International Journal of Modern Trends in Engineering and Research
www.ijmter.com
e-ISSN No.:2349-9745, Date: 2-4 July, 2015

# Robotic System for Military Aplications

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**Abstract-** This Paper is an attempt to design, develop and validation of vision based autonomous robotic system for intrusion detection in predefined area under surveillance for military application. This system can also work in adverse environmental conditions where it is hard for a human soldier to reach. Entry restricted areas such as line of control must be safe from intrusion, so this system is used in such areas. Background subtraction algorithm is used for the implementation of the proposed image processing algorithm. The developed algorithm is validated in real time by using moving object detection method. Validation of developed algorithm is done both in offline using MATLAB simulation and in real time using an experiment. Developed algorithm is coded in to the microcontroller based hardware.

**Keywords-** intrusion Detection, surviellance, wireless Camera, Object Tracking.

## I. INTRODUCTION

Nowadays, security is the main priority in any developed or developing country. There are many difficult task in maintaining the security in military applications like walking through minefields, deactivating unexploded bombs, intrusion detection, etc. These are some of the dangerous jobs a person is asked to perform in the line of duty. In such cases an autonomous robot can be very useful. But, complete autonomous robot which can perform various tasks is still under development. Therefore, researchers all over the world work towards the design and development of such robots, so as to simplify our tasks in various fields.

This system is proposed for detecting and tracking intruding objects in areas such as kargil, siache etc, where it is difficult for human beings to reach. For intrusion detection background subtraction algorithm is used. Once the object is detected, it is tracked using the Kalman filter and position of the object is given to the stepper motor system. The camera on stepper motor system will provide the complete live video feedback and further decisions can be made accordingly.

Autonomous robots are robots that can perform desired tasks in unstructured environments conditions without continuous human guidance [3]. Many kinds of robots have some degree of autonomy and different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, cleaning floors, mowing lawns and military. The structural layer, for many micro-scale platforms, has commonly been implemented using a silicon die. Thus this lets robotic platforms referred to as “walking chips” [4].

Object-tracking is one of the popular areas of video processing; most of the methods so far are object-dependent and mainly concentrates on one constraint of the object [9]. Image differencing is used for many applications like change detection. Although it is usually followed by a threshold operation to isolate regions of change from the background, there are few methods available in literature specific to change detection [10]. For real-time motion detection using an active camera mounted on a pad tilt platform, image mapping is used to align images of different viewpoints so that static camera motion detection can be applied [11].

 

To overcome the drawbacks mentioned above, this paper presents a vision based technique for obstacle identification and path planning for autonomous robot by using image processing algorithms. The captured image is processed using BS algorithms and the obstacles are identified. The developed algorithm is validated in real time by using Change-based moving object detection method. To identify the obstacles and determine the path for an autonomous robot, this paper aims to develop a vision based algorithms using image processing technique

## II. PROPOSED METHODOLOGY

Figure 1 represents the block diagram of the robotic system. The camera is mounted on Robot. Camera captures the image of the area under surveillance and sends the data to a processing PC for the records. The acquired images are processed in MATLAB. The position of the intrusion is sent to the stepper motor system in the form of the number of rotations and also the direction of rotation, whether clockwise or anticlockwise. The tracking of the object can be observed by the motion of the stepper motor

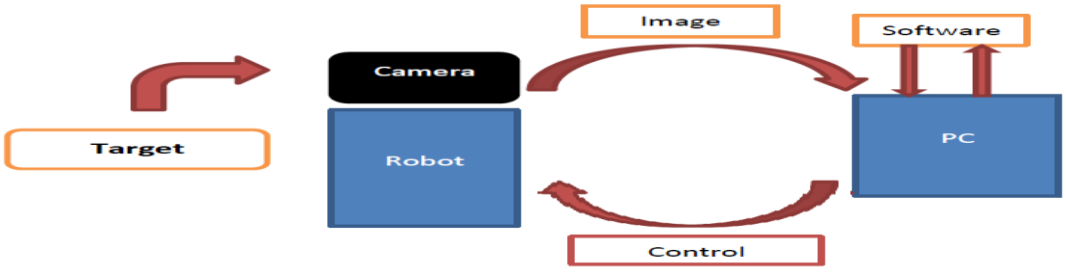


*Figure 1. Block Diagram of Proposed System*

The main function of military robotic system is to collect the information in difficult places, where human beings can work continuously. To meet the said objective vision based robot is required. The purpose of this research work is to design a robot that would be capable of reaching close to the objects of threat and the real scenario can be observed through an onboard video camera which can send back video feedback to the observatory. By looking into this video the observer can control the robot to perform various tasks according to different real time situations like border security, tracking remote places etc.

Powerful motors are used to make the unit move in different directions. A dc motor in the front end is used for the direction controlling mechanism. A main DC motor is used for driving the unit in forward/reverse direction. The camera is mounted in the front which shows clearly where the unit is moving and also detects the intrusion location. The power supply unit is mounted on board and is used to power the entire unit. In the prototype the power from

## III. MOTION DETECTION

For motion Detection Background Subtraction is used. Assuming that the scene illumination does not change, the image changes are due to relative motion between the scene objects and the camera (observer).It works on the principle of image subtraction. Figure 2 shows the step by step procedure in Background subtraction algorithm.

 

**1.Video to frame conversion:** Video is nothing but the series of frames with respect to time[2]. Videos are image sequences over the time. A video is a function of $f(x, y, t)$ over time t. The camera will continuously capture the images. It is difficult to directly process on the video, so the conversion of the video into frames is done. Once the frames are ready then the pre-processing is done on them.

**2.Pre-processing:** After the video to frame conversion, pre-processing is done on each frame to reduce the noise which is present in frame. The pre-processing can be done using the mean filter, convolution filter, median filter [6,1]. The mask of the filter will multiply with the frame and noise will get removed so that the result is accurate. Due to this only the background or foreground objects are seen and unwanted factors which are presents in the frame at the time of the capturing the images like dust are removed.

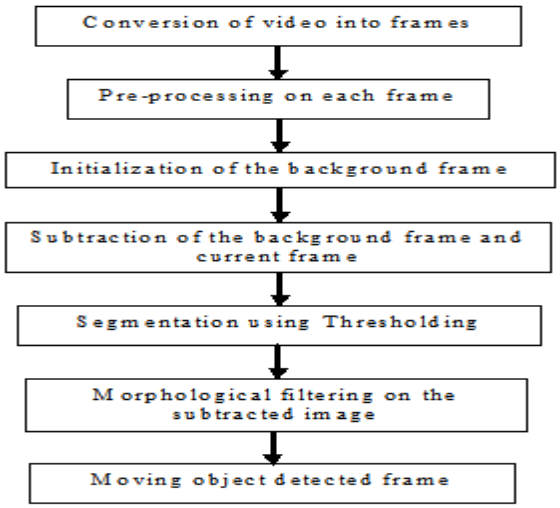


***Figure 2. Flow of Background Subtraction algorithm***

**3. Background frame initialization:** After pre-processing background frame initialization is very important. Once the background frame is initialized it will referred as the reference frame. There are many ways to obtain the initial background image. For example, take the first frame as the background directly, or the average pixel brightness of the first few frames as the background or using a background image sequences without the prospect of moving objects to estimate the background model parameters

**4.Background subtraction:** After the background frame is initialized the subtraction of the current frames and the reference frame is done for the moving object detection [1- 5]. The subtraction will be done pixel by pixel of both frames. The simple version of this scheme where a pixel at location (x,y) in the current image is f(x,y) marked as foreground if the following condition in the equation 1 is satisfied.

$$F(x,y)-B(x,y) > T_d \qquad (1)$$

**5. Segmentation:** After the subtraction of the frames the subtracted image is then segmented using the threshold value. That value is practically set. The segmentation can be done using equation 2

$$D_k(x, y) = 1 \text{ for } |F_k(x, y) - B_{k-1}(x,y)| > T \qquad (2)$$
$$0 \quad \text{for others}$$

 

If the subtracted pixel value is greater than the threshold value then it will represented by 1 and if less than the threshold value it is represented by 0. In image processing the value of 1 is black and 0 is white. So the segmented image gives the moving object in white and the background is black. It will detect the moving object in the frame.

**6. Morphological filtering:** Motion digital images are often interfered by a variety of noise distributions depending on the prevailing conditions. The observed noise can be modeled either an additive white impulsive signal dependent or a combination of them. Some of these noise distributions are very annoying when involved in intensity changes in video frames. They randomly and sparsely corrupt pixels to two intensity levels: relatively high or relatively low, when compared to its neighboring pixels. Therefore, the need emerges for implementing smoothing techniques that are able to treat different kinds of noise.

**7. Motion detection:** After the segmentation and morphological filtering the moving object is clearly seen in the frame and that will be the output of the system which is display on the VGA monitor.

## IV. SIMULATION RESULTS

In this experiment we use the background subtraction algorithm for the detection of the moving object in the surveillance area. The demonstration system has the set up for the implementation of the proposed system in the Matlab software. The Fig 4.1 shows the reference image which is initialized as the background image. This image is referred as a background image because there is no any moving object. In the real time extraction the background image processing approach is used to provide the most complete feature dataset, but it is extremely sensitive to dynamic scene changes due to lighting and extraneous events .The Background image is not fixed and it must adapt to motion changes like tree branch move, changes in background because of objects entering in a scene, stay for longer period without motion

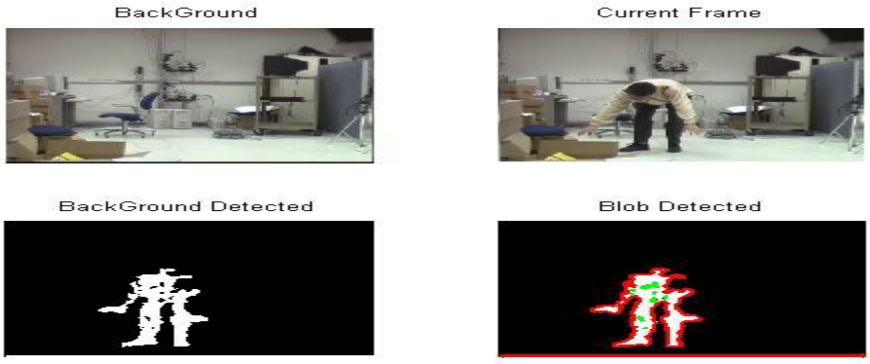


***Figure 3. Result obtained after Background subtraction***

## V. CONCLUSION

In this paper for motion detection background subtraction is used. The software reference model of the chosen architecture is developed in MATLAB/ Simulink. The subtraction of the two images give the good result of the moving object in the surveillance area. The resultant subtracted frame contains the information or data from both the input frames. It provides an effective way of detecting moving object and gives better information of the moving object in video as compared to other algorithms.

 

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