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# Suspicious Human Activity Recognition for Video Surveillance System

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**ABSTRACT**

In this research work Suspicious Human Activity Recognition for Video Surveillance System, we detected cheating activities in examination hall. We used SURF (Speed Up Robust Features) to extract interest points, and use SURF method to match and find the corresponding features. We used some algorithms to classify the suspicious activities. We also use Viola Jones object detectors for finding the faces and labelling the activities. We also use tracking algorithms to track detectors in the input video. The proposed techniques use fast detectors and they are robust. In addition to the detectors and tracking algorithms, we used text labelling to avoid false classification, if detectors and tracking algorithms fail to track the faces.

***Key Terms – SURF, BoW, Detectors, Trackers, Interest Points***

## I. INTRODUCTION

Human activity detection for video surveillance system is an automated way of processing video sequences and making an intelligent decision about the actions in the video. It is one of the growing areas of Computer vision and artificial intelligence. A lot of cameras are installed in many places for surveillance, but the surveillance is done by human, and it is done only if there is a report of anomaly behaviour, otherwise the videos are kept as archives, and never use. Developing algorithms for automatic detection of Human movements, and making appropriate decision when there is any suspicious behaviour, it will result to real time processing of Human activities in public places. It will help in security, and ensuring public safety.

Previous Human Activities Recognition approaches were used in classification of activity rather than predicting ongoing activities. The methods were good in recognizing simple actions, but they were not good for complex actions (similar body gestures). Hidden Markov Model was one of the famous approaches for Human activity recognition: It is a sequential state that model human action as hidden states and create postures to enable recognition of actions. The shortcomings of the traditional activity recognition approaches are: 1) They are not suitable for predicting real time activities 2) They are not suitable for modern high dimension videos 3) They are not suitable for noisy and multiple subjects recognition.

In this research work we will use objects detection algorithms to detect faces and hands, and tracking algorithms to track the locations of the objects. We will also use interest points of two correlated images, to find suspicious activity in the Examination Hall. If there is any suspicion the system will detect the hands and the faces of the subjects and also notify the invigilators by alarm.

In this research work a surveillance system will be implemented to detect suspicious activities in examination hall. This system will be among the pioneer system for real time supervision of students writing examination. There is no need of Human supervisor, if computers will handle the task efficiently. Examination supervision is one of the activities that are carried manually, even in the most modern universities. It becomes tedious if the examination hall is large, more supervisors are needed. However most Universities reduce the rate of examination malpractice by mixing up students from different disciplines to write the exam together, although this method is useful, but is not applied always especially during writing tests, quizzes or practical evaluation.

Examination Malpractice or Cheating is any form of unlawful activity in an examination hall. It is very dangerous practice, which should be avoided because of its negative effect in the society. A lot of techniques are learned every day, and that requires intelligent surveillance to detect and recognize these illicit activities. Some of the negative impacts and malpractices were mentioned in [1] paper. Unqualified Personnel, Condemn of future if student caught in school or later life, dishonest and corrupt minds, discredit certificates, unproductive brains. There many cheating activities in the examination hall: bringing exhibits i.e. book, summary papers, suspicious activities i.e. exchange of papers, use of electronic gadgets i.e. Mobile Phones, Verbal communication, Inscription i.e. writing answers on Hands,

In our work we will be more concern with two major cheating activities in the examination hall:

1) Viewing answers from Neighbours

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2) Passing cheats to other students
Consider the fig below:

Fig 1 Viewing answers from neighbour

Fig 2 Passing cheats to neighbour

In this research work we will explore different methods of Human activities recognition. We used SURF (Speed Up Robust Features) to extract interest points, and use SURF method to match and find the corresponding features. We also use Viola Jones object detectors to find the faces and labelling the activities. The proposed techniques use fast detectors and they are robust.

The above scenes are suspicious, our system will detect and recognized the activities and labelled them. It will also alert the invigilator that suspicious activity is going on, that will be a good evidence to present to the examination authorities. The following will be the output of the system.

Fig 3 Suspicious Activity Detected

## II. RELATED WORK

There are a lot of researches in Human detection and recognition for Surveillance System. Human detection and recognition involves the following: object/motion detection, classification, tracking, and behaviour and activity analysis. Most surveillance systems consist of the following components: CCD cameras, Thermal Cameras, Night vision devices.

Human recognition is very useful in activity recognition, because we need to identify the Human (doing the actions) in surveillance system. Multitudes of papers were written for Human recognition. One of the research papers is [17] paper. In this paper they suggest an innovative system, which use face profile and gait silhouette. They also use curvature-based matching method (CBM) for recognition. Gait Energy Image was used to describe human walking properties. Object Detection using optical flows was explained by [16]. He also explained the general stages involved in video surveillance

Human activity recognition in video using Hidden Markov Model (HMM) was discussed in [11] paper. They modelled Human behaviour as a stochastic sequence of actions. They explain Actions using feature vector containing the trajectory information, and a set of local motion descriptors. Activity recognition can be attained using probabilistic search of image databases representing previously observed actions. They use non-parametric sampling from earlier learned actions and Bayesian networks for estimating the probabilistic activities.

Another important paper is [16]. This research paper presents an approach for automated activities recognition of human from video sequences. They classify features with high correlations into Category Feature Vectors (CFVs). Each activity is depicted by a combination of GMM (Gaussian Mixture Models). Adding new events to overcome lack of training data for unusual events is easy using their proposed approach. Confident-Frame-based Recognizing algorithm (CFR) is used to recognize the human activity. Confident-Frames are used for classification of the video frames.

Recent technological development in pattern recognition and computer vision made recognition of human activities possible. Human Activity Recognition using Silhouette Directionality was discussed in [9] paper. In this paper, they propose an algorithm for nonintrusive human activity recognition. They use an adaptive background–foreground separation method to extract motion information and create silhouettes (foreground) from the input videos. They emphasize that they approach can be applied to both frontal and lateral views of numerous activities, and it is robust.

A comprehensive survey on efforts to address the problems of representation, recognition, and learning of human activities from video and related applications was presented in [12] paper. They have discussed various

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approaches and classify them according to levels of complexity. They begin with a discussion of methods to model the simplest classes of actions (primitive actions) that do not require sophisticated dynamical modelling. They also discussed some methods to model actions with more complex dynamics.

Other interesting areas like early detection and recognition of activities was suggested by [10]. In this research paper they present a method of human activity prediction. They are more concern with recognizing events in an early stage (an example is a man put his hand to pick a gun). They formulate the probabilistic activity prediction problem, and introduce new methodologies to solve the problem. They use integral histogram of Spatio-temporal features. They named their new recognition methodology as dynamic bag-of-words, which considers sequential nature of human activities and handle noisy data. Another important paper was the one proposed by [4]. They proposed another method for predicting of Human activities using Spatio-Temporal Points of Interest. They prove that their method is more accurate and efficient than Dynamic & Integral Bag of Words.

Human activity detection and recognition has an application in elderly homes and hospitals. It was use to monitor the patients and if there is any unusual activity the system notifies the concern authority. One of the papers that discusses about is [8]. In this research paper, they present human activity detection model that uses only 3-Dimension features produce from an RGB-D camera. They use Gaussian Mixture Modal (GMM) based Hidden Markov Model (HMM) to understand human activity. Other papers that are dedicated to elderly homes includes: [18]. In this paper some abnormal activities were detected. R-transform and kernel discriminate analysis (KDA) were used.

Numerous methods for Human activity recognition were suggested by many researchers. A method using Blob features was suggested in [7] paper. In this research paper, they present an approach for human activities recognition in video. They use background subtraction to extract foreground object in sequence of video. They later use foreground blobs of the current frame and a series of frames before the current frame to form a new feature image using certain rules. Finally, they use the component method to combine the non-zero pixels in the feature image into blobs. Each blob corresponds to an activity which is characterized by the blob appearance. They use Gaussian Mixture Modal (GMM) to model features different type of human activities, and Mehalanobis distance to estimate the similarities.

There are also some papers on biometric methods of Human recognition [3]. This research paper addresses the shortcomings of traditional iris acquisition systems. They proposed an iris recognition system for long-range human identification. The system acquires faces and iris images from many humans.

Another important paper is [5]. In this paper suspicious activities like object exchange, entry of a new person, peeping into other's answer sheet and person exchange from the video captured by a surveillance camera in examination halls. They use face recognition, hand recognition and body gestures of one or more persons to detect suspicious activity.

## III. METHODS

**A. Face Detection:** We use Viola Jones algorithm to detect faces of our victims. The following are the three approaches used by [14]: Integral Image (representation), AdaBoost (Classifier), and Cascade (More Complex Classifier). Integral Image is computed using some pixel wise operations. The integral image is computed by finding the sum of left pixels and top pixels of the affected pixel. It is given by the following formula:

$$II(x', y') = \sum I(x, y) \quad (1)$$

Where $x' \geq x$ and $y' \geq y$

Haar like features are then computed. AdaBoost use feature selection techniques to select few features, each phase of AdaBoost algorithm select new weak learner. The Following figures demonstrate the working condition of AdaBoost Algorithm.

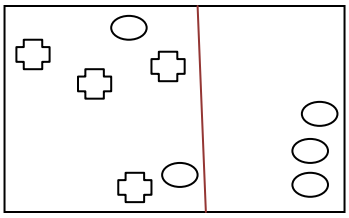

Fig 4 Week Classifier

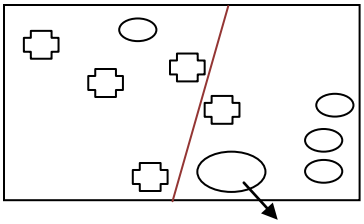

Fig 5 Week Classifier 2 Weights Increases

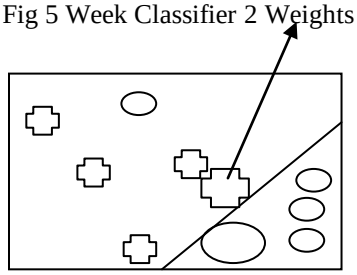

Fig 6 Week Classifier 3

Cascade combines classifiers into cascade structure, and form the final strong Classifier.

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The following command is used in matlab to define a face detector object using Viola Jones Algorithm:

```
faceDet = vision.CascadeObjectDetector;
          .
          .
          .
```

**B. Extracting Interesting Point and Matching Points:** There are many algorithms available for extracting points. We used SURF to extract Interesting points. Hessian Matrix Approximation is used detecting the interest points. Suppose a point p=(x,y) in an image I.

$$H(p, \sigma) = \begin{bmatrix} Lxx(p, \sigma) & Lxy(p, \sigma) \\ Lxy(p, \sigma) & Lyy(p, \sigma) \end{bmatrix} \quad (2)$$

Where Lxx(p, σ), Lxy(p, σ), Lxy(p, σ), Lyy(p, σ) are convolution of Gaussian Second Order Derivation of p in I.

The descriptor is extracted by constructing square region around interest points. The region is divided into smaller sub regions then Haar wavelet is computed. The gradient information is contained in sub patches. Details of SURF are explained in [6] paper.

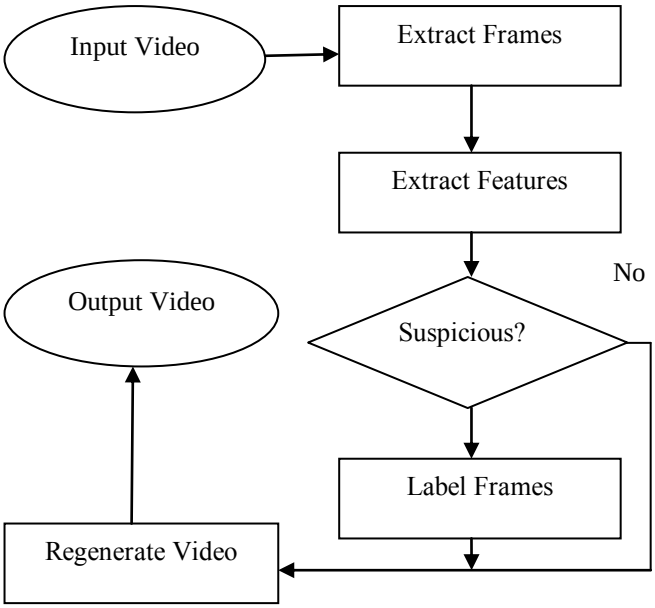


Fig 7 Proposed Methodology Overview

## IV. RESULTS AND DISCUSSIONS

**A. Extracting Frames:** In the following section, we display the result of extracted frames. The frames were saved in JPEG format. In the following typical output we have 804 frames.

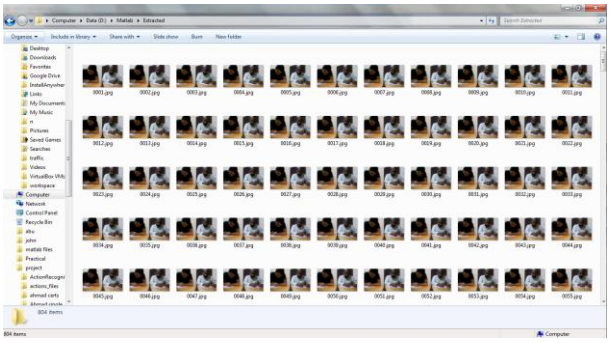

Fig 8 Extracted Frames

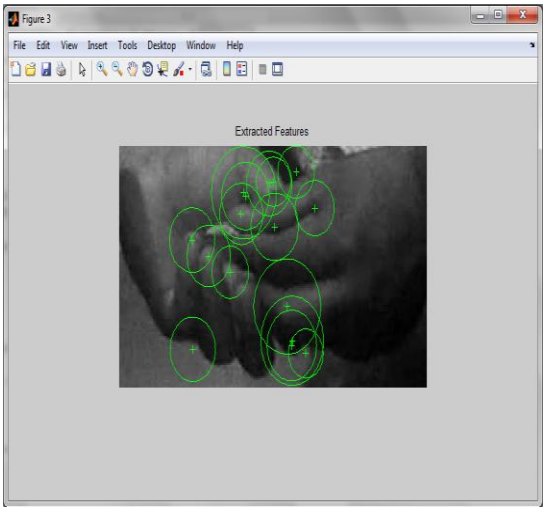


Fig 9 Extracted Features

The figure below demonstrates the suspicious recognition task. In addition to Viola Jones detectors, we use text labelling to avoid false classification, if detectors and tracking algorithms were not able to track the faces.

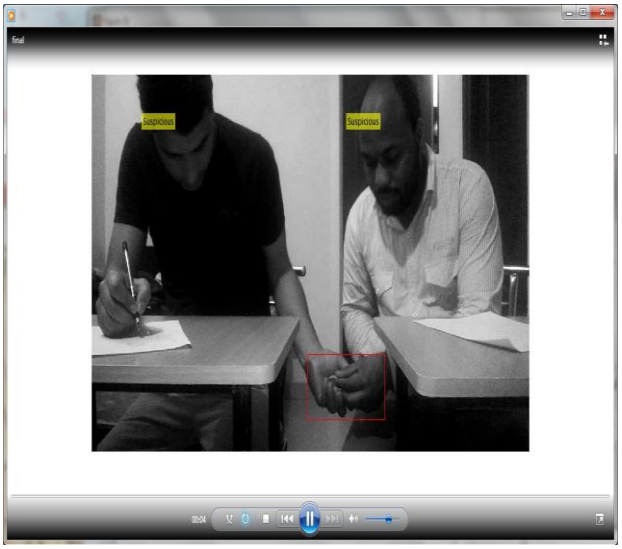


Fig 10 Suspicious Activities Recognition

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## V. CONCLUSION AND FUTURE SCOPE

**A. Conclusion:** We implemented Suspicious Human activity Recognition Surveillance System, which will be useful in detecting and recognizing cheating activities in the examination hall. Human supervisors are error prone, and their efficiency is affected by fatigue, sickness and any other factor. We studied several algorithms of face, hand, eyes, nose detection and recognition for tracking Human in Videos and Other Crowded Scenes. We also study several algorithms of feature extraction, Feature Matching, and Human Activity Recognition to build a fast and also a robust system to detect and recognise cheating activities in the hall.

**B. Future Work:** We will improve some algorithms of Human Activity Recognition to develop fast and reliable system of recognizing any Human activity. We will also work on other biometric features to incorporate variation into Human activity Recognition System. We will develop algorithms that can predict Human Activities with high certainty and efficiency to prevent criminal activities before occurring.

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