Unmanned object detection using computer vision

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ABSTRACT

Use of computer vision for security purposes has been gaining traction in recent years. One very important application of computer vision in the security systems is video surveillance. A video surveillance system observes the scene in the image area and tries to identify the abnormal activities and alerts the concerned authorities by triggering notifications for any situation that requires manual intervention. This research area is of notable significance as timely detection of illegal activities can save countless lives across the globe.

Detecting an object that has been carried by a human into the scene and suddenly left unattended is an important problem in visual surveillance research. Since the spectrum of suspicious objects is broad, we can use general purpose object detection algorithms to identify these objects in the scene. We aim to develop a system that initially detects the static foreground objects and then analyzes the back-traced trajectories of object owners to decide whether the object is left unattended or not.

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1 INTRODUCTION

In public places like railway stations, airports there may be scenarios where a person enters a scene with an object, places the object that may be suspicious and leaves the scene after placing the object. There are incidents where a vehicle is parked in a no parking zone. These kinds of objects are difficult to identify in a video scenario as they change from a moving position to a static position. There are many algorithms to find the moving foreground objects and also the objects that are static from the beginning of the scene. The algorithms that detect the objects that change from moving to stationary either do not detect the objects accurately or add more overhead in time and memory. Also, there may occur a scenario where a person places an object accidentally and then returns back to take the object. These kinds of scenarios should not result in an alarm, so it requires a tracking of the owner of the object. After the verification of the owner and if the owner does not return to the object only then the alarm should be raised.

The objectives of the proposed work include:

- Find the static foreground object that changes its state from moving to static with less overhead of time and accurately when compared to the current state-of-the-art work.
- Track the owner of the candidate static object identified to verify that owner does not return to the object and raise an alarm.

2 PREVIOUS WORK

Stationary foreground objects [1] are detected by using a finite state machine(FSM) approach where three detector results are passed on to a FSM to classify the pixels between background and foreground objects. Short, medium and long term detectors are used to update the background at different rates. Based on the update status on objects in each detector, the objects are classified as either foreground or background objects. The three detectors which are used for detecting the different types of objects make a disadvantage as they have processing and time overhead.

The survey [2] gives a good insight on various stationary foreground object detection techniques. The methods discussed in the survey are used in objects that become stationary completely or only for some amount of time. The survey mentions background subtraction as the best technique for stationary object detection as it compares the previous frames with the current frame and identifies granular differences in the pixels. The survey acts as a premise for implementing background models with different absorption rates to identify the foreground objects.

Suspicious objects [3] are detected by different morphological and thresholding techniques. The video frames are taken one at a time and thresholding techniques are applied to separate the background and foreground objects. Some techniques involve multilevel thresholding and histogram. To get a clear picture of the detected regions different morphological techniques like erosion / dilations are used. The main advantage is the ability to distinguish foreground and background objects in the video. However, this method suffers due to its performance as it takes longer time to process as the video quality diminishes and the method does not perform verification of the owner.

3 CONTRIBUTION AND METHODOLOGY

The time taken in the work [1] by three detector models - long term, medium term and short term is directly proportional to the number of models used and it results in 8 different states in a finite state machine. The proposed work reduces the model to two detectors, short and long term detectors, thus improving the performance and reducing the number of states in FSM to identify static foreground objects without losing much of its accuracy.

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Phases	Actions and Goals	Deadline
Phase 1	Region of interest selection	Mar 4
Phase 2	Implementing Gaussian mixture model	Mar 10
Phase 3	Short and Long term detector model	Mar 31
Phase 4	Defining and implementing finite state machine to detect static foreground objects	Apr 10
Phase 5	Running performance evaluation and surveillance dataset	Apr 25
Phase 6	Webpage completion	May 2

The Performance Evaluation and Surveillance dataset will be used to verify the new proposed approach and the results will be compared with the three detector implementation for its accuracy.

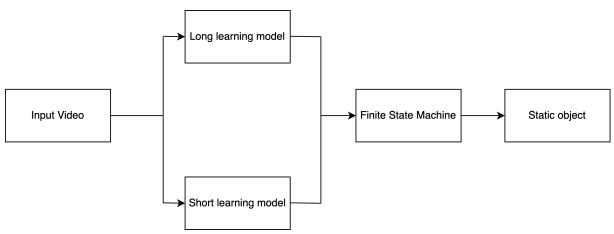

Figure 1: Architecture Overview

The unmanned object detection system starts by identifying a candidate static foreground region and then to analyse the region for unmanned object. Identifying a static object is difficult as there may be many objects surrounding an object that has changes its state from a moving to static object which is the main area of interest. The steps involved in identifying the static foreground object are shown in Figure 1. After selecting the region of interest the input video is fed into two background models namely Short and Long Learning models with different learning rates which learn the background at different updation rates. The result of these models are subsequently passed through a Finite State Machine the result of which shows whether there is any candidate static object or not. The states of the Finite State Machine represent the different states of the object at each stage.

A widely deployed object identification technique is the background subtraction algorithm of Gaussian Mixture Model. The Gaussian Mixture model is the primary algorithm for detecting moving objects in a video because of its ability to detect various scenarios in a video. Each pixel in this method is made by a separate Gaussian mixture that is learnt continuously as the video proceeds. This method is used the most because of its ability to handle the changes in lightning etc. Moving objects can be identified using this method but in order to identify objects that come from a moving to a static state an extension is needed. To use the extended algorithm the objects must attain a static condition from a moving condition. First the generic Gaussian mixture model is used to detect the moving objects then the extension is added.

The extension proposed to identify the static foreground objects proceeds with Gaussian Mixture model by building two models that are generated at different learning rates. A model that learns and updates quickly is called a short learning model and the model that learns and updates slowly is a long learning model. The usage of both the models can be used to detect the stationary foreground object as the long learning model would make the stationary object as a foreground object as it updates at a slower speed while the short learning model considers it as a background object.

4 PROPOSED TIMELINE

The proposed timeline of the project is shown in the above table.

REFERENCES

[1] C. Cuevas, R. Martínez, D. Berjón, and N. García. Detection of stationary foreground objects using multiple nonparametric background-foreground models on a finite state machine. *IEEE Transactions on image processing*, 26(3):1127–1142, 2016.

[2] C. Cuevas, R. Martinez, and N. Garcia. Detection of stationary foreground objects: A survey. *Computer Vision and Image Understanding*, 152:41–57, 2016.

[3] T. M. Pandit, P. Jadhav, and A. Phadke. Suspicious object detection in surveillance videos for security applications. In *2016 International Conference on Inventive Computation Technologies (ICICT)*, volume 1, pages 1–5. IEEE, 2016.