Detection And Identification Of Derelict Objects (DIDO)

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Abstract - *With concerns about terrorism and global security on the rise, it has become vital to have in place efficient threat detection systems that can detect and recognize potentially dangerous situations, and alert the authorities to take appropriate action. Of particular significance is the case of unattended objects in mass transit areas. Our approach involves the recognition of four sub-events that characterize the activity of interest. When an unaccompanied bag is detected, the system analyses its history to determine its most likely owner(s), where the owner is defined as the person who brought the bag into the scene before leaving it unattended. Through subsequent frames, the system keeps a lookout for the owner, whose presence in or disappearance from the scene defines the status of the bag, and decides the appropriate course of action.*

Key Words: **surveillance[1], monitoring[2], image processing[3], video analysis[4]**

1.INTRODUCTION

Visual surveillance systems today consist of a large number of cameras, usually monitored by a relatively small team of human operators. Typically, each operator watches a set of screens that cycle through views of different locations every few seconds. Recent studies have shown that the average human can focus on tracking the movements of up to four dynamic targets simultaneously, and can efficiently detect changes to the attended targets but not the neighbouring distractors. It appears that there are spatial and temporal limits to the tracking capability of humans. When targets and distractors are too close, it becomes difficult to individuate the targets and maintain tracking. This difficulty in selecting a single item from a dense array, despite clear visibility, has been attributed to the acuity of attention, or, alternatively, to obligatory feature averaging. Speed of the target is another factor that limits the tracking accuracy of the average person.

Further, according to the classical spotlight theory of visual attention people can attend to only one region of space at a time, or at most, two. Simply stated, the human visual capability and attentiveness required for the effective monitoring of crowded scenes or multiple screens within a surveillance system is limited. Thus more often than not, camera footage at such locations finds greater use in post event investigations than in crime preventions and security enforcement.

Intelligent video analysis offers a promising solution to the problem of active surveillance[1]. Automatic threat detection systems can assist security personnel by providing better situational awareness, enabling them to respond to critical situations more efficiently. In this paper, we present a new methodology for detecting objects left unattended in public areas such as mass transit centers, sporting events and entertainment venues. The algorithm is general, and may be readily adapted for several related applications such as the detection of fallen rocks and other obstructions on roads, railway tracks and runways, and the monitoring of cargo. Here, we focus on the detection of abandoned baggage at train stations, where an object is defined as abandoned in a spatio-temporal context: when its owner has left a predefined detection area for longer than a certain time period t (60 seconds in our case.

Our system essentially emulates the behavior of a human operator. At the first sighting of unattended baggage, the system traces it back in time to look for its owner. The owner of the bag is conservatively defined as the person who brings it into the scene. Once a candidate owner has been associated with the bag, a search for the owner is initiated. If the owner is found to be missing from the detection zone for longer than t seconds, the bag is deemed as abandoned and an alarm is raised. If eventually the person returns to the bag, the alarm is stopped. The flow of events and the order of processing are illustrated in Figure 1.

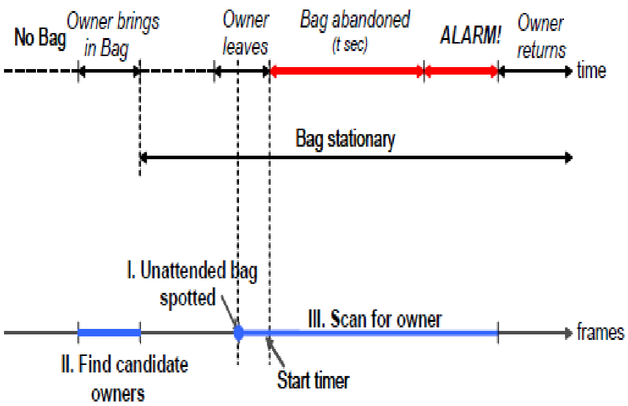

Fig- 1: Working structure

1.1 Proposed Algorithm:

Our method is designed to capture and exploit the temporal flow of events related to the abandonment of a bag. Figure 1 shows the formal representation of our task, adopted from Allen and Ferguson's classic temporal interval representation of events. Their framework applies temporal interval logic to define the relationships between actions and events, and their effects. An event is defined as having occurred if and only if a given sequence of observations matches the formal event representation and meets the pre-specified temporal constraints. Here, we define the activity of the abandonment of a bag in terms of four sub-events that lead to it – entry of the owner with the bag, departure of the owner without the bag, abandonment of baggage and consequent timed alarm, and the possible return of the owner to (the vicinity of) the bag.
The algorithm is composed of three computational modules that operate to detect the four aforementioned sub-events that describe the activity: the detection of unattended baggage, reverse traversal through previous frames to discover the likely owner(s), and the continued observation of the scene. The process is preceded by a basic preprocessing stage as discussed below.

1.2 Low Level Processing:

For efficiency and ease of computation, we perform background subtraction on each frame. To enhance the generality of our framework, the system is designed to automatically estimate the background from the image sequence. A background initialization algorithm adapted from it was used to build the background model. Initially, at each pixel, stable intervals of time are identified and local optical flow is computed to help determine which interval is most likely to display the background.
This method has been shown to yield impressive results when optimal parameters are selected. In our system, this critical process of parameter estimation is automated by analyzing the input sequence. The static background thus extracted is impressively close to the true setting.

1.3 Detection Of Unattended Objects

The goal of the first module (as depicted in Figure 1) of the algorithm is the detection of any stationary baggage that seems to have been left by itself. Until such an event occurs, it is unnecessary to track and monitor all ongoing activities in the scene. Doing so not only cuts computational costs but also avoids ambiguities born of inaccuracies in tracking in the presence of much movement and occlusion.
The algorithm is composed of three computational modules that operate :

1. To detect the four aforementioned sub-events that describe the activity: the detection of unattended baggage.
2. Reverse traversal through previous frames to discover the likely owner(s).
3. The continued observation of the scene.

The process is preceded by a basic pre-processing stage as discussed below:
We have decided to approach this problem in two phases.

Phase 0

- In this phase we have to establish basic framework for catching the culprit in case any threat is posed. Phase Zero (P0) involves the implementation of giving each owner a QR code to stick on the bag/car.
- Upon booking a ticket, parking ticket, a QR code is generated and that is placed on to the bag/car. This code shall be generated against the PNR number/license number only.
- The entry to the mass transit area will be only through this QR code and such a system will streamline the process.

Phase 1

- This part is the main algorithm for detection and assessment of situation.
- Python 2.75 is used for majority of the algorithm.
- Rasberry Pi3 is used since the mobility, robustness and cost-effectiveness is most. Also, image processing applications have been credited to have performed better on this platform
- OpenCV 2.4.5 is a image library which is used on an interim basis till more image libraries and their data sets are procured.
- Haar Classifier in cascade is used for feature detection.
- This phase sets the boundary for the actions to be taken after detection.
- Np-Numpy2.7 is used as an add-on over the Open CV.
- OpenCV supports till 2.7.5 python so newer versions of python cannot run this library.
- Alternatively, MATLAB can be later used if necessary to test the results but shall be avoided to prevent complications.

Phase 2

- Phase Two (P2) is initiated if P1 sounds an alarm.
- A security personnel will go and scan for any threat in the abandoned bag and take necessary action.
- Rapid action teams will be deployed for the task.
- Scanning can be done using different sensors. The proposed sensors as of now are a metal detector(proximity induced sensor), GS-MC.

Fig-4: car being identified via camera

2. Components

HARDWARE:

1. .Rasberry Pi3
2. Voltage source.
3. Compatible PC for developing and implementing code.
4. Keyboard
5.Mouse
6.Webcam

DETECTION PART

1.Transistors (BC547)
2. capacitorsS(2.2 uf,10uf)
3. resistors(2.2Kohms,47Kohms)
4. inductor(300 TURNS)
5. 9V battery
6. General purpose board

SOFTWARE:

1. Python 2.7.5
2. OpenCV 2.4.5*
3. Numpy 2.7
4. Various Image datasets

3. Block diagram/schematics

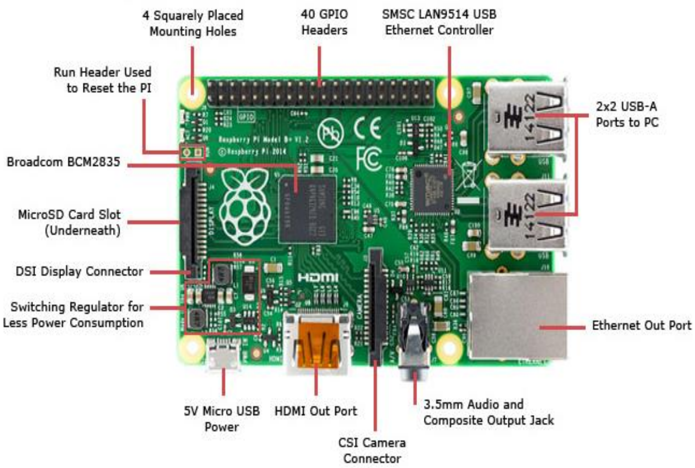

Fig- 2: Block diagram of the raspberry pi3

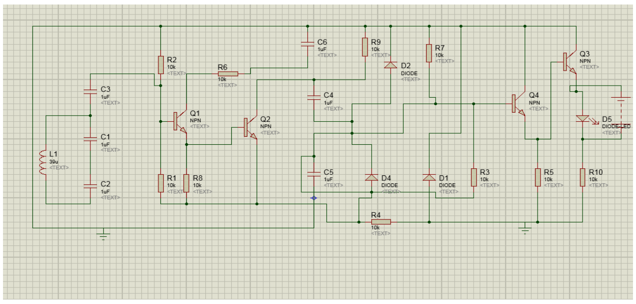

Fig- 3: Schematic diagram of the metal detector.

Once all the phases are finished, the detection as well as the identification of derelict or unattended objects is obtained.

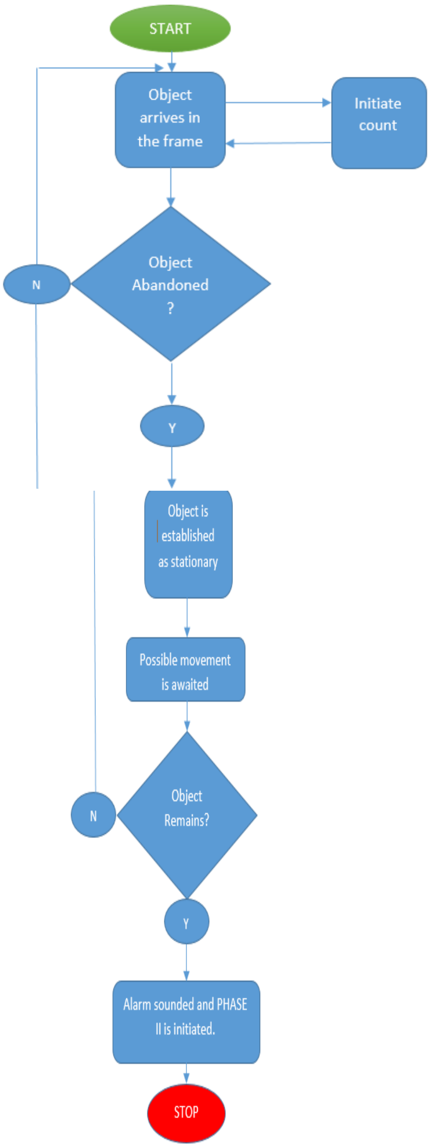

Fig-4: Possible scenario flowchart

4. Applications

Intelligent video analysis[4] offers a promising solution to the problem of active surveillance. Automatic threat detection systems can assist security personnel by providing better situational awareness, enabling them to respond to critical situations more efficiently. The algorithm is general, and may be readily adapted for several related applications such as the detection of fallen rocks and other obstructions on roads, railway tracks and runways, and the monitoring of cargo. Here, we focus on the detection of abandoned baggage at train stations, where an object is defined as *abandoned* in a spatio-temporal context: when its owner has left a predefined detection area for longer than a certain time period *t(100 for our case).*

5. CONCLUSION

This paper introduces a general framework to detect objects abandoned in a busy scene. The algorithm is, to the best of our knowledge, novel and unique. The proposed algorithm is appealing in its simplicity and intuitiveness, and is demonstrated experimentally to be conceptually sound. It is well-equipped to handle the concurrent detection of multiple abandoned objects swiftly, in the presence of occlusion, noise and affine distortion. The algorithm lends itself naturally to the recognition of a vast variety of related activities, ranging from surveillance and corridor observation to traffic management and cargo monitoring. Its modular structure allows the flexibility for integrating more functionality and sophisticating various sub-modules without disturbing the remaining framework. The performance and success of our methodology is promising, but much remains to be done.
The proposed algorithm is appealing in its simplicity and intuitiveness, and is demonstrated experimentally to be conceptually sound. The algorithm lends itself naturally to the recognition of a vast variety of related activities, ranging from surveillance and corridor observation to traffic management and cargo monitoring.

6. ACKNOWLEDGEMENT

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7. REFERENCES

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