

Border Intruder Detection System Using Digital Image Processing Techniques

Shivani¹

¹Department of Electronics and Communication Engineering, Punjabi University, Patiala, India

¹garg.shivani78@gmail.com

Abstract—Now a day, it has become very necessary to secure each and every public place, like stations, bus stands and also other general areas from intruders. For this video surveillance is playing a very important role to secure the areas. In our paper, we present an intelligent framework to detect the multiple events in Region of interest with this video surveillance. From the region of interest we get a set of variables, create classes like humans or vehicles, attributes of the classes like speed or locality, and create notions to detect and understand the activities in the circumstances. Now all the knowledge got from it is used to understand the any complex activities of the objects. The objects may be pet, human or any vehicle and are detected on the basis of ratio of height and width given by horizontal and vertical clamps. After calculation if objects falls into range than a boundary box is set around that object and a signal is given to the users. Finally the proposed algorithm is giving very good results and intruders are found out and marked by a boundary box in the frames given by video of CCTV or any camera footage.

Keywords: Border surveillance, intruder detection, Thresholding, DIP, Multiple events detection Compositional modeling

I. INTRODUCTION

Ensuring a nation's border is an imperative undertaking for Homeland security. One of the greatest difficulties of fringe security is to secure sheer extent region of border locales. Nations like India have long land fringes and interruption is a long standing issue. Security personals work in round the check and in various landscapes from snow to thick woodland and from sharp slopes to leave. In the day, the visual checking is useful; nonetheless, it is exceptionally hard to recognize potential interlopers or dealers in absolute obscurity or in other low-light conditions. Indeed, even Europe and USA additionally have comparable interruption issues. Security Industry is developing at a fast rate because of expansion in wrongdoing rate in the previous couple of years. Interruption location gadgets have been utilized widely for security purposes as a part of request to distinguish the section of unapproved individual in an ensured zone [1]. Different video reconnaissance frameworks are introduced with the alert framework at open and private spots. Video reconnaissance is an extraordinary security answers for control the suspicious exercises. There exist some customary vision-based methodologies that could distinguish interloper utilizing hued picture successions. Be that as it may, the aftereffects of these works are confined by the non-stationary foundation [2]. In addition, in the event that they can work in such conditions then they are unreasonable. Like other security extends, the idea of accomplishing control over the fringe zones depends on the composed connection of brilliant sensors and monitors and their key is the precise alert framework that watchmen can depend on. The current sensors and radars, which had been utilized at borders, are productive. In any case, a few times because of foliage or creatures they trigger sensors aggravation alerts rather than really distinguishing human gatecrashers. It is on account of these sensors are not ready to separate amongst people and creatures and in this way, send wrong flags oftentimes.

1.1 Motion Detection

Movement is distinguished in the grouping of pictures obtained over a caution occasion. Strategies, for example, optical stream or highlight permitting the objective item to move an extensive separation (a few times its length) and generously change shape. This strategy has the favorable position such that it is to a great degree touchy to changing pixels between progressive pictures. Progressive edges in the picture succession are subtracted from a reference picture speaking to the scene in its undisturbed state. In a perfect world all non-zero pixels in the distinction picture speak to movement.

1.2 Sequence Formation

A boundary-based feature extraction algorithm measures the size and position of the binary blobs in the image. The extracted image blobs arising from motion are assembled into temporal sequences. This temporal filtering allows noise blobs that do not form part of any sequence but only occur sporadically, to be eliminated.

II. LITERATURE SURVEY

Irgan et al. [6] propose a practical technique for element (on-the-fly) prioritization of picture large scale squares. In this manner, they utilize as induce encoding plan at the source hub by naming information obstructs as "imperative" and "not-essential" taking into account the data they contain. The system then transmits "critical" information reliable from solid ways. They set up an



exploratory setup to survey the achievement of the proposed technique utilizing different prioritization measures for marking and they contrasted the outcomes and JPEG encoding. The aftereffects of comprehensive simulations demonstrate that the naming should effectively be possible utilizing application based edges and the need encoding plan smoothly adjusts to the application's quality necessities. In their tests, the greater part of the measures, i.e. entropy, edge and reproducibility, delta-entropy, delta-edge, are fruitful in transmitting the useful parts of the pictures. By along these lines, roughly 50% of the data transmission is spared in the border investigation situation. The delta-edge measure accomplishes the best execution by transmitting a greatest measure of the article pixels with the base transfer speed and the base preparing time. Then again, the edge measure has the base memory condition. They make a conclusion that the proposed apportions performs JPEG as far as calculation time and vitality.

Raheja et al. [7] talk about another strategy for Cross Border Intrusion recognition in bumpy district. The Kinect camera guarantees that intruders crossing the border can be distinguished among daytime and additionally in night. They present an border investigation framework that can distinguish intruder activities like standing, strolling, slithering, and twisting, and so forth in progressive and in addition in dull conditions. The framework can distinguish whether the moving article is an individual or a creature and activates an alert on the off chance that it recognizes human development. Additionally, the framework functions excellently in plain and also in bumpy territory. Utilizing skeletal following application gave by Kinect console; the activities are grouped and perceived. The HMM based arrangement makes the framework energetic and in this way, makes it a flexible segment for being a piece of other distinctive applications. The proposed framework gives result for general discovery precision of 92%. Their proposed framework serves a promising bearing in precisely distinguishing any intruder. The framework functions are admirably for new clients without the need to complete extra preparing. For border security with this proposed framework there is more important opportunity to guarantee that when the watchmen are cautioned by the alert framework and need to react, by not wasting time pursuing irritation cautions. Additionally to expand the field of perspective, we can utilize the turning highlight of Kinect as well. In this way, making the framework more powerful, as of late propelled Microsoft Xbox One can be further utilized for border investigation reason as it gives better execution.

Kumar et al. [8] present the idea of trespassers' most loved ways (TFP) and give an apparatus that can be utilized to estimate the recognition likelihood of a investigation system in such a system with TFPs. The discovery likelihood is diminished to the geometric line crossing point issue utilizing bisection and the limit states of intruder directions for the border range and the most loved locale are resolved. The line crossing point issue is tackled utilizing instruments from the essential geometry and geometric likelihood. The impact of the good district on the identification quality under various conditions is computed utilizing probabilistic models. The exactness of the proposed quality metric is approved by both logical strategies and restoration results. Besides, the significance of the interruption model on the system execution is exhibited utilizing practical situations. It is demonstrated that the presence of most loved ways has important effect on the discovery nature of the system. The proposed identification quality metric gives explanatory apparatuses reasonable to both genuine and rebuilding situations to the system creators to figure and upgrade the normal location execution, and is computationally modest contrasted with both recreation based and circulated quality estimations.

Lim et al. [9] present a smart structure for identification of various occasions in observation recordings. In light of the guideline of compositionality, they modularize the observation issues into an arrangement of variables involving districts of-interest, classes (i.e. human, vehicle), characteristics (i.e. velocity, area) and an arrangement of thoughts (i.e. rules) related to each of the attributes to build an information based comprehension of nature. The last yield from the thinking procedure, which consolidates the definition spaces of the different variables, permits a more extensive and coordinated comprehension of complex example of exercises in the scene. This is as opposed to the best in class arrangements that are just ready to perform just a particular assignment, at once. Keeping in mind the end goal to exhibit the usefulness of the information developed in light of the proposed idea of compositionality, they perform exhaustive trials on 100 video successions acquired from the standard dataset (PETS and CANTATA), and in addition continuous open datasets got from the youtube.com. Test results and a correlation with the best in class arrangements have demonstrated the proficiency of the proposed technique. One of the limitations of this work is missing of testing information to encourage assess the framework execution.

Rosin et al. [10] created (Perimeter Intrusion Detection System) PIDS. This is information based vision framework for mechanizing the clarification of alert occasions. The PIDS contains number of cameras survey zones introduced with variety of alerts. At the point when alert is set off the picture grouping crossing the caution occasion is put away. Its duty is to decode the caution occasions and judging between the alerts activated by human intruders and numerous false alerts activated by creatures, climate related occasions or noise. Also, the false alerts ought to be sub-arranged to empower the execution of PIDS to be checked. Issue in this application is that because of the huge scope of intensity in the scene target protests frequently has a poor spatial determination.

Ellis et al [11] created Model-based vision for programmed caution understanding utilizing PIDS (Perimeter Intrusion Detection System). The issue of identifying the moving items in grouping of pictures is exceptionally exciting in many fields. It incorporates military target following and visual investigation framework. Previous paper describes the principal period of PIDS and this works upon second stage. Previous framework depicts the grouping of digitized pictures caught over the time of alert coming about because of some physical occasion, are broke down to distinguish the reason for caution. The framework keeps up the model of possible alert causes. Pictures are handled to identify and remove estimations from movement related terms. Real issue emerges



from shadow, changing viewpoint focuses and varieties in lightning conditions. These offers emerge to division mistakes. To beat some of these issues static camera position together with feeling that critical changes of force between pictures in the series relate to moving articles. For this straightforward picture division calculation (picture subtraction took after by Thresholding) is satisfactory to distinguish development

Nishad et al. [12] presents the vision based border security framework with programmed terminating unit. This paper presents convincing strategy for border security. The framework clarified contains a few picture handling methods for intruder discovery at last terminating an objective. This can be utilized for the observation of border for nations or ranges requiring high security, particularly in areas of convincing atmosphere conditions. Framework has two methods of working – programmed mode and manual mode. In manual mode terminating happens after the declaration of definitive work force while in programmed mode terminating happens consequently. In this manner just a couple work force can screen a few kilometers of border. Moreover PIR sensors are included so that terminating at blameless creatures can be maintained a strategic distance from. This framework is a powerful measure to guarantee border security and to diminish the expense and at last stay away from death toll of armed force men. This framework identifies intruder as well as gives video scope. These cameras are introduced for imaging. These cameras constantly check the doubtful zones and after that associated with computerized signal handling (DSP) unit, which finishes the assignment of interruption identification by eternally contrasting the pictures acquired, with reference picture furthermore with the pictures caught beforehand. Any adjustment in indication of progressive pictures demonstrates the nearness of intruder. This whole framework is produced in research facility environment, utilizing MATLAB. The framework is effectively tried on different occurrences of interruption and for different surrounding conditions. In future, RADAR can be coordinated into this gadget by which the framework can be made more flexible. It won't just expand the scope, additionally gives extension to deciding size, pace and heading of movement of intruder.

Chu et al. [13] presents the programmed visual following control framework utilizing implanted computers. Visual detecting is a standout amongst the most essential detecting abilities we use in our day by day life. Soldiers for the most part depend on their sensors to distinguish to recognize their own particular positions and measure the area and position of enemies. This framework is essentially specifically appropriate to moderate moving targets. In this framework, ease visual following control framework utilizing video pictures and implanted framework is made-up and illustrated. The objective picture is isolated from whatever is left of picture in light of the unique element of an item. The position data of target is then decided and utilized by the following controller to control the two engines in a container and tilt head unit to turn the camera on a level plane and vertically until the objective article is at the focal point of picture. The framework can be connected to camera following and trail taken after by slow moving vehicles. For rapid target following application the visual detecting speed should be enhanced by utilizing fast unique reason video DSP microchip with projects written in C.

Sanjana et al. [14] presents a low complicated nature calculation for interruption discovery in PIR-based remote sensor system. This paper speaks to low complicated nature calculation for interruption location in nearness of disorder emerging from wind-blown vegetation, utilizing inactive infra-red (PIR) sensors in a remote sensor system (WSN). The calculation depends on the blend of Haar change (HT) and support vector-machine (SVM). This paper is nearest shape expression for the sign produced by intruder moving at a steady speed. This expression demonstrated to decide the title of movement data and the speed of intruder from the signs of three all around situated sensors. Fundamentally, this paper shows a low-unpredictability SVM-preparing calculation that uses the HT (Haar Transform) to separate intruder from mess. With the end goal of boosting battery life Haar change is utilized as a part of the whole procedure. The option arrangement is to utilize Walsh Hadamard change (WHT) however it was favored Haar change as it is less involved contrasted with WHT. Haar change has capacity to reuse past registered HT coefficients for the following window. Restriction of this paper is the information recorded was for the time of October 2008 to March 2009 at the physique of summer in Bangalore. The future scope of this strategy is to utilize various sensors that would allow diminishment of false alert rate.

Wang et al. [15] presents the intrusion discovery calculation to remote sensor systems. In this paper, to make sensor hub equipped for identifying a intruder, a basic element truthful model of neighboring hubs is expected to construct, together with low versatile nature identification calculation. This calculation depends on security plan for remote sensor systems.

Paul et al. [16] presents a continuous article following framework utilizing shading camera. This ongoing item following framework based shading camera and PC. The framework is fit for following colored objects in the camera view continuously. The calculation utilizes the shading, shape and movement of the item to accomplish energetic following even in nearness of fractional obstacle and shape change. The key segment of framework is a computationally effective way to track colored objects which makes it conceivable to do powerful continuous tracking.

Vittal et al. [17] presents PC controlled intrusion indicator and programmed terminating unit for border security. This paper presents PC controlled intrusion locator and programmed terminating unit, which might be utilized for investigation of borders. This framework recognizes intruder as well as gives video scope by means of satellite based correspondence framework. It additionally gave the programmed terminating system which naturally find and fire the objective. In this way, a few kilometers of borders which required a few hundred work forces can be easily screen with this framework. Real terminating happens just because of legal work force has doubly confirmed the nearness of a intruder, odds of terminating at blameless creatures is totally



inexpensive. This is similarly suited for operation aimed the night. This unit makes utilization of extremely straightforward calculation coded on MATLAB to prepare the pictures and screen changes. The camera is interfaced to the PC by means of USB port, utilizing picture procurement tool stash. The edge got by camera is gained into the MATLAB workspace and is put away in three dimensional networks. For the simplicity of calculation, the picture is initially changed over into two-dimensional grayscale picture. The picture is then decayed utilizing the straightforward technique. At that point it begins contrasting the pictures progressively and the reference picture and any mess in n th and $(n+1)$ th picture would derive an adjustment in picture coming about nearness of intruder. In future as opposed to utilizing MATLAB code DSP processor with continuous code for this reason will be more effective and dependable. The execution of framework is observed to be pleasant in the research facility. It is clear from the framework that if sent in the borders can rearrange the duty of defending them furthermore reducing the general work force score.

III. PROPOSED METHOD

The security and safety are one of the major concerns at border areas especially where is problem of terrorism and intrusions by drug suppliers. The countries put a lot of resources and wealth on border security and surveillance. Thus there is a need for the surveillance systems which are both cost and application efficient. The traditional method used for surveillance has been manpower. But with the need for 24 hours surveillance and security, came into existence the camera surveillance systems. These traditional camera systems lacked the intelligence of the humans and it was challenging to cover large area with these systems as it would require more number of cameras and manpower to monitor. So, there is a need to combine both the intelligence of humans and the working efficiency of camera systems to come up with "Intelligent Camera systems". Here the camera will have an ability to track the intruder and ensure requirement of less number of cameras to cover a particular area. This work describes such intelligent system which can be brought up into practical applications. Image processing is an important part of the entire operation. The efficiency of the algorithm used for image processing determines the efficiency of the entire system.

IV. ALGORITHM FOR MOVING OBJECT DETECTION

Input: Video

Output: Detected Moving objects

Step 1: Read the video using Videoreader and extract the frames from it

Step 2: Converts each RGB frame to Ycbr color space

Step 3: Apply background subtraction of current and previous frame.

Step 4: Apply dilation and erosion morphological operations

Step 5: Apply connected component analysis and using Bounding Box property eliminate noisy pixels and keep moving objects

Step 6: Mark the moving object in running video frame

Step 7: Measure accuracy of the system in terms of recall ratio ad precision ratio

V. SOFTWARE TOOLS

For the completion of this dissertation, the major requirements can be categorized being as hardware requirements and software requirements. The various hardware requirements for completion of this thesis include:

- Intel processor , Intel® Core-i3 CPU GHz 2.00
- Disk space of 5 GB for MATLAB
- RAM of 4GB minimum
- Scanner
- Printer
- Graphics card

The software requirements for the dissertation are:

- MATLAB 2013a
- Microsoft Word 2007
- A Windows 7 or 8 based 64-bit operating system

MATLAB (R2013a) has been used for the implementation of this dissertation work. MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. Using the MATLAB product, can solve technical computing problems faster than with traditional programming languages, such as C, C++, and FORTRAN.



VI. RESULTS AND DISCUSSIONS

For implementation and testing our work it is decided that using a camera and creating an intruder detection system with image processing would be efficient, as it offers customizability and is much harder for an intruder to avoid.

The customizability of image processing will let us apply filters and functions to improve the accuracy of the system, thus satisfying the requirement of minimizing false positives and false negatives. Additionally, through image processing we will also be able to differentiate between single or multi objects in a frame.

Detailed Engineering Analysis and Design Presentation

First of all, video has been captured where there are running vehicles and walking humans on the road. This video is fed into Matlab for processing. The difference between the current frame of the video and its previous frame is analyzed. If there is an intruder in the video, an alert signal gives us the information about the intruder.

Results of Image Processing system using matlab has been shown below

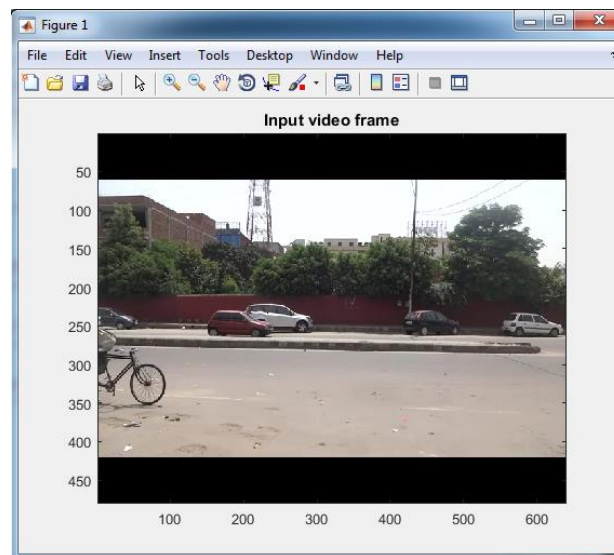


Fig. 1 Input video frame need to be processed

1) Frame differencing method output used for background subtraction

The current frame of the video is subtracted by its previous frame using the frame differencing

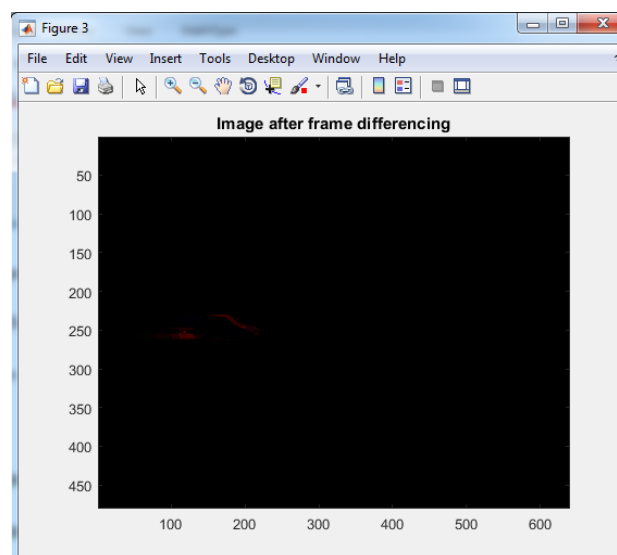


Fig. 2 Frame differencing output used for background subtraction



2) Threshold Image

Turn the subtracted image into a binary image by using the image binarization so that each pixel will have a value of either 1 or 0. Then we can filter out unwanted noises easily.

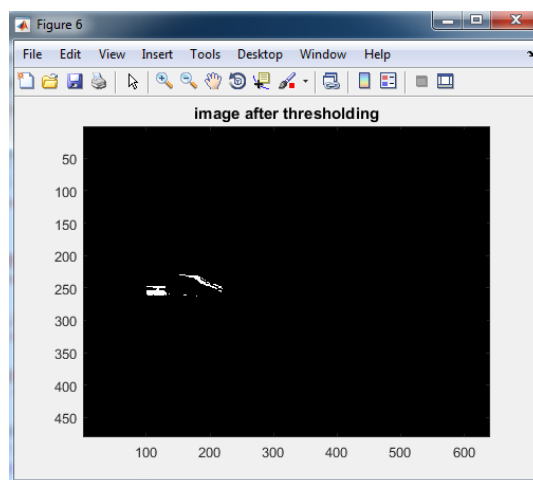


Fig.3 Image output after thresholding method

3) Filter Out Noises and Fill Holes using dilation and erosion

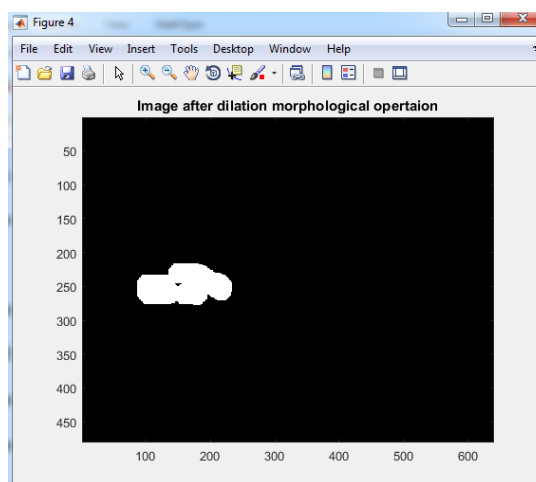


Fig.4 Image after dilation operation

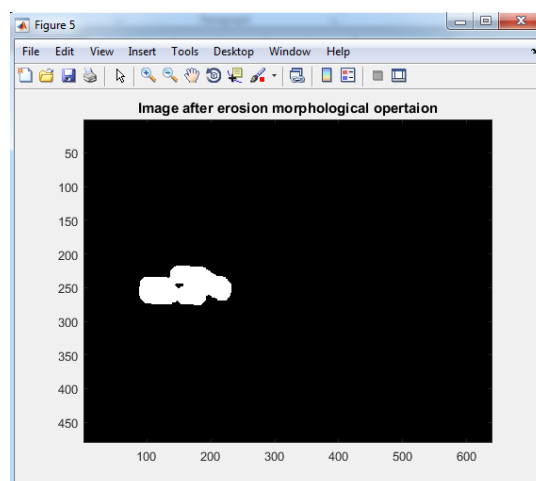


Fig. 5 Image after erosion operation

4) Marking the Filtered Image after motion detection

Apply boundingBox operation using regionprops to the filtered image to get the height and width of the figure in the image.

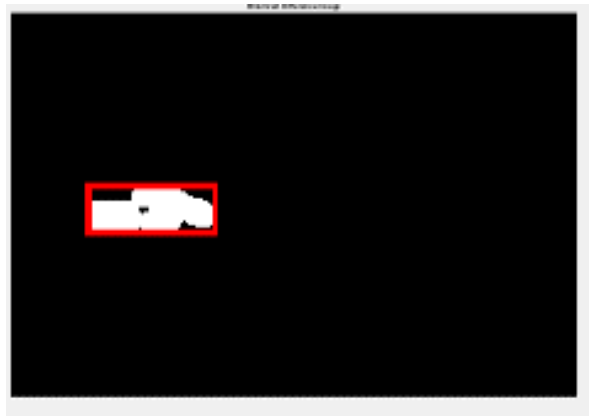


Figure 6: Image after boundingbox markings

5) Draw Tracking Box

Draw a box around the moving object based on its height and width. Then overlay the tracking box on the original image for visual appeal to users.

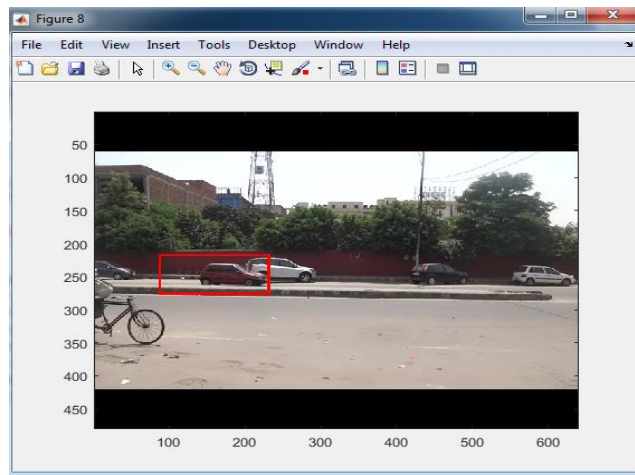


Fig. 7 Image after marking the tracking on frame

Results for Unique objects retrieved after connected component analysis has been shown below



Fig.8 Objects one retrieved from video tracking



Fig.9 Objects two retrieved from video tracking



Fig. 10 Objects three retrieved from video tracking



Fig.11 Objects four retrieved from video tracking



Fig.12 Objects five retrieved from video tracking



Fig.13 Object six retrieved from video tracking



Fig. 14 Objects seven retrieved from video tracking

Alert

The height given by the horizontal clamp is first compared with a range of threshold set by designers, which checks if the moving object is a pet. If the height is high enough to fall out of the range, the height is then divided by the width given by the vertical clamp to get the height-width ratio. The ratio is then compared with another range of threshold set by designers, which is the possible range of human height-width ratio. If the calculated ratio falls into the range, the alarm will be triggered and alerting emails and text messages will be sent to the users.

We also provide buzzing alarm while moving object is in scene. It plays sound tune which can be controlled in pitch wise as well as duration.

VII. CONCLUSION

Illegal entrance by the intruders on borders and obstacle detection are challenging issues due to security reasons of the country. To overcome this problem it is not possible to secure each and every region by military because such a vast area can not be covered by this idea. So now a day, video surveillance is very effect to know the activities on border by any type of object. In our proposed work we introduced with a technique which is used to detect the object and can also detect the various activities by that object. For this purpose we divide the video into frames and then get a set of variables, create classes like humans or vehicles, attributes of classes like speed or locality, and create notions to detect and understand the activities in the circumstances. Object activities are detected by knowledge based on these all factors. Even the objects are identified by the height given by horizontal clamps in the frames. Height and width ratio is used to differentiate the category of that object and we create a detecting and boundary box around that object. Also an alarm is set to give signal of intruder in the Region of interest. In last the presented algorithm is giving better results and any activities of the objects are marked under our detection and boundary box. In future, more work can be done to know the multiple functionalities of that intruder. Like if the object is not a human being and is a innocent creature then it would not alarm us as a intruder. More efficient techniques can be used to extract key frames.

REFERENCES

- [1] Y. Li, et al., Ultrasonic Intruder Detection System for Home Security. Intelligent Control and Automation, Springer, Berlin Heidelberg, 2006, pp. 1108–1115.
- [2] B. Wang, Z. Chen, C. Jing, Gesture recognition by using kinect skeleton track-ing system, in: Intelligent Human-Machine Systems and Cybernetics (IHMSC), 2013 5th International Conference on. IEEE, 1, 2013
- [3] KeremIrgan, CemUnsalan, SebneBaydere, "Low-cost prioritization of image blocks in wireless sensor networks for border surveillance" Published in Journal of Network and Computer Applications Volume 38, February 2014, Pages 54–64.
- [4] JagdishLalRahejaa, Swati Deoraa, AnkitChaudhary, " Cross border intruder detection in hilly terrain in dark environment" Published in Optik - International Journal for Light and Electron Optics Volume 127, Issue 2, January 2016, Pages 535–538.
- [5] Can Komar, Mehmet YunusDonmez, CemErsay, " Detection quality of border surveillance wireless sensor networks in the existence of trespassers' favorite paths" Published in Computer Communications Volume 35, Issue 10, 1 June 2012, Pages 1185–1199.
- [6] Mei Kuan Lim, Szeling Tang, CheeSeng Chan, " iSurveillance: Intelligent framework for multiple events detection in surveillance videos" Published in Expert Systems with Applications Volume 41, Issue 10, August 2014, Pages 4704–4715.
- [7] N. Custance, P. Golton, T.J. Ellis, P. Rosin, P. Moukas, " The Design, Development and Implementation of an Imaging System for the Automatic Alarm Interpretation using IKBS Techniques. "Proc. Int. Carnahan Conf. on Security Technology, 223-228, 1989
- [8] T.J. Ellis, P. Rosin, P. Golton, "Model-Based Vision for Automatic Alarm Interpretation."IEEE Aerospace and Electronic Systems Magazine, 6:3, March 1991
- [9] Nishad T. N AkhileshV, "Vision based border security system with automatic firing unit, " international journal of engineering sciences and emerging technologies (IJESET), 2014
- [10] FC Chu, Chang "Automatic visual tracking control system using embedded computers", Published in: Mechatronics, 2005. ICM '05.IEEE International Conference Date of Conference: 10-12 July 2005.
- [11] Abu Sanjana, R.; Subramanian, R.; Kumar, P.V.; Krishnan, S , " A low-complexity algorithm for intrusion detection in a PIR-based Wireless Sensor Network, " Published in: Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 2009 5th International Conference.
- [12] Qi Wang; Shu Wang; ZhonglouMeng, " Applying an Intrusion Detection Algorithm to Wireless Sensor Networks, Published in: Knowledge Discovery and Data Mining, 2009. WKDD 2009 Second International Workshop on Date of Conference: 23-25 Jan. 2009.
- [13] Paul, G.V; Ann Arbor; Beach, G.J.; Cohen, C.J, "A real-time object tracking system using a color camera, Published in: Applied Imagery Pattern Recognition Workshop, AIPR 2001 30th Date of Conference: 1-12 Oct 2001.
- [14] Computer Controlled Intrusion-Detector Published by IEEE in Computer and Network Technology (ICCNT), 2010 Second International Conference Date of Conference 23-25 April 2010.

