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INTELLIGENT AUTOMATED VIDEO RELAY TRACKING USING PREDICTION

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***Abstract*--Video data is widely used in civilian and military security domains as well as in navigational applications like (autonomous vehicles). With increased levels of automation of systems it's imperative to process the video feed efficiently to be effective in their respective environments. For this, better understanding of the entities in the video feed is required. Entities in a video feed say humans, animals, man-made entities like vehicles and other things (entities of interest like a briefcase) etc. need to be tracked effectively. This will help in better utilization of time to increase productivity by helping in thwarting the security threat or to help in the navigation of the autonomous systems with minimal human intervention. The proposed system is designed to use a video stream (say form a camera) to analyse the video stream and to provide output which is a processed video stream with entities (humans, animals, man-made entities) get tracked. Existing systems are plagued by issues like fluctuating background clutter, occlusion, merging and splitting of entities of interest. The proposed system is designed to provide improved tracking of the entities irrespective of the degree of presence of background clutter or other hindrances. This can be adopted and used in civilian and military security systems as well as aid in navigation for autonomous systems like robots and drones etc.**

Keywords—Video data, autonomous vehicle, navigational applications, entities, background clutter, occlusion, merging and splitting.

I. INTRODUCTION

It is imperative for personnel operating vehicles to be informed about the entities in their surroundings to avoid any un-necessary incidents. When an obstacle is about to be encountered evasive taken by the person at the controls. The increasing demands of the present human civilization has led to the increased utilization of the autonomous vehicles. These autonomous computer systems or vehicles need to possess the necessary ability that the vehicle operating personnel do so as to perform the efficient work as it is being done by the human operator.

determined by employing tracking and classification system. The autonomous vehicles are required to work in various environments and in varying weather conditions. This makes it important for the system to work in various weather conditions. The system needs to work properly with nearly 100% efficiency in the presence of varying trajectories of people or vehicles with varying levels of merging and splitting patters with partial and complete occlusions.

Autonomous systems employ sensors to gather data form the environment. For this project video feed from a camera will be used. The video will be processed in order to identify the various entities that are present in the video file in consecutive frames. The detection, classification and tracking of entities is complex task. Apart from this there are situations that arise where the merging, splitting and presence of occlusion in the frames lead to loss of tracked entities. Also, the duration of the existence of occlusion results in the failure of tracking. These problems have to be tackled in order to achieve the desired results.

For classifying entities across video feed and to track them the following three main steps have to be performed. They are segmentation of motion, entity tracking and entity classification. In segmentation of motion process the pixels associated with each moving entity are detected. This process of segmentation of motion consists of background subtraction and foreground pixel segmentation. Gaussians techniques can be used to perform background subtraction along with 2-pass algorithm for grouping for foreground pixel segmentation. But in the filter used this paper Approximated Median was used to achieve better background subtraction and this was because of the introduction of the step factor in the filter.

Once the segmentation of motion is achieved entity tracking has to be performed. This is very error prone as it is much easier for the system to lose track of the entity that is being tracked. Adding to this are issues like merging, splitting, interaction of entities through occlusion etc. The Condensation method can be used to track entities. Other methods like Invariant bipartite graphs can be used to model the dynamics of the tracking process. Apart from these linearly predictive multiple hypotheses tracking algorithm uses correspondence matrix and a merging and splitting algorithm to relate the foreground regions to the tracked entities.

Classification of the entities into humans or vehicles can be achieved through Support vector machine technique. Thus the detection, tracking and classification of the entities in the video feed is thus achieved.

II. SYSTEM DESIGN AND WORKING

The environment to be monitored is observed and recorded with the help of a video camera. The data that is recorded is stored. The video is fed through the system, processed and the output video feed is displayed. In case of autonomous vehicles the whole system has to be built into the particular system. Segmentation of motion detects the moving entities from frame to frame. The output generated is used by the tracking algorithm which maintains history of each entity.

One of the advantages of the tracking algorithm is to be able to track the entities without the knowledge of their size or shape and also it is able to track entities even after prolonged duration of occlusion. After this the output produced is used by the classification systems. This uses modified version of the system presented in Sha and Javed's approach. The algorithm uses motion history of each entity and by determining the type of motion exhibited by them. Following which the output is used in the classification system. These three steps are interdependent and so the overall output will be errant if one of the stages produces inaccurate result.

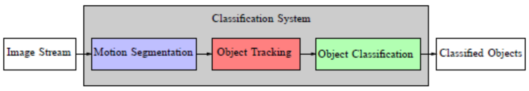

Fig 1.Common Classification System

The camera used is a web cam and it has a resolution of 768 * 576. It has a frame rate of 25 fps. Java was used and the OpenCV Java was used in order to exploit the Open Source Computer Vision Library.

III. SEGMENTATION OF MOTION

In both entity classification and in entity tracking the motion pixels of moving entities are segmented accurately. Segmentation of motion involves two steps: background subtraction and segmentation of foreground pixels. Background subtraction is used to identify moving entities. This is achieved by selecting parts of the frame which differ significantly from the other parts of the frame (background portion – portion of frame with less changes).

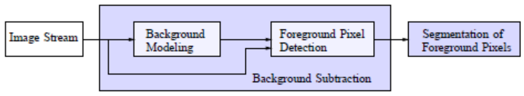

Fig 2. General Background Subtraction

Statistical description of the current scene is called as background modelling. Binary candidate foreground masks are outputted by identifying the pixels that are different from that of the earlier frame. Background modelling is performed by the Approximated Median Filter. Incrementing and decrementing by scaling the approximate median filter results in better output.

In each frame the foreground pixels are segmented into regions. A bounded box is applied to connected regions using a 2-pass connected component labelling method. After this step only the regions in bordered rectangles are taken into consideration. Size filter is used to remove any remaining noise in the frames. The rectangle boxes merge if they (2 or more) are below the threshold distance between eachother.

IV. MULTI-ENTITY TRACKING AND OCCLUSION

Establishing correspondences amongst entities across frames is the goal of tracking them. Inaccurate tracking will result in non-robust classification of moving entities. The implemented entity tracking algorithm is shown as flow diagram below.

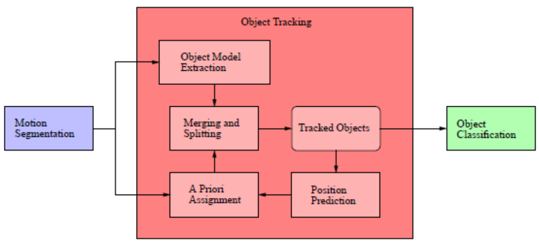

Fig 3. Multi-Entity Tracking Algorithm

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Entity model extraction is one of the parts of the multi-entity tracking algorithm. Models of entities are extracted using region based approach. The normalized Red Green Blue colour histogram is determined for every entity that has been measured. A histogram calculation is done by counting the number of pixels those entities that are within the rectangle that borders them.

The position of each entity tracked is predicted by Kalman filter. The position of each entity is obtained by using homograph. Assumption is such that the entities are orthogonal to the plane and homograph is predicted by deducing the midpoint of the lower rectangle edge from the rectangle that has been projected on to the plane. Each tracked entity is tracked a Kalman filter each. For the usage of Kalman filter a constant speed model is used. A Priori assignment is used in the process of tracking and measuring the entities that can be classified into the following 3 categories. They are matched tracked and measured entities, unmatched tracked and unmatched measured entities. This step cannot handle merging and splitting of entities as one track the assigned multiple measured entities.

The merging and splitting events are handled in the merging and splitting subsection. When 2 or more entities interact a large rectangle is generated around all the entities those are in close proximity with each other. This doesn't necessarily mean that those entities are occluding each other. Merging detection algorithm is use d to decide upon the issue whether the track is merged with another track or it remains unmatched. If the entity's track data remains unmatched its age is increased and this happens until the entity is no more significant. Splitting detection algorithm is developed for unmatched detected entities.

V. ENTIIY CLASSIFICATION

Each moving entity in the input frames gets classified as a single person, group or vehicle. An appearance history of the entities form the tracking algorithm by means of a bounding box and the correspondence of each entity over the frames.

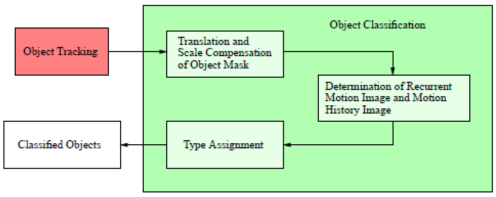

Fig 4. Entity Classification Algorithm

An entity mask is defined as the portion of the mask image within the bounding box of the entity. Translation and scale compensation of entity masks is given below. A moving entity is allowed to change its position within the bounding rectangle and its size. Compensation of entity masks over time is required to eliminate the effects of mask over time. This is done by aligning the entities in the frames along their centroid. The entity is scaled is both entity mask and direction. Determination of recurrent motion and image motion history along with type assignment is done here.

VI. CONCLUSION

A video feed based system has been readied for tracking and classification of entities. The system shows enhancements in detection and classification of people and vehicles. The system can handle prolonged occlusion and has demonstrated good results over multiple entities and varying conditions. In each test case the system identified and tracked the entities correctly. Multi-object tracking has been employed even in the presence of occlusion and in merging and splitting situations. The system is efficient and the continued research in this direction will aid in the process of improving the situational awareness of the autonomous systems to a greater degree.

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