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Reveiw of Developed Object Detection Techniques for Auto Detection System

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Abstract
The automatic detection has emerged as a technique in a realistic manner within the field of automation. This is very useful in defence as well as civil sector. The main objective of the paper is to model, simulate and analyse Automatic Target Detection and Shooting (ATDS) of objects, used for target acquisition, tracking, detection and shooting. The proposed paper can be divided into the following techniques:

- Improvised parametric ratios algorithm for blob analysis of object recognition.
- Feature based target classification algorithm.
- Analysis of different data samples for classification by Bag of feature technique.
- Algorithm for imprecise test detector, HOG-SVM classifier technique.

This system has the ability to classify the physically existing objects like tank, jeep, tetra truck in real time using thermal imaging cameras during night time as well as in bad weather conditions. The Analysis of all techniques are provided in tabular form.

Keywords- Vehicle Detection, Classification, Background Subtraction, Surveillance, Feature Extraction.

1. Introduction

Auto Detection (Bhanu and Jones, 1993) is a mechanism for selecting a specific object shown in Figure 1. Targeting is basically used to focus on a single or multiple targets. It aims at the current target and skills function based on the distant and direction, the target is compared with system position. The camera's direction has also been taken into account to determine target path.

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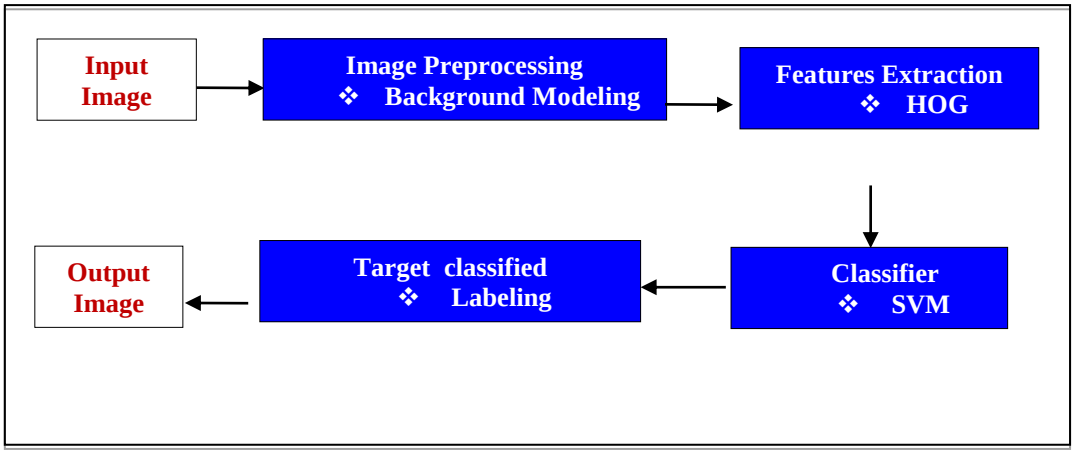

Figure 1. Auto detection of moving vehicle block diagram

Target surveillance, tracking and moving object detection are the different operations (Yung et al., 2000) of surveillance which is achieved with the help of sensing methods such as radar, ultra-sound or laser scanning. The ability to track the targets at a required range without using the above mentioned methods will reduce the cost and complexity of the control system. The upgraded thermal imager along with the modern digital cameras provides an ideal platform for experimental development in computer vision. These kinds of quality optical sensors are low at cost, readily available and are more possessed with high-resolution images. Applications of ATDS are not only for automated security systems provided for defence, it may be for wide-scale civil automation. ATDS is simulated by lab based experimental setup realised by small toy targets. This developed simulator is able to automatically locate and aim the moving target, such as a tank, car or jeep. The ATDS, in real scenario can detect moving object at a distance of 500m and recognize the target upto a range of 150m, further it can also select a projectile for short range shooting at a correct position in feasible time. The features of proposed system can be upgraded after validation and verification. The detection of target depends upon the specifications of camera used for surveillance (Burden and Bell, 1997). The target acquisition is done by processing of an image stream from a single camera or by fusion of two camera images of different Field of View (FOV). The Speeded Up Robust Features (SURF) detection model along with a trajectory path calculation (Walters, 1967) model helps ATDS to work accurately in real world. In fact, the projectile launcher has no sensors to provide feedback of its position. The flight parameters are framed in terms of the altitude and azimuth angles of its barrel (Qihang et al., 2015). In this work development of simulator with results are analysed for performance of a visual servo system. The proposed ATDS system uses digital as well as thermal cameras mounted on the barrel for launching projectile. These cameras used for detecting as well as recording movement of detonated weapons. The experimental results of lab based simulator have been provided for analysis of target detection and recognition as well. For target shooting, realization ballistic simulator is developed for both training and testing. The developed ballistic simulator test is conducted on

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different size, different range and different velocity of projectiles to get the calculation of the desired launcher position in order to shoot detected target at correct location.

The proposed surface based algorithm used for target detection has less complexity than that of local feature based matching algorithms (Oihang et al., 2015) which is also used for Ariel target recognition. The detection of the target is based on the different features of the object extracted using background subtraction (Burden and Bell, 1997). It effectively works on inputs from both digital and thermal camera, which improves the clarity in vision during day and night. In order to develop an effective target classification system for accurate shooting, the system must fulfil the following requirements

- Effective clustering of the object from the background.
- Proper extraction of the features used for classification.
- Classification of segmented object into specified classes.
- Adaptive background models to cater various long term illumination changes.
- Insensitive to noise captured by camera like small motion in the background.
- Selection of projectile for shooting depends upon target detection range.
- Calculation of azimuth and elevation, both for proper positioning.

The fundamental problem here is to design the system, which should be simple and easy to use as per user requirement. The ATDS must be as simple as possible. A user need not know the details of system. Once the system is mounted, it automatically works during day and night. A method is designed to develop an algorithm for different operations of image processing to detect, identify and recognize the moving surface target. The target detection module is dependent on different kind of sensors. Infrared sensor and digital camera in surveillance are two of them used to classify the identified moving object. The algorithm is verified on the basis of experimental data.

2. Object Detection

Border security is a prime task for defence to counter foreign attacks at the border. To overcome this problem, a combined interface of automatic target detection is required that contributes a lot in the battle field surveillance. This kind of defence system consists of two modules: fire control unit and tracking unit. The targeting unit consists of a fire control computer along with sensors to detect the presence of target taking into account the various atmospheric parameters and to process them electronically. The visual sensors are used to determine the target, while the firing unit is responsible to hit or miss the target. The targeting unit comprises a unique algorithm which can position the gun automatically, once the parameters are obtained.

The target tracking unit receives the signal (Burden and Bell, 1997) from the camera located at a remote location and responds according to the training of the system. The image signal can be processed by various image processing technique like blob detection, feature extraction, contour extraction, tyre detection, ratio analysis, thresholding thermal image

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processing and CCD image processing techniques. The auto detection techniques are shown in Figure 2.

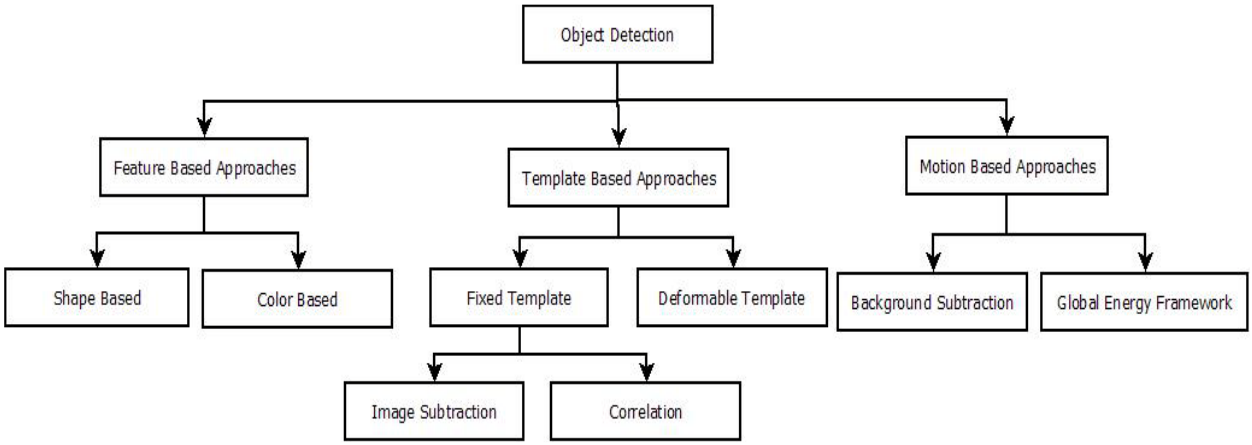

Figure 2. Different object detection techniques (Gonzalez and Woods, 2007)

This technique is widely used as object detection/blob detection technique in vehicle detection (Gupte et al., 2000; Lai and Yung, 2000). The performance of technique is effected by lighting and the climate situations. Therefore, several researchers work to resolve the outcomes by many algorithms on this field.

3. Comparative Study of Developed Object Detection

Table 1. Comparison between different developed object detection techniques

Method	Accuracy achieved	Complexity	Edge Detection	Comment
BLOB Analysis (parametric ratio based)	Moderate. (71.5% - CCD)(60% - TI)	Low	Yes	Low memory requirement. It works for moving as well as stable objects. Accuracy achieved with static and single moving target, accuracy effected by multi- targets. More accuracy achieved by charge-coupled device (CCD), which is reduced in case of Thermal Imager (TI).
BLOB ANALYSIS (No. of tyres, distance between	**High** (87.5%-CCD) (71.7% - TI)	Moderate	Yes	Low memory requirement. It works for moving as well as stable objects. Accuracy enhanced from first technique in both CCD and Thermal Imager (TI). Accuracy of Thermal Imager depends upon contrast.

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tyres, speed)				
Bag of Features (BOF)	**High** (90%-TI)	Moderate	Yes	High memory requirement. Accuracy achieved for TI is 98% by reducing false alarm rate for positive class data. Accuracy achieved for TI is 82% by reducing false alarm rate for negative class data. Due to high memory requirement not easily compatible with hardware of system.
HOG-SVM	**High** (Training-98%) (Testing-87.5%)	Low	yes	Low memory requirement for training. Accuracy achieved in testing is 87.5%, due to high complexity, more consumption of power and resources. hence, may reduce performance of system. Accuracy effected for multiple class data.

3. Conclusion

For object detection, four different kind of approaches have been studied i.e. Blob Analysis (parametric ratio), Blob Analysis (Speed & Tyre detection), BOF and Improvised HOG-SVM. The accuracy is analyzed for respective targets for both TI (Thermal Imager) and CCD data shown in Figure 3 and Figure 4.

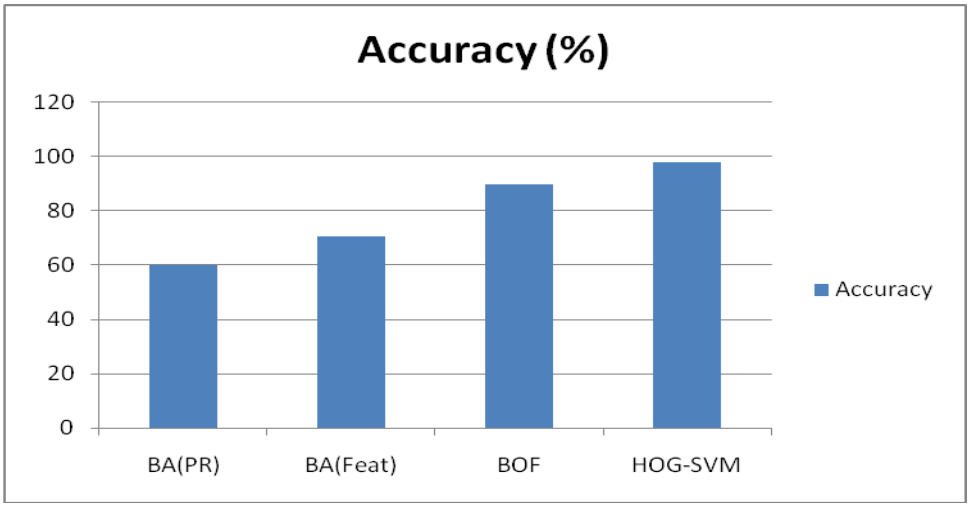

Figure 3. Accuracy analysis of different approaches on thermal camera

The Blob Analysis with parametric ratios is easy in implementation but work well only when full blob is extracted from frame. Therefore, the correct ratios of blob have to be determined for categorization of class.

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Further, the Blob Analysis with specific feature of tyre detection and speed has been implemented. So, in case of tie on ratio decision one can go for tyre detection, number of tyres and speed detection in video. It achieves better accuracy on testing.

The Bag of Feature (BOF) approach is studied for comparison with developed algorithm. Some innovative parameters are introduced to reduce the rate of false alarm. The BOF has been tested for thermal videos and achieves moderate accuracy with high complexity.

The accuracy of HOG-SVM is highest among all approaches, due to the reason that training is done by HOG which is able to develop a multidimensional data base into less memory. Apart from this SVM is a classifier that is able to detect the class of testing data by correlation the feature vectors by support vectors. Hence, SVM is able to classify more efficiently. This work provides an improvised version of HOG-SVM classifier, which able to select the region of interest in less time and more accurately.

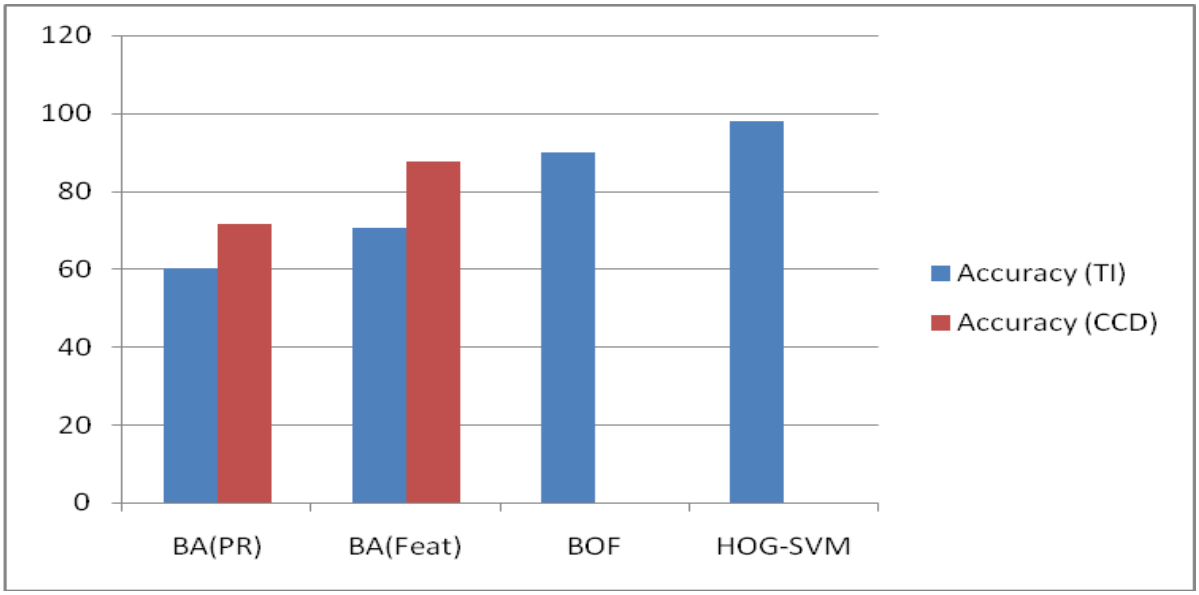

Figure 4. Accuracy analysis of different approaches on thermal camera Vs CCD

Considering the performance analysis, ATDS is considered as more feasible for surface target perform well for medium range target. This studied system is used for border security and surveillance. The investigation concludes that the compared algorithms are validated on the basis of critical review but verification for real scenario is another future issue for increasing the accuracy. There is scope of development of algorithms for aerial targets and multiple targets at a time.

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