ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 7, July 2017

Survey on Automatic Intrusion Recognition and Tracking for Security Systems

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ABSTRACT- This paper is an assay to develop a system which is completely independent and it will automatically recognize, track intrusion for security system. There are some untoward environmental conditions where Human Soldiers find it hard to fight this system can also works in those conditions. Intrusion should not be present in Entry-Restricted areas such as Line of Control. This set up will be placed at some suitable spot from which it can capture a complete view of line of control with a camera. The system has a battery powered computer installed on it which will analyze the captured images from camera. It will find out and then recognize the object. This is done by comparing the features of detected object with features of the objects which are stored in database. The object will get tracked to find its velocity if match is found in the features, and get bombarded with bullets and bombs until object gets destroyed completely. Thus without imperiling a valuable life of Human Soldier safety and very tight security can be provided. For the implementation point of view the system is kept as simple as possible. Due to the low execution time of the system and Simplicity of algorithm ensures real time operation of system and low implementation cost.

KEYWORDS: Object tracking, object recognition, shape description, color detection.

I.INTRODUCTION

For detecting intrusions, tracking it this system is proposed. This set up will be placed at some suitable spot from which it can capture a complete view of line of control with a camera. In this system a high resolution camera, image processing hardware, microcontroller, two servo motors and other supplementary hardware and mechanisms are provided. Camera is used to capture the images after some predefined interval of time then these images are provided to Image Processing hardware. Then every captured image will be processed by image processing hardware for detecting intrusion. It will extract the features of that intruding object if intrusion is detected and compare that features with features of objects stored in database. The objects those are to be destroyed are collected in the database.

Object is said to be recognized if match between intruding object and one of the objects from database is found. Then to calculate its velocity of motion, system will track that object. The system will need this velocity information to destroy that object, and for that it decide the angle and time instant at which projectile is to be launched at object. In the form of x-y co-ordinate, the position of the intruding object is taken out and given to microcontroller. To position the cannon it will control the angle of rotation of two Servo Motors aiming at the intruding object. At the end cannon will get fired.

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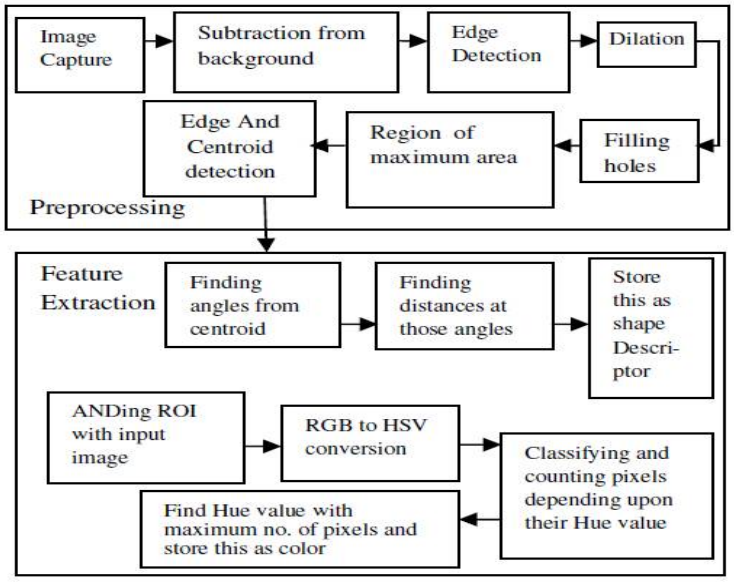

Figure.1 Block diagram of Image Processing software

1. Preprocessing

After installing camera at its place background image has to be captured and once background is captured camera shouldn't move. Background and current image captured from camera is used to find out intrusion and for that subtraction is carried out between these two images. Previously taken background image and current image which is taken from camera will have none difference and subtraction result will comes out none if there is no intrusion. But if some object has presented in the scene then subtraction between that two images will be the query object itself and is none, as in previous case.

As exterior edges of object are clearly invisible therefore result of subtraction is unsuitable for extraction of features. This is the image which is obtained from inversing the subtraction result which shows above mentioned problem. So before feature extraction this subtraction result has to be preprocessed. Subtraction result is also a color image as subtraction is obtained subtracting color images, so it is converted into image which is binary one. For edge detection of the object Canny edge detection is the method which is operated on Binary Image depending upon threshold chosen adaptively. To increase overall accuracy correct choice of threshold is important which will lead to proper edge detection. At this stage problem of unclear and broken boundary is present, with the proper mask the image is dilated to connect these broken edges to remove this problem. Here, instead of white region related to the query object we have various undesired white regions other in the image. Illumination variations, small changes in the background at the time of obtaining images, camera impurities will result into unwanted white regions. The attributes of the unwanted region is used over here; their area is always less than intruding object. So only maximum area of white region is kept which gives out the intruding object.

Canny edge detection method is used for detection of edges. This edge belongs to boundary of intruding object. Here there is presence of error introduced because of operation of dilation. So depending upon size of object; mask for the dilation operation is adaptively chosen and after this process image with detected edges is suitable for detection of shape.

2. Feature extraction:

2.i. Shape description:

Distances of all the points on its boundary from some reference point is nothing but Shape of an object. Centroid (center of mass) of an object is the reference point which is unchanged though object is rotated. Centroid is the center

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of circle and centroid has equal distances from all points. Likewise we can obtain descriptors of shape if we calculate distances of some points on the object's boundary. For this section it is assumed those points on the boundary of the object which are differ by 10 degrees angle and all then all angles are calculated from object centroid.
Hence total 36 distances results into to 36 various angles detached by 10 degrees are obtained. In order to increase accuracy this angle of separation can be reduced. But as the angle separation is reduced, number of readings will increase which ultimately increases time required for computation. So there is tread off between capability of system to work in real time and its accuracy.

2.ii. Color detection:

Gross features of the object are taken into consideration instead of fine details. When some objects are observed from long distance, the color which is covering most of the area of that object is considered, and it is said that object is of that color in case object is having different colors on its different parts.
To search the hue of the object, image acquired from camera is logically ANDed with image which is made with preprocessing. And then resulting image is converted into HSV. Color information of HSV image is in its hue plane only. Values of color plane are between 0 and 1. And color is detected with the help of these values. And in this way second important feature of the objects that is its color is detected.
On database images acquiring of color and shape is also done. If there is any suitability atmen one of the object within the database and intruding object then object is said to be found and then before bullet is fired towards it, for finding its velocity object is tracked. Size of object and its distance from camera is calculated and stored in database. By using formulagivenbelow the distance of intruding object from camera can be obtained

$$\text{distance} = \frac{\text{distance of database object} * \text{intruding object's size}}{\text{Size of database object}}$$

By calculating distance covered by the object in two following frames obtained by camera and time period difference atween two frames, the velocity of intruding object can be calculated. This allows system to compute angle for launch of projectile and time when projectile has to be fired. Two servo motors are taken, one is used for motion of cannon in X-direction also other for Y-direction which together decides angle of projection. Angle of rotation of servo motor can be varied by making a change in width of PWM signal which is given at servomotor. 89v51RD2 microcontroller is used which has inbuilt PWM module in it.

III. RELATED WORK

This section of paper describes the work that has been done in the area of video surveillance systems, different approaches followed for better results in object recognition and tracking.

Researchers have attempted to develop a complete independent system for detecting an intrusion and tracking it until it gets destroyed using image processing algorithm, microcontroller, servo motors and other supplementary hardware [1], [2]. Shape and color of an object is extracted and compared with database object to decide whether it is intruding one. Canny edge detection algorithm has been used and PWM pulses are used to adjust rotation of servo motor. Satisfactory results are obtained in experimentation.

Qi Zang and ReinhardKletteg [3] have reviewed previous research on moving object tracking techniques, analyzed some experimental results, and finally provided conclusions for improved performances of traffic surveillance systems. They have used one stationary camera. Many applications have been developed for monitoring public areas such as offices, shopping malls or traffic highways. Tracking of pedestrians and vehicles play the key role in video surveillance systems. Dimensions of bounding box are used to distinguish between pedestrians and vehicles.

YigithanDedeoglu [4] has presented a smart visual surveillance system which is capable of moving object detection in real-time, classification and tracking. The system has a stationary camera; system is capable of operating on color as

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well as gray scale video. An adaptive background subtraction scheme is used for moving object detection which is found to work reliably in indoor as well as outdoor environments. Temporal differencing and adaptive background mixture models are the two other object detection schemes, proposed for detection and performance quality comparison. The proposed system is able to perform functions like distinguishing transitory and stopped foreground removed objects; classifying detected objects into various groups such as vehicle, human and human group; tracking objects and generating trajectory information in multi-occlusion cases and detecting fire in video imagery. This system is assumed to work in real time. And for real time performance, the computational complexity and the constant factors of the algorithms used are important. Use of this system is restricted to stationary cameras and video inputs obtained from Pan/Tilt/Zoom cameras. The initial input to this system is fed from video imagery from a static camera which is monitoring a required site. These methods are able to work on both color and monochrome video imagery.

Aristeidis Diplaros [5] discussed various methods for object detection, computational models and techniques are studied to merge color and shape invariant information to recognize objects in 3D space.

SanketRege, RajendraMemane, MihirPhatak and ParagAgarwal [6] have presented an approach which involves digital image processing and geometric logic to recognize two dimensional shapes of objects, e.g. squares, circles, rectangles and triangles and the color of the object. Following are the methods involved:

(1) Conversion of three dimensional RGB image into two dimensional black and white images.
(2) Classification of color pixel for separation of object from background.
(3) Filtering based on area.
(4) Calculation of object metrics by using bounding box and its properties.

The shape recognition of the objects is made rotation invariant. Further, RGB information of all pixels within each object is used for analysis of color of the object.

Shih-Chia Huang and Bo-Hao Chen [7] presented a new approach for motion detection which is based on the cerebellar model-articulation-controller (CMAC). This approach makes use of artificial neural networks which is useful in detecting moving objects completely and accurately in both high and low bit-rate video streams. It consists of two modules namely, a probabilistic background generation (PBG) module and a moving object detection (MOD) module. The proposed PBG module makes use of an unsupervised learning process to produce an effective probabilistic background model which ensures that the properties of variable bit-rate video streams are accommodated.

Two procedures are implemented using MOD module:

1. A block selection procedure

2. An object detection procedure.

MOD module is based on the CMAC network; it detects moving objects completely and accurately in both low and high bit-rate video streams by using above two procedures. The detection results show that proposed approach is able to perform with higher efficiency as compared to the results obtained by other approaches in variable bit-rate video streams.

In object recognition, whenever feature extraction is performed, it should be taken into consideration that feature matching should be rotation and scale invariant. Swati Nigam, Kaushik Deb and AshishKhare [14] proposed a new approach for shape based recognition which uses moment invariants for shape feature identification. Object and non-object data are classified using Support Vector Machine (SVM). Here moment invariants are used which are functions of central moments and are invariant against rotation, scaling and translation. This approach gave better result compared to other shape descriptor based recognition methods.

System can be made more efficient if it is made illumination invariant. A popular method used for appearance and illumination invariant human detection is Histogram of Oriented Gradients (HOG) detector [17]. To recognize the

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objects on different scales Scale invariant feature transform (SIFT) [18] based method is used. S. Nigam, M. Khare, R.K. Srivastava, and A. Khare proposed a hybrid of HOG and SIFT methods [19] for human object detection.

Object recognition is also used in inspecting faults in the product depending on their shape and edges. Kyekyung Kim, Sangseung Kang, Jaehong Kim, Jaeyeon Lee, Joongbae Kim and Jinho Kim [20] proposed multiple object recognition including complex shape object which is useful in manufacturing process in industrial robot application.

IV. CONCLUSION

The system proposed in this paper is very useful for military applications where it is needed to detect and track the intruding object in the area under surveillance. A simple system is implemented which automatically detects and tracks the intruding object. This system avoids need of appointing human soldiers in entry restricted area where a very tight security is needed. Thus, precious life of human soldiers is taken care of. Simplicity of algorithm will ensures operation of system in near real-time because of low execution time. Simplicity will also ensures low implementation cost.

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