipeline and its modules, method of two core modules, dynamic face modeling.

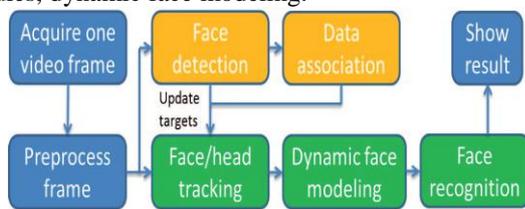


Fig. 5: Video Processing Pipeline

Yinghao Cai and Gérard Medioni(2010) This research paper tells about the problem of automatic detection and tracking in uncertain scenarios while using a pan-tilt-zoom (PTZ) network camera. Corresponding people and trajectories are associated while detecting faces, real-world scenerios are of dynamic nature and the restrictions in this real time complicate our task. Previous work done

includes a mixture of PTZ cameras and wide angle cameras, limits can be explode to whatever can be expected from a single PTZ camera. The system uses different modes i.e. zoomed-out mode to detect and track pedestrians, wide area mode. It selects things like a scheduler, person to zoom in to a camera. Data association problems i.e. person-to-person, face-to-person and face-to-face are solved. The effectiveness of the proposed system is challenge by performing extensive experiments indoor and outdoor with their uncontrolled conditions.

Jatin Chatrath, Pankaj Gupta, Puneet Ahuja, Aryan Goel, Shaifali M.Arora(2013) This research paper describes a modified version of the suggested algorithm of Paul viola and Michael Jones for face detection and tracking. This research introduces detects and interacts human face and then followed by the apprehension of the viola Jones algorithm and then comes the discussion about implementing them in real video applications. Viola Jones algorithm detects object by extracting some features of an image and the same approach is used in this research paper for real time human face detection and tracking. The simulation results supported the detection and tracking of up to 50 faces. This algorithm produces results in fraction of seconds by computing the data.

Yohan Dupuis, Xavier Savatier, Jean-Yves Ertaud, and Pascal Vasseur (2014) This research paper discusses the researched topics like bio-inspired, non-conventional vision systems, omni direction vision systems (geometrical interpretation of scenes). The matter of investigation is how to perform detection using such systems. Before the interpretation of picture the geometrical transformation is needed in existing approaches but this research includes the investigation to process the omni directional images which are provided by sensor. This paper particularly highlights defects that the research should pay attention to descriptors on omni directional images for successful face detection. Obtaining high rates of direction is a critical choice.

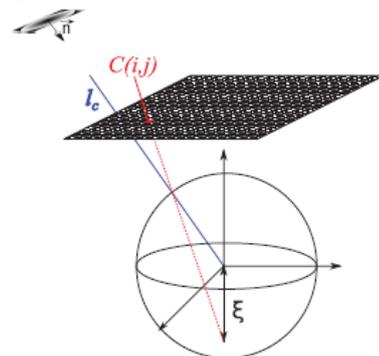


Fig. 6: Frontal Face in the Unit Sphere Reference Frame

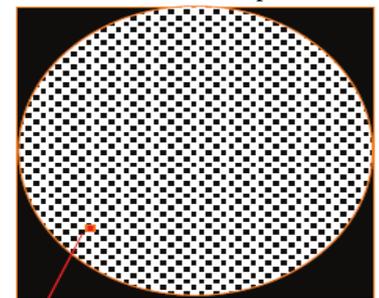


Fig. 7: Corresponding Omni Directional Image Plane.

Fei Yang, Junzhou Huang, Xiang Yu<sup>1</sup>, Xinyi Cui<sup>1</sup>, Dimitris Metaxas(2010) This research paper addresses the problem of lighting condition and poses while tracking human faces. Different people have different shapes or faces and there could be dramatic changes with various expressions, poses, identities etc. low contrast image or the casting shadows on faces are the conditions which are caused by poor lighting effects i.e these degrades the performance as a tracking system. This paper uses both depth information and color information to track face shapes this framework is developed. In this the researcher built linear face models piece wise because faces in various poses lies manifold which is non linear in nature. Microsoft Kinect is used to capture the depth image of lower resolution; it is also used for the prediction of the head pose and generates some other constraints of face boundary. The performance of a tracking system is improve by exploiting the depth information. Single optical camera was used by the most previously used face tracking systems.



Fig. 8: The face subspace of closest pose

Jan Portmann, Simon Lynen, Margarita Chli and Roland Siegwart Search and rescue and surveillance are the topics of extensive search for researchers in the past decades in which the detection of images and the tracking of images are done of images which are visible in light. All these leads to the growing availability of the cameras and detecting and tracking devices, however efforts are made on the distinct signatures of humans thermally. The transition of thermal images from visible light images is a challenge as recently trending the thermal cameras which are used on onboard aerial platforms, for example the search and rescue operations. This research paper presents a dataset of thermal images sequence and also proposes a particle filter based framework which will track people in thermal images. The thermal cameras are exclusively used in military applications which make it easier to track people faster.

### III. IMAGE PROCESS TECHNOLOGY IN FACE RECOGNITION

The facial image pre-processing step can be described. First collected color image is greyed by image greying part turning into gray image. Then through a series of processing course, such as image equalization, image normalization, image segmentation, image enhancement, Image binaryzation etc, to enhance the important trait information and eliminate the useless information of facial image.

#### A. Image Graying

The image collected by image collecting is color image that includes much information is unrelated to the face traits. Furthermore, color image takes up a many memory space of the computer and is not easy directly to storage and process. So it is necessary to twist the color image into gray image.

#### B. Histogram Equalization

In general, the face image of human beings has the disadvantages of leaning to be low or to be light and lacking of enough setup. The fundamental plan of the histogram equalization is that turned the histogram of original image

into well-share distributed histogram image to enhance image.

#### C. Image Normalization

Facial image normalization is that a changing the gray of facial image to the desired variance value and mean value. Image normalization do not change the clarity of the facial image. Just remove the difference among the gray scales caused by external noise during sampling process.

#### D. Image Segmentation

Facial image segmentation is that segmenting the facial image region from the background. In the following processes only deal with the before-ground region to reduce the computer data and increase the processing speed.

#### E. Image Enhancement

A variety of random noise make by the optical imaging system will be added into collected 2 dimensional images because of all objective factors. In addition, a few artificial noises will be added into face image in image processing. These noise will worsen the quality of facial image and make image information submerged and even changed the image's feature. In order to improve the excellence of the image, it is necessary to remove the noise to enhance the image's quality.

## IV. CONCLUSIONS

This paper has tried to review a noteworthy number of papers to cover the recent development in the field of face recognition. Present study reveals that for improved face recognition new algorithm has to grow using hybrid methods of soft computing tools such as SIFT, KLT etc may yields better performance. The list of references to offer more detailed understanding of the methods described is enlisted. We express regret to researchers whose significant contributions may have been overlooked.

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