A REVIEW: OBJECT TRACKING AND ANALYSIS BASED SMART VIDEO SURVEILLANCE SYSTEM

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ABSTRACT

Video surveillance security system is process of automatic recognition and evaluation of critical situations in LC environments in order to object tracking and analysis. In the road and railroad transportation field safety and security are the most examined topics. Recent security activities in the field of railroad transportation propose to implement video surveillance at level crossing (LC) conditions. When there are enough detected pixels belonging to moving objects then object is tracked. Primarily there are two major kinds of methods to perform visual tracking. The first type is based on target representation and localization and the second type of methods uses filtering and data association. The smart security system starts by detecting, separating, and tracking moving objects shot in the LC. By allowing the identified targets to discard unsafe situations, ideal trajectories are predicted. Then the level of danger of each objective is instantly estimated. The analysis allows also for recognizing dangerous scenarios. Hazard scenarios are checked and evaluated with different real video image sequences.

KEYWORDS: object detection and separation, level crossing (LC), tracking, and video surveillance.

I. INTRODUCTION

Surveillance can be defined as the behavior monitoring, activity, or other knowledge or data, usually of person with the objective of managing, giving direction, or for their safety purposes. This is done by observing with the help of electronic equipment (for example a CCTV camera), or electronically transmitted information. Video cameras used for observation of an area are called as surveillance cameras. A surveillance camera is simple and cheaper that these can be used in systems for home security, and for daily surveillance [1].

Modern LCs or railroad crossings as called in America have become more developed from the early days where human railway employees used to wave flags of red or green colour to indicate situations at level crossing. Also shining lanterns were used to clear railroad tracks for approaching trains from vehicles and pedestrian traffic. Due to these concerns, railroads began with implementation of manual barriers which eventually developed into electrical gates (crossing barriers) to avoid road traffic from coming on the rail tracks. High traffic areas having crossings requires active warning systems which consists of electrical boom gates, flashing lights, and alarming bells that go off when an approaching train trips a nearby track circuit.

Despite of the modern safety procedures, railroad crossings possess a serious safety issue around the consuming. Moreover railroad crossing accidents tend to be caused due to human error and traffic regulation violation. Although human error may seem like an in-eliminable obstacle, it is one cause of accidents that can be reduced by equipping people with the correct information at the correct time [2]. Almost every year tens of thousands of people die on road, at Level Crossing which involves more than one vehicle. Improving level crossings (LCs) safety became an important field of research and took increasing railway concerns Human errors cause 99% of the LCs accidents, 93% of which is caused by road users. Generally, whenever there is an occurrence of an accident, the operator waits for a road user to notice the accident to use an old telephone which is installed at the Level Crossing premises to warn the traffic center about the accident at the LC. Then the operator at the traffic center calls all the approaching trains to tell them to stop immediately without any additional information on what is going on. Till then the situation at the level crossing is becoming worse, because of the wounded users and/or the blocked traffic. This is a "blind" way of managing LC incidents. Thus, implementing a more improved management of LC safety and performance is required to reduce the hazards due to accidents as also reducing the situation from becoming worse due to unattended accidents scenarios [3].

The "Safer European Level Crossing Appraisal and Technology" (SELCAT) project [3] has proposed a common

LC accident information system for evaluation of possible technological LC safety solutions and for reporting all LC accidents in European countries. The PANsafer project [2] aims to actively contribute to reducing LC accidents. In this project, one of the objectives is to perform a video-analysis-based system to recognize hazard situations and evaluate the degree of danger of each detected and tracked moving object at LC.

II. DETECTION METHODS

A. BACKGROUND SUBTRACTION METHOD

The way of extracting moving foreground objects from stored background image or generated background frame form image series is known as background subtraction [4][5]. It is an advanced background subtraction technique used to detect and extract features for vehicles in complex road scenes in traffic surveillance. The non-adaptively is a drawback which is raised because of the adjustment in lighting and the climatic circumstances [6]. A major contribution suggested the statistical and parametric based strategies which are utilized for background subtraction techniques; some of these strategies utilized the Gaussian probability distribution model for every pixel in the picture [4].

B. FEATURE BASED METHODS

Another pattern which the scientists research and motivate on sub-features like the edges and corners of vehicles, the moving items portioned from background picture by gathering and breaking down the arrangement of these elements from the development between the consequent edges [4]. Morever, the feature based strategy supports the occlusion handling between the covering vehicles and compared with background subtraction technique represents a less level from the computational difficulty view[7][8].

C. FRAME DIFFERENCING AND MOTION BASED METHODS

The frame differencing is the way towards subtracting two subsequent frames in picture sequence to segment the moving object (foreground object) from the background frame image. The movement segmentation process is a vital and key step in recognizing vehicle in dynamic view which is done by isolating the blobs (moving objects)[9].Blobs can be created through analyzed and assignment sets of pixels to different classes of objects which is based on orientations and speed of their movements from the background of the motion scene [4].

III. TRACKING METHODS

A. POINT TRACKING

Tracking can be formulated as the correspondence of recognized items given by points across frames. Point correspondence is a confused issue essentially in the presence of occlusions, misdetections, entries, and exits of items. In general, point correspondence strategies can be separated into two general classes, in particular, deterministic and statistical techniques [5]. The deterministic techniques utilize subjective movement heuristics to constrain the correspondence issue. Then again, probabilistic strategies expressly consider the object measurement and take instabilities into consideration to establish correspondence [10].

- Deterministic Method

In Point tracking this method works on connecting each object in previous frame with single object in current frame. This is done with the help of set of motion constraints. Deterministic methods for point correspondence define a cost of associating each object in frame t − 1 to a single object in frame t using a set of motion constraints[11]. Minimization of the correspondence cost is formulated as a combinatorial optimization problem. These approaches are made for different application for different purpose.

- Statistical Method

Statistical or Probabilistic Method is works on measuring position of object in the frame with detection mechanism. This method used for model the object properties such as velocity and position. There are two classes of tracking: Single object and multi object tracking. Estimations got from video sensors constantly contain noise. Also, the object movement can experience random perturbations, for example, moving vehicles. Statistical correspondence techniques take care of tracking issues by considering the estimation and the model instabilities into account at object state estimation. The state space approach is utilized by statistical correspondence techniques to demonstrate the object properties like position, velocity, and acceleration. Measurements usually consist of the object position in the image, which is obtained by a detection mechanism [5].

B. KERNEL TRACKING

Kernel tracking is based on object motion. It is typically performed by computing the motion of the object, which is represented by a primitive object region, from one frame to the next. These algorithms differ in terms of the appearance representation used, the number of objects tracked, and the method used to estimate the object motion.

- Template Based Models

Template base is method of searching the image, for the object template defines in previous frame. Because of its relative effortlessness and low computational cost templates and thickness based appearance models have been regularly utilized. We partition the trackers in this class into two subcategories in view of whether the items are followed separately or together. There are two types of template based method: Tracking single object and Tracking Multiple object [5].

- Multi-view Appearance Models

Multi view appearance is the new approach utilized for items that may have diverse perspectives in various frames[12]. There are difficulties in other method to track object like this. The appearance models in the previous tracking methods are usually generated online (for example histograms, templates etc). Thus these models represent the information collected through the most recent observations from the object [5][6]. The objects may appear different from different views, and if the object view changes dramatically during tracking, the appearance model may no longer be valid, and the object track might be lost. Diverse perspectives of the object can be learned offline and utilized for tracking to beat this trouble.

C. SILHOUETTE TRACKING

Silhouette Tracking is utilized when complete region of an object is needed. Complex shape objects for instance hands, head, human body, can be precisely explained by silhouette based method. The objective of these type tracking methods is to find the object region in each frame by means of an object model generated using the previous frames. There are mainly two categories of silhouette tracking namely shape matching and contour tracking [6].

- Shape Matching

Shape matching can be performed tracking where an object silhouette and its associated model is search in the current frame which similar to tracking based on template matching. In this approach, the search is executed by methods of computing the closeness of the object with the model produced from the presume object silhouette based on past frame[13][14].

- Counter Tracking

Compare to shape matching method, contour tracking method is advancing an underlying form in the first frame to its new area in the present frame. This shape advancement requires that some piece of the item in the present frame cover with the item region in the past frame [5]. Tracking by evolving a contour can be executed by utilizing two distinctive methodologies. The primary approach utilizes state space models to show the counter shape and its movement. The second approach specifically develops the counter by limiting the shape vitality utilizing direct minimization methods, for example, gradient descent[15][16]. Contour based tracking algorithm includes further classification, namely, state space model and direct minimization of contour energy function.

Table I: Comparision Of Tracking Techniques

Type of Tracking	Methodology	Advantages	Limitations
Point tracking	GOA tracker	Handle occlusion and misdetection	Assume no object entries and exists
	Kalman Filter	Track points in noisy images	State is distributed bygaussian
	MHT(Multiple Hypotheses tracking)	Deal with entries of new object and exit existing object	Computationally exponential both in time and memory
	Particle Filter	Solves the problem of Kalman Filter	state of a single object is estimated
Kernel Tracking	Colour Histogram	Robust to occlusion, clutter, distraction	Spatial information of the target is lost, cannot give good performance when an object & its background have similar colour
Silhouette tracking	Contour tracking	Object Shape is Implicitly modelled	-
	Shape Matching	Less sensitive to appearance variations	Training is required

IV. SYSTEM ARCHITECTURE

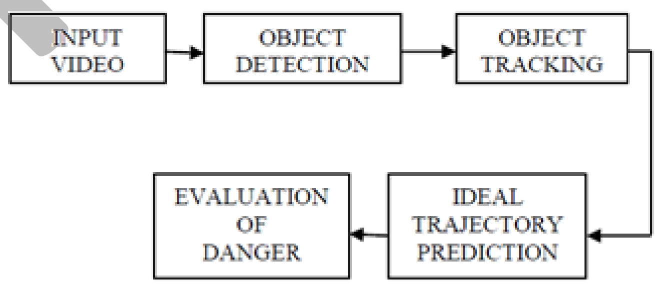

Figure 1: Block Diagram Of Video Surviellence System

Video surveillance systems have long been in use to monitor security sensitive areas. The making of video reconnaissance frameworks brilliant requires quick, dependable and vigorous calculations for moving article identification, order, following and action investigation. Moving item location is the fundamental stride for further examination of video. It handles division of moving items from stationary foundation objects. This not just makes a concentration of consideration for more elevated amount preparing additionally diminishes calculation time extensively.

Ordinarily utilized procedures for object detection are background subtraction, statistical models, fleeting differencing and optical flow. The next step in the video analysis is tracking, which can be simply defined as the creation of temporal correspondence among detected objects from frame to frame. This procedure provides temporal identification of the segmented regions and generates cohesive information about the objects in the monitored area such as trajectory, speed and direction.

The output produced by tracking step is generally used to support and enhance motion segmentation, object classification and higher level activity analysis. The final step of the smart video surveillance systems is to recognize the behaviors of objects and create high-level semantic descriptions of their actions. The last stage of the model is to analyze the predicted ideal trajectory considering various sources of dangerousness.

V. RESULTS

Figure shows the tracking of various vehicles from right to left. Fig. 2 shows an example of multiobject tracking by combining the object detection and separation method and the tracking process.

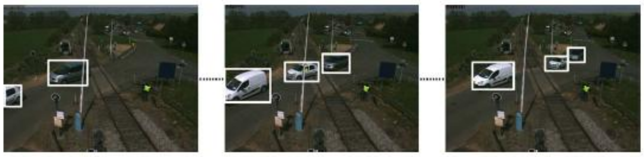

Figure 2: Tracking Process: From Right To Left

Fig. 3 shows an example of predicted trajectories obtained from optical flow of a vehicle in an LC environment. The purple lines in Fig. 3 represent absolute ideal trajectory of the center of each extracted region from the object. The white curves in the figure represent the instantly predicted ideal trajectory of the centers (yellow points) of the extracted regions.

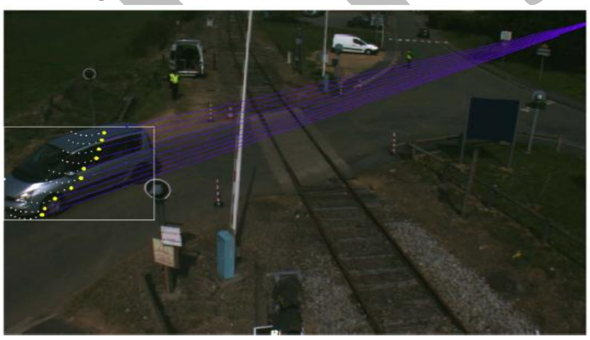

Figure 3: Ideal Trajectory Prediction Result

VI. CONCLUSION

Various detection and tracking techniques are discussed in this paper. A point tracking involves detection in every frame, while kernel based or contour based tracking requires detection when object first appears in the scene. Point trackers are suitable for tracking very small objects which can be represented by a single point representation. In kernel tracking approach, different estimating methods are used to find resultant region to target object. Comparison of different tracking techniques based on methodology, advantages and limitations are also given in this paper. These detection and tracking techniques are used in smart video surveillance system. This smart video surveillance system is used at level crossing for railroad safety.

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