Human Detection in Video Surveillance System

[1]Ajinkya Sapkal, [2]Sushil Nemade,[3] Nikhil Mohadikar, [4]Pallavi Gosavi
[1,2,3,4]Department of Computer Engineering Sinhgad College of Engineering, Pune, India
Email: [1]aju.sapkal93@gmail.com,[2]sushilknemade@gmail.com,[3]mohadikarnikhil09@gmail.com,[4]pallavi.gosavi7@gmail.com

Abstract— Object detection is a crucial part in today's video surveillance systems. Many methods have evolved over the years that include Background Subtraction at the pinnacle. Background subtraction is a technique in which the video is segmented in multiple frames. A base frame called as "Background" is used to subtract another frame from it to detect "Foreground". Motion–based and shape-based algorithms boost the Background subtraction method.

The multiple objects detection technique used in surveillance system uses Support Vector Machine (SVM) to detect and classify the different objects. In this project, study proposes a novel object detection and its classification using Support Vector Machine (SVM) which is used to differentiate objects according to the set of points on the objects. The algorithm then aims at the classification of these key-points, namely at discriminating between the points which belongs to objects and all the others, by means of a Support Vector Machine (SVM) classifier. At the end of the procedure, the objects present inside the scene are identified by analyzing at the key-points previously classified as specific object points. It begins with a feature extraction process from which a set of consistent key-points is identified. Being able to identify specific objects or a particular class of objects in an image can provide several advantages and can open the door to the development of various interesting applications.

Index Terms— *Human detection, Image Segmentation, Feature extraction, Support vector machine (SVM) classification*

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I. INTRODUCTION TO VSS

Object detection has evolved over the years. There have been many advances in the technology of object detection and classification. Object detection and classification is a very key part in today's surveillance systems. Technology can be classified into mainly three generations namely 1GSS, 2GSS, 3GSS.

- 1GSS: This generation used analog systems for Image processing and the retrieval of data was a tedious job
- 2GSS: This generation used both analog and digital systems which improved the speed of object detection
- 3GSS: This generation used full-fledged digital systems for image processing and object classification. This proved the retrieval of the data to be fast and a central repository reduced the cost of the systems. The proposed system targets human detection and it is database management in a video surveillance system for security purposes and marketing strategies. The rest of this paper is organized as follows. Sections II and III introduces the motivation and main idea respectively. Section IV and V are preprocessing and feature extraction from a particular frame respectively. Section VI consist of the classification module.

II. MOTIVATION

This work is motivated by the ever increasing application of image processing and high capacity storage devices used in places such as military services, traffic surveillance etc.

Also, the technology provides a useful application in modern vehicles such as Unmanned Aerial Vehicles (UAV)

There is increasing demand for data analysis in the field of security systems, banking environment, forensics etc.

III. MAIN IDEA

There are three main jobs in this system. The jobs are preprocessing, extraction of features and feature matching/classification using SVM (support vector machine).

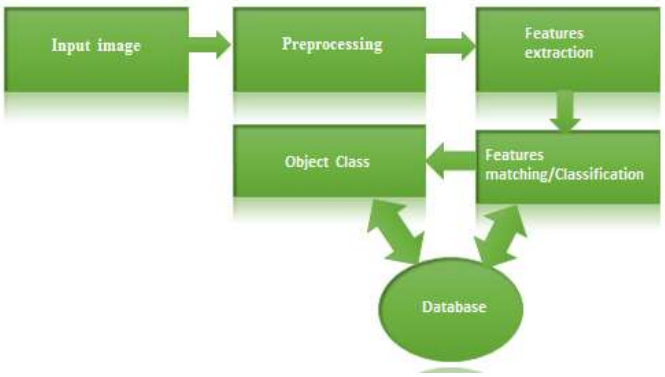

Figure 1. Block Diagram

Aim is to extract a complete human body region from a video. The difficulties are in determining a human region in frames and to find the correct human regions.

First frame is taken as initial background. Input frames are subtracted from the background to generate a coarse mask of foreground regions. Then connected components searching and operations are applied on the mask to obtain refined foreground regions. Subsequently, we collect sample points on the contour of a foreground region and from which shape feature vectors are abstracted.

An SVM classifier is used for identifying whether the input vectors belong to human or nonhuman based on the model previously trained by positive and negative samples. Every independent foreground region is classified and regions identified as humans are recorded for updating background.

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IV. PREPROCESSING

The main of preprocessing is an improvement of the image data that suppresses unwanted distortion and enhances some image features important for further processing. Input video is converted into frames and these frames are converted into grey images.

Preprocessing consist of converting video into frames and background subtraction. Background subtraction is based on frame differencing. Background subtraction attempts to detect moving objects from the difference between the current frame and the reference frame.

Fig 2. Preprocessing

Fig 2 shows actual preprocessing of a video. Fig 2. (a) is the base frame and (b) is the current frame taken for background subtraction. One can see the actual result of background subtraction in Fig 2. (c). Thus, the resulting image will contain information about how much changes occurred between the two frames.

V. FEATURE EXTRACTION

The purpose of image segmentation is to separate foreground regions from background area in order to detect any moving objects. Main concern is the foreground region for further processing after background subtraction.

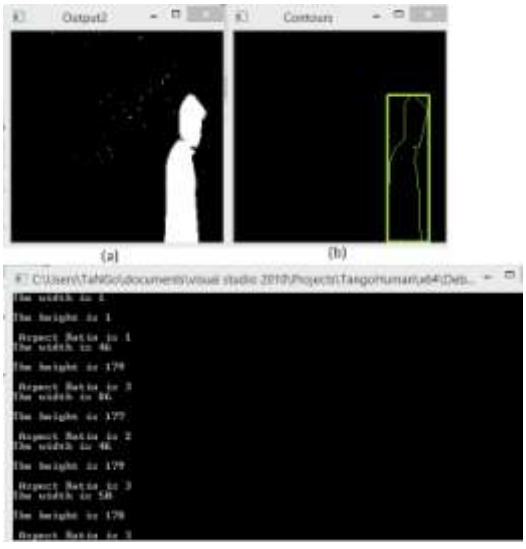

Fig 3.Feature Extracted

Correct features for human detection are necessary for accurate results. Feature such as aspect ratio (height to width ratio) is a reliable source as aspect ratio of any human being is fairly greater than 1. Fig 3.(a) background subtraction result is used for further feature extraction. Fig 3.(b) shows a contour around the foreground mask in a form of green rectangle. This rectangle is used for calculating height and width of the extracted object. Aspect ratio is calculated frame by frame as,

Aspect ratio = Height/Width

(a) (b)

Fig 4. Face Detection

Living things and non-living things are generally differentiated on the basis of facial feature. Often, non-living objects do not have faces. This feature is used along with Aspect ratio so as to eliminate more objects other than humans. Fig 4.(a) shows two persons and their faces detected. Pink-colored ellipse is drawn around person's face. Fig 4.(b) shows three persons and their faces detected on the basis of frontal-face. For face detection, two eyes are required to be seen in the frame.

VI. CLASSIFICATION

In recent years, SVM raised so much importance in the field of image processing because of its accuracy. As our matter is to classify objects into human or non-human is a two class problem SVM is the best known in finding solution to such problem.

SVM is the binary classifier. As shown in Fig 5 it classifies detected objects into two classes i.e. human and non-human. Hyperplane is constructed to differentiate between two classes.

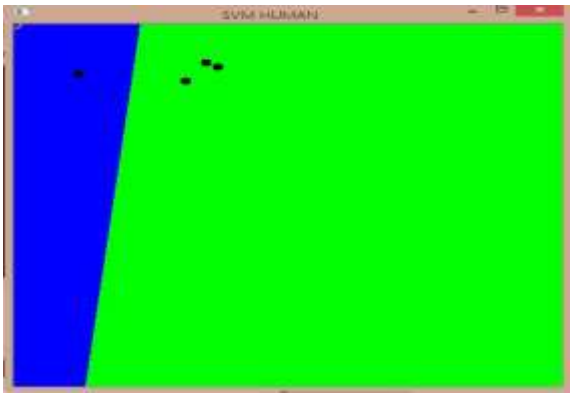

Fig 5 SVM Classifier

The line differentiates green and blue region is hyperplane. The hyperplane is equidistant from two closest

points from both the classes. Blue portion consist of non-human objects and green portion is for humans.

VII. EXPERIMENTS RESULTS

We have tested the proposed human detection technique on a number of videos. These videos are of various real time scenarios.

Single human videos: Only single person appears. Videos have different backgrounds.

Multiple human videos without occlusion: These videos have multiple humans but they move in such a way that occlusion doesn't occur. The study shown the human detection result with video consisting of human and non-human objects at a resolution of 720*1080, a frame rate of 22fps and for effective calculation purpose we skipped 10 frames per second. The video consisted of around 300-400 frames. One can observe from Fig 5 that the proposed method classifies objects into two classes from one considered frame accurately.

VIII. CONCLUSION

Nowadays various sectors are facing the security problem hence we introduced this system so that human can be detected in video surveillance system.

Input video is preprocessed i.e. converted into frames and background subtraction is performed. Foreground objects are obtained from background subtraction. Features are extracted from these objects. These features are given as input to the SVM classifier which classifies the object into Human or non-human objects

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