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Real Time Face Tracking and Identification for Surveillance System

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ABSTRACT

The demand of smart cameras for various applications in surveillance for security purpose is growing rapidly. However till now, the handling required for real time face detection prohibits integration of the complete application into a small sized camera. The Real Time Face Tracking and Identification for Surveillance System proposed in this research work has originated ahead with a simple and an efficient approach to satisfy the handling requirements and enable constant and precise face detection. The core functionality of Real Time Face Tracking and Identification for Surveillance System is to allow tracking and recognition of human faces in a video stream and thereby provide a centralized, cost effective and robust mechanism of securing business and government premises. The primary objective of the proposed system is to reduce detection redundancy, minimize misclassification risk, provide huge processing capacity and work within a reasonable computational budget.

Keywords: Face tracking, Face Identification/ Recognition, Surveillance System, Camera Security, Multiple face detection, Face reorganization, HMM (Hidden Markov Model), PCA (principle Component analysis), HOG (Histogram of oriented Gradients), Descriptor, Viola-Jones

I. INTRODUCTION

The need for authentication and access control has been increasing tremendously since last few years. Face recognition plays an important role in this field. Many algorithms have been established to build the face detection task easier but in real setup this task is very difficult.

An well-ordered face recognition system must be capable to deal with variations of face images in position, illumination and expression. The variation in the images of the same face due to clarification and posture are always larger than variant owed to face identity. This makes face recognition task very challenging.

In this paper, a powerful multiple face recognition system has been proposed. The system is build, using a combination of HOG feature descriptor and SVM feature classifier along with the Viola-Jones face detection framework.

The original size of image is taken after preprocessing of image by using the equalization technique. The Viola Jones object detection framework is utilized for face detection and histogram of oriented gradients (HOG) include descriptor is utilized for face highlight extraction. The picture is segregated into little – related locales called cells, and for the pixels inside each phone, a histogram of slope headings is incorporated. The outcome results into better light and shadowing.

Support vector machines (SVMs) which is a capable apparatus for creating design arrangement and capacity estimate systems is used for face identification.

II. METHODOLOGIES

A. Principal Component Analysis (PCA)[5]

Principal component analysis (PCA) utilizes an orthogonal change procedure. It is utilized to change over a course of action of impression of potentially related elements into an arrangement of estimations of directly uncorrelated factors called essential segments.

The quantity of essential segments is not exactly or equivalent to the quantity of unique factors. This change is portrayed in a way that the primary important part has the greatest possible fluctuation and each succeeding segment thusly has the most significant difference possible under the limitation that it is orthogonal to the previous segments. The resulting vectors are an uncorrelated orthogonal started set.PCA is sensitive to the relative scaling of the first factors.

B. Hidden Markov model (HMM)[3]

In hidden Markov model (HMM) the modeled system is thought to be a Markov procedure with shrouded states. In easier Markov models (like a Markov chain), the state are straightforwardly obvious to the eyewitness thus the state move probabilities are the principle parameters. While in a concealed Markov display, the state is not specifically unmistakable, but rather the yield, subject to the state, is obvious. Every state has a likelihood conveyance over the conceivable yield tokens. In this manner, the arrangement of tokens created by a HMM gives some data about the progression of states.

Hidden Markov models are mainly known for their application in worldly example acknowledgment, speech, handwriting, gesture recognition and part of speech tagging.

Hidden Markov models have been generalized recently to pair wise Markov models and triplet Markov models, which allow non-stationary data modeling.

C. Viola jones[8]

This algorithm is developed for face detection. It is commonly implemented in OpenCV to detect the faces from printed image. Viola–Jones requires full view frontal upright faces. So, in order to detect a face, the face must point towards the camera and it should not be tilted to either side. It seems that these constraints could lower the algorithm's utility to a certain extent, but in practice these limits are quite acceptable.

The characteristics of Viola–Jones algorithm which makes it an appropriate detection algorithm are:

Real time - For practical applications at least 2 frames per second must be processed.

Face detection only (not recognition) - The goal is to distinguish faces from non-faces (detection is the first step in the recognition process).

The face detection process undergoes four stages:

1. Haar Feature Selection
2. Creating an Image
3. ADA boost Training
4. Cascading Classifiers

The features gathered by the detection framework involve the sum of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection. The value of any given feature is the sum of the pixels within clear rectangles subtracted from the sum of the pixels within shaded rectangles.

1. Haar Features - Every human face shares few properties like, the upper cheeks are brighter than the eye region and the eye region is darker than the nose bridge region.

The similarities in all human faces can be matched by using Haar features. The features matched by this algorithm are then sought in the image of a face.
Viola & Jones uses rectangle features.

The rectangle feature: Value = Σ (pixels in black area) - Σ (pixels in white area).

Each feature is related to a special location in the sub-window.

2. The rectangular features - They are evaluated by an image representation called the integral image in short time, which gives a considerable speed advantage.
The integral image at location (x,y), is the sum of the pixels above and to the left of (x,y), inclusive.

III. PROPOSED BLOCK DIAGRAM

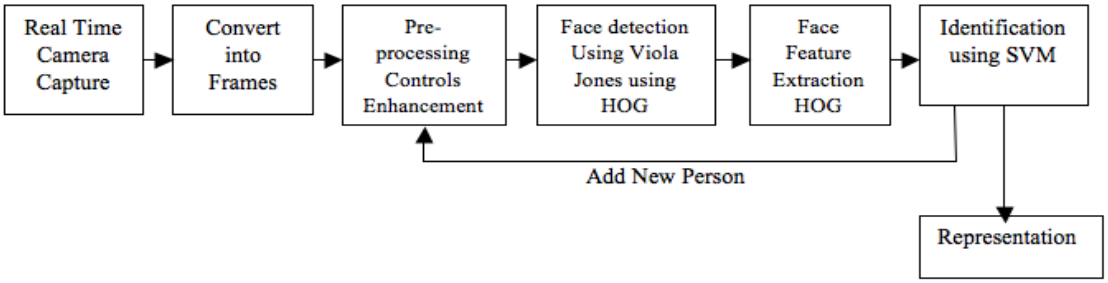

Figure 1. Proposed system flow

i. Real time camera capture
Real time camera capture can be done with some options like Real Time Streaming or Real Time Recording.

Transmission of an electronic message through a Local Area Network or across the Internet so that video and/or audio from a source can be seen and heard on PC, Smart Phones or mobile devices, is called as Live Video Streaming.

Generally, the process of using the Internet to transmit content by encoding it into a number of decodable formats is called Streaming.

Real time recording is simply a security DVR (Digital Video Recorder) that displays and record 30 frames per second i.e. each channel on the DVR is able to capture and record at least 30 frames per second. This is called full motion recording. The main purpose is to have smoothest and clear picture because in security we cannot afford to have glitch, unclear video.

ii. Convert to frames
When you extract all frames from a video clip, capturing the images one at a time is incredibly inefficient and time consuming. For that purpose a program that can extract image and save it in format like jpg or png, is needed.

Pre-preparing controls: Equalization procedure is utilized for improvement as a part of preprocessing of picture. The technique is helpful in pictures with foundations and forefronts that are both brilliant and both dull. This technique as a rule expands difference of pictures and forces can be better circulated. This considers territories of lower nearby complexity to pick up a higher difference. Histogram evening out

fulfills this by adequately spreading out the most incessant force values.

iii. Face detection using Viola Jones

The Viola–Jones framework is the first object detection framework that has provided competitive object detection rates in real-time for face detection (distinguish from non-faces).

Although Viola–Jones framework can be trained to recognize a variety of object classes, it is motivated primarily by the issue of face recognition. During the learning stage, cascades of detectors are trained so as to gain the desired accuracy.

Some characteristics of Viola–Jones algorithm which make it a good detection algorithm includes Robustness because of very high detection rate (true-positive rate) & very low false-positive rate always, Real time.

iv. Face feature extraction HOG

The histogram of oriented gradients (HOG) is including descriptor utilized as a part of picture preparing with the end goal of protest identification. The picture is partitioned into little associated areas called cells, and for the pixels inside every phone, a histogram of slope headings is ordered. For enhanced precision, the nearby histograms can be complexity standardized by processing a measure of the power over a bigger locale of the picture called a square. Utilize this esteem to standardize all cells inside the square. The outcomes results into better enlightenment and shadowing.

The HOG descriptor has a couple key favorable circumstances over different descriptors. Since it works on nearby cells, it is invariant to geometric and photometric changes, besides from protest introduction.

v. Identification using SVM

Support vector machines (SVMs) is a powerful tool for evolving pattern classification. SVM are used to hold the face recognition problem.

SVMs have achieved knowingly advanced search accuracy than traditional query refinement schemes. Main applications of these techniques are, speech and image analysis, character recognition, person identification, industrial supervision, etc.

IV. EXPERIMENTAL RESULTS

As Shown in figure 2 the design is made in Visual Studio 2010 with opencv and Running Results is also shows in figure 3

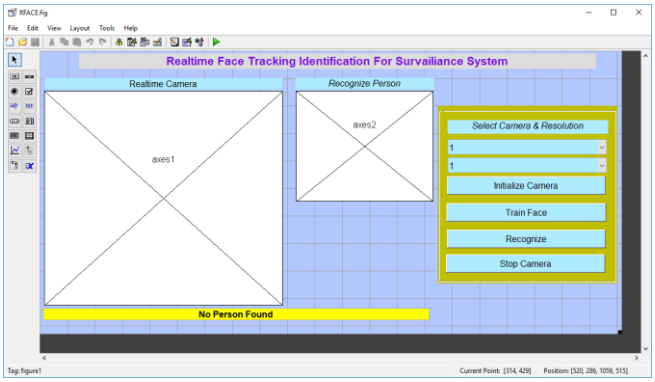

Figure 2. Main GUI Design

Figure 3. GUI Running

V. COMPARISON ANALYSIS

Table 1. Comparison of methods

Name	Method	Rate of Accuracy	Pros/Cons
Face Detection	Viola –Jones [1]	90.5%	Pros: - It is very efficient algorithm for face detection in real times as it has a very low false positive rate. Cons: - Detects only limited head poses.
Face Features Extraction	PCA [2]	94.00%	Pros: - PCA algorithm helps to achieve satisfactory real time performance. Cons: - It lacks detection ability.
	HMM [3]	90%	Pros: - HMM model is easy to understand. Cons: - Long assumptions about data and huge number of parameters are needed.
	HOG [4]	99.71%	Pros: - Speedy and accurate face feature extraction results. \Cons: - complete processing is time consuming.
	Haar – like [5]	95%	Pros: - Gives highly accurate and precised results as feature extraction part is very efficient. Cons: - High execution time required. Complex to implement.
Classification	SVM [6]	93.20%	Pros: - SVM algorithm can find the optimal separation hyper plane and can deal with high dimensional data. Cons: - It Require lots of memory and CPU time.
	Neural Networks [7]	78.9%	Pros: - Less expensive. Acceptable false detection. Cons:- The results are not so accurate.

VI. CONCLUSION

In this paper we have present new approach where HMM AND HOG features are incorporated into the Viola-Jones face detection algorithm, allowing the algorithm to detect multiple faces with greater efficiency. The work deals with real-time algorithms and techniques for multiple face detection and face tracking in videos. These will help the industry, big organization, security area monitoring, etc for managing security issues.

In this work we have used Viola Jones algorithm, HMM and HOG face recognition models are explained, analyzed and tested for face tracking.

The proposed system is a windows based application. It can be implemented on different operating system like IOS, Linux, Ubuntu, etc in future.

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