International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-12, October 2019

Frameworks for Animal and Human Detection using Camera Images to Detect Anomaly

Deepak P., S. Krishnakumar,

Abstract: ***Human and animal interacting events in video image frames will leads to anomalies and it cannot be predicted. These anomalous events was happened due to the interactions of human, animals and birds with each other. Some of the human and animal anamolous interactions will leads to anomalous actions in camera surveillance sites and are to be considered as a serious issue. All anomalies will leads the system or the authorities who dedicated for monitoring to the suspicious events. To detect the anomalies, the animals and human objects must be identified in each image frames first. After object identification events detection phase has to be done. Before going to the event detection phase, noise elimination, shadow detection, object classification can be carried out according to the needs. This paper reveals general detection methodology for animal detection and human crowd. The proposed work mainly concentrated on the detection of animals in human territory based on its palm print images and video images. Human crowd can be treated as smoke- screen for all types of anomalies and so this paper mainly concentrated to detect the crowd well in advance and thereby preventing the crowd before it is happening.***

Keywords: Anomalies Detection, Video Surveillance System Animal Detection, Palm print Image, Crowd Detection

I. INTRODUCTION

Anomalies mean something that deviates from what is standard, normal, or expected. Anomaly detection is one of the most inspiring and long standing problems in computer vision [1]. Most common human anomalies happening is in networks. There are a wide varieties of network anomalies [15]. But in this paper we are presenting other human and animal anomalies. In this section, a general over view and the literatures of the human and animal created anomalies was presented.

A. Animal Detection

Forests and its surroundings are the quickly changing spot on the earth and it is not easy to watch all the jungle and its surrounds area by authorities. But watching of animal activities at human forest interface area is an essential job to protect the human from animal attacks or to protect their valuables. Similarly to animals is to be protected from human attack to save their lives to maintain the bio-diversity.

Revised Manuscript Received on October 30, 2019.
***** Correspondence Author
Deepak P*, Master degree in Engineering, Anna University, Chennai, India.
S. Krishnakumar, M.Sc., Department of Physics with Electronics specialization, Mahatma Gandhi University, Kottayam, Kerala, India.

Animals usually come to the human territory because of the scarcity of food in the forests, disturbances created by human in forests by cutting the trees and mining. Similarly the natural calamity like flood, tremor, cyclone, fire and land sliding causes mass damage to vegetation. All these will disturb the animals and they tend to move to the border area in search of food or safe place. In the last decade, population of animals was drastically increased in all over the world and a result of this, deficiency of food is an issue. The elephant, pigs and monkeys etc. are the main problem makers in the agriculture fields and therefore human animal conflicts can be expected. So nowadays human wild animal life interaction is going very verse and it results damage to both animals and human.

Recent research shows that animals sometimes populate certain diseases and impose health hazard from infection from bacteria and so as to be expelled from the main human areas. Conventional methods such as nets, electric fence, trap, are normally used to prevent animals from the human area [2]. Some strategies have been used either to scare the animals away from the human area by using loud noises, gas exploders or bring them to safe area with the help of guard animals like dogs [2]. Many methods like sunlight reflecting surfaces, reflecting mirrors, and nonhazardous current flowing metal mat or remove grass or animal eating vegetation to prevent the animals that are coming to human territory [3]. However these methods are less applicable in animal monitoring because of its inefficiency or time consuming.

In most of the countries, power lines, railway tracks are going outskirts of the forests area and it is harmful to the animals. Every year, thousands of wild animals were killed or severely injured during their crossing of roads or railway track or due to shocks from high tension power lines. Due to the increase of the number of victims, the detection of animals and its classification in human area and to take preventive measures is a vital job in vision based animal detection systems. So the development of a new system is a necessity to tackle the situation and the detection of the animals was done either by using animal footprint images or by animal video images [3].

Most of the animals are coming to human area by crossing the roads or some form of barriers and this will happened mostly at nights. So video monitoring in nights is an issue and to accomplish this, IR camera was used. The images produced by IR camera are related to the heat released by objects to surroundings. As the detection of all the heat emitted objects, unnecessary noises are also detected and it must be eliminated from the image sequence. The benefit of using IR camera is that, it can record the activity in both day and night. In the same way animal detection is possible even if the fog exists in the monitoring area.

In general IR camera gives good results in poor lighting conditions. There are a lot of issues while designing a system for animal monitoring as well as human monitoring using IR camera. Infrared video makes some disadvantage i.e. low image quality which makes blurring and noise. Another issue is the similarity in background and foreground pixels. It is due to the low contrast of pixel intensity. If the thermal radiations from the animals are higher than background, animals appear bright. However during sunlight, the thermal difference between background and animal is smaller. So we have to adopt filtering techniques to enhance the appearance. Occlusion and illumination changes will affect the performance of the system. Availability of power at the agriculture or forest area is limited. So the system has to use a standalone power source like batteries or solar panels. The power production by solar cell depends on the climates and it is very less in forest area due to shadow. In some cases sun light cannot be guaranteed.

The animal detection based on full body detection is not practicable because of the large variations in their posture and then image classification becomes a big issue because of the huge database. It is very easy to detect the animals based on their heads. But the problem is that, there may be some similarity in animal head images. The situations becomes very verse if the image is captured using IR cameras because all the objects those emit IR radiation will be detected by the IR camera and resultant image will be an IR map. So this paper is mainly concentrated in the design of animal detection based on their foot print images.

De- forestation is a man-made activity and is to be restricted to fight with global warming and terrorists are aiming our forests for their safe activity by the last years. Hunting is another type of abnormal events created by human and is to be reduced to maintain the animal population. Such human activities must be detected earlier and take preventive measure to handle the situations. All these can be done effectively by video analysis. Apart from these, this system can be utilized to detect any other type of abnormality happening in the forest as well as surveillance sites with slight modification in the design. Here we are giving some of the examples of animal detection.

In the paper [3], Debao Zhou proposed a technique to reduce the deer vehicle collision using infrared thermal imaging technique with tracking functions to detect the presence of big animals, mainly deer, in the environment. Deer vehicle collision (DVC) is frequently a main safety issue while driving on rural road and it can be treated as an anomalous event.

Animals was effortlessly recognized using their footprints and several features contained in it can be used to identify an animal. Wild animals are very dangerous and life threatening specious as we were consider the life of people staying aside the forests. Sometimes these animals may attack the human and this attacking video footage is an abnormal events and can be detected using a camera surveillance. By analyzing the animal's foot print image, type of specious can be identified [4]. In this paper Deepak P. et.al. specified about the tiger census using image processing techniques.

Orchard fruits are vulnerable to wild birds and animals. In the paper [2] Seung You Na proposed a concept to protect orchard produce from wild animals and birds using universal sensor network devices, which is applied to orchards along with old methods to improve the security performance. Microphones and camera units are added to the basic sensors. Camera images are studied for a wide area watching. Audio signals from microphones are used for close watching around a node. Infrared motion sensors are applied mostly for the finding of animal intrusion from the outside of orchards.

During grassland trimming in spring time, every year numerous animals such as fawns are killed or severely injured. Many different approaches have been developed to either scar the fawns away or to detect them, for example by searching with a hunting dog. These methods are either ineffective or very time-consuming and therefore less applicable. In the paper [5], A. Fackelmeier present a detecting method which is based on microwave signals. This disjointed radar system uses antennas organized as a matrix. It detects the reflection signals of covered targets of a certain shape e.g. metals or objects with high water content.

B. Human Anomalies Detection in Surveillance Sites

The significance of ensuring protection of the assets and lives of people in a country from the trespassed human in some areas are the very important phase where a government should be concentrated. Any abnormal events can be treated as anomalies and abnormality detection can be considered as a coarse level video understanding which filters out anomalies from normal patterns. The main goal of a real-world anomaly detection system must timely specify an action that deviates from the normal patterns. In modern era, many security organizations are listening carefully to the management of anomalies created due to human and animal interaction [12]. Abnormal events learning is one of the major applications of video surveillance system and detection of all the current anomalous events clips and detection of such clips well in advance is a vigorous research area in this field [17]. All actual anomalous instances are composite, different and so we can see and detect a wide varieties of anomalies, but it is difficult to list out all of the feasible anomalous events due to the rapid increase of urbanization. Still, it is evident that the solutions to detect all such events cannot be generalized because of the dissimilar patterns [4]. The upcoming sections gives a brief history of anomalies, a generalized structure of a system and the results and discussion of an abnormal event detection in an earlier style. The following are some of the human anomalies detection.

Waqas Sultani et al. specifies about human violence from the paper proposed by Datta et al. by exploiting motion and limbs orientation of people and about the audio data to detect aggressive actions in surveillance videos proposed by Kooij et al [1].

Passenger safety is a main concern of railway system but, it has been vital issue that lots of publics are killed every year when they fall off from train platforms [6]. In the paper, Sehchan Oh propose a platform observation and watching system using image processing technology for passenger safety in railway station. Detecting unusual activities is important for automated surveillance. In the paper [7], Ayesha Choudhary et.al. proposed a new framework for automatic analysis of surveillance videos. By analysis, the authors imply summarizing and mining of the information in the video for learning usual patterns and discovering unusual ones.

Surveillance cameras is a more useful tool because of the recording of footage, they can be used to detect events needful attention as they happen, and take action in real time. In the paper [8], Teddy Ko gives a survey to analyze human behaviors and identify subjects for standoff threat analysis and determination.

To study or imitate the dynamics of a crowd, researchers have considered a number of physical factors, social factors, and psychological factors when describing the crowds in their models. Several works aspires at the "outside characteristics" of a crowd, such as look, poses or movement patterns, corresponding location of individuals; and some other job focuses on how a crowd's public behaviours progress over time upon some events. In our previous paper [9], we have proposed an advance crowd detection model to detect the crowd in a prior fashion and thereby preventing the anomalous event formation.

II. RESEARCH METHOD

Cameras was considered as a substitute of human eye and it can be treated as an electronic eye as we consider its image capturing features. Advanced anomalies detection systems mainly rely up on cameras. Most of the anomalies were happened due to the interactions among human and animals. So in the proposed work we have addressed the animal detection using camera images to detect the anomalies created by animals and human detection from video images to detect the anomalies formed by human. Here we have consider the presence of animals in the camera view point and the palm print or foot print that was detected in the human territory is an anomalous event. Similarly we are presenting a frame work to detect the presence of crowd well in advance thereby preventing the formation of crowd and thus the anomalies.

A. General Modelling for Animal Detection from Images

The manual watching of large human forest interface area is practically difficult, inefficient and makes large cost. Consequently, animal presence and their behavior can be expected at any time and at anywhere. As a result, there is in need of an automatic animal detection system in video image frames and also from foot or palm print images. Figure 1 shows a general model of the proposed system for animal detection.

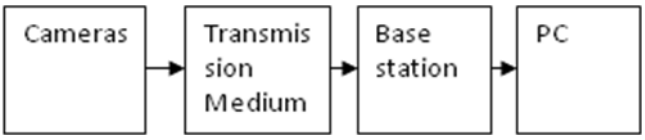

Fig.1. General Model of the Planned System.

In our proposed system, a high definition camera is fixed at specified locations where animals are usually making troubles to human in night as well as day time. The image is taken at fixed intervals and image data from the camera is transferred to a control station where an operator monitors the animal presence in a PC using image processing techniques. All the videos that are coming from cameras placed at different positions are processed using image processing algorithms. The decision making capability is left to the officials for taking appropriate decisions after any of the animal presence was found. The proposed work can also detect the presence of an animal from its footprint images and the official can give warning about presence of wild animal to the citizens who lives around the forest area. The nature of the warning signals is related with the decision of the authority. The authority can send warning signal about the presence of a dangerous animal or an animal that destroys the agriculture in the form of audio or message alarms to the humans. Authorities can also send scaring sounds to the animals or by sending officials to the sites.

At night times, it is difficult to record the animal's foot print images using cameras and no light illumination is possible incorporate with camera. So the forest officials in the control station can identify the animals with their sound data that was recorded and sent using an audio recording device. This sound can be identified automatically by comparing the sound signal with a sound database stored in the computer.

In this work, we have implemented an image processing frame work aimed for the computer in the figure 1 to detect and identify the animals form their footprint images. Because of the huge range of animal kinds, it is difficult to store the foot print data base for all the animal class. So in the proposed method, we have focused to detect the animals that interact with human area more often such as tiger, deer, wild dog, fox, cheetah, elephant and wild pig. Binarization, Noise removal, Orientation checking and foot print matching are the typical steps performed in the proposed footprint matching method. As a first phase, Black and white footprint images are kept in a database after binarization and noise cancellation methods. In the second phase i.e. in the animal detection phase, the recently recorded footprint image after binarization and noise removal is compared with the database. Figure 2 shows the frame work for animal detection using footprint images.

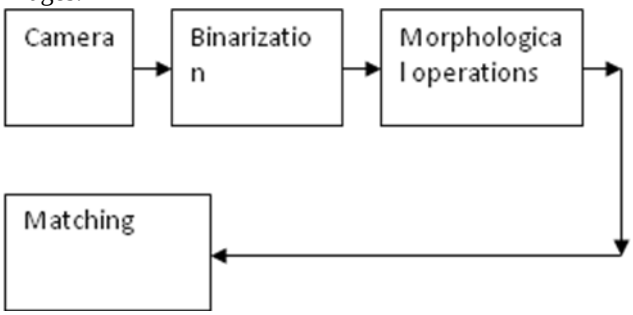

Fig.2. Proposed Framework

B. Universal Modeling for Human Anomalies Detection from Video Images

Developing models for anomalies detection has been always bothered by experts from various areas because different anomalies events exhibits different patterns. This section gives a generalized picture of a system for detecting anomalous events using video images.

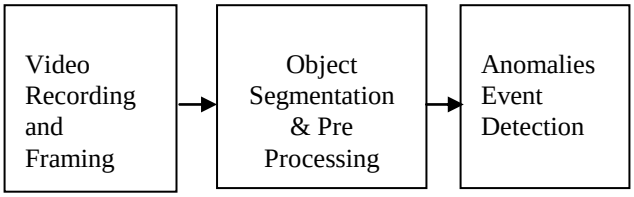

Fig. 3. A frame work for general abnormal events detection model

A smart video surveillance system has three major stages: detection, classification, and activity recognition [14]. Happening of abnormal events in public places is budding at an extraordinary rate, from closed-circuit security systems to contemporary systems that can monitor individuals at airports, subways, concerts, sporting events etc., to network of cameras covering vital locations within a city. Figure 3 shows a general architecture of all abnormal events detection models that were used today. Video capturing was done using a camera and the crowded video footage is used to detect all the moving objects in the consecutive frames. Any digital camera can be used for this purpose because resolution of video frame is not a big issue. After video recording and framing phase, moving object segmentation has to be done to prepare all frames for pre-processing works. Various concepts were utilized for the anomalies detection models in the event detection phase to detect the abnormal events. These systems have numerous of applications in the surveillance sites. Human crowd detection and monitoring is a significant but tough job among the surveillance applications because crowd will be always prone to anomalies. In this section we have proposed a human crowd detection model.

Figure 4 shows a frame work for crowd detection. From the specified video of a congested scene, the first step is to separate all the moving objects from the background in the consecutive frames. The second step is to use certain stages to eliminate noise and shadow. The human object classification is performed as the third step to select the human objects from other objects using SVM classifier [13]. Finally crowd detection was performed using object rectangular box model and a central perpendicular axis model.

Video was captured using a stationary camera and each frames are separated to apply the further steps to each image frames. All moving foreground object pixels are separated from the background pixels and in all image frames using GMM method [11]. We have successfully utilized this techniques in our previous works in this field [9]. Gaussian mixture model is the widely acceptable model for background modeling to detect moving objects from background using fixed stationary camera.

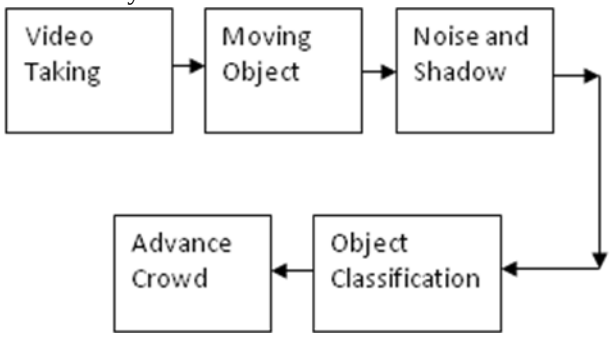

Fig. 4. Phases for crowd detection model

III. RESULT AND DISCUSSIONS

In this section, the results of research are explained and at the same time is given the comprehensive discussion. Results can be presented in figures. The first section shows the results of animal detection from video images and second section shows the results of animal presence detection from palm print images.

A. Animal Detection from Images

Figure 5 (a) shows a processed image of deer walking near the forest area captured using an IR camera [3]. We have processed the image given in 5(a) to make it as a binary image. The result of binarization is shown in figure 5(b).

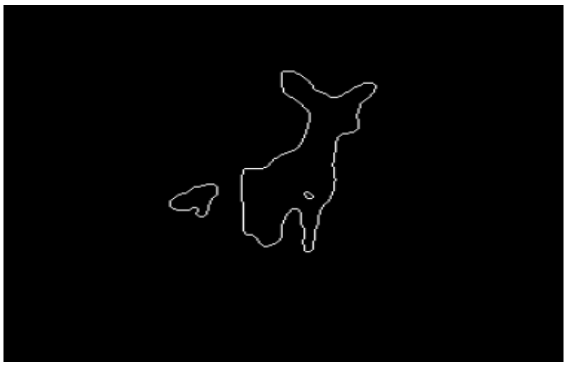

Fig. 5(a). Processed Image

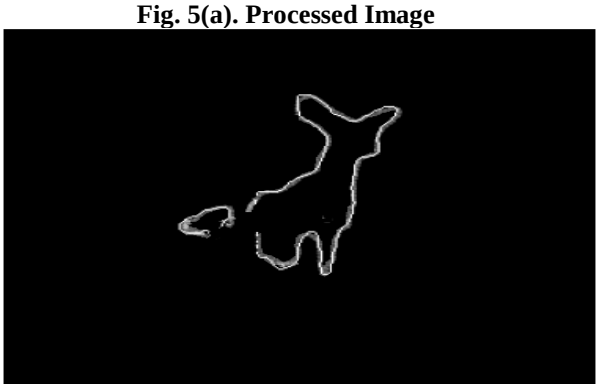

Fig. 5(b). Binarized Image

B. Animal Detection from Palm print Images

This binarized image takes lots of similarity with other animal shapes. So we have developed a model to detect the animal based on their palm print images. Figure 6(a) shows the tiger's footprint images and figure 6(b) shows the result of binarization.

Fig. 6(a). Tiger's Palm print

Fig. 6(b). Binarized Tiger's Palm print

C. Crowd Detection from Video Images

Formation of human crowd may leads to anomalous events in the image frames. This has to be detected in an efficient surveillance system using video images. For that video images were captured and video is converted to image frames to apply the proposed frameworks [9].

Figure 7 shows a video frame that was taken from a recorded video at an outdoor street. Here we can see a simple crowd formation. Now all the moving objects are separated form the background image using GMM. Now this was applied to all image frames to detect the foreground images. Figure 8 shows the result of object detection algorithm applied to the above image frame.

Fig. 7. Sample Video Frame

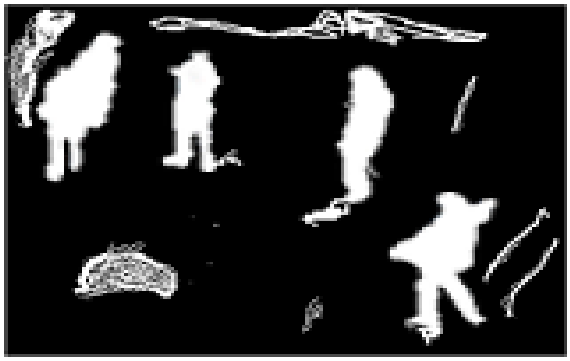

Fig. 8. Object Detection using GMM

The GMM left some noises in the image frames and this was removed using morphological operations. In Fig 8 the white pixels associated with stationary objects are considered as noise and we can see that, these noise pixels are present in the background. After noise removal using morphological operations, resulting frame undergoes for shadow elimination. The main problem in foreground object detection is the misclassification of shadow pixels as foreground object. So shadow detection and removal is a vital task while dealing with the outdoor environments. Figure 9 shows the implementation result after noise elimination and shadow elimination process.

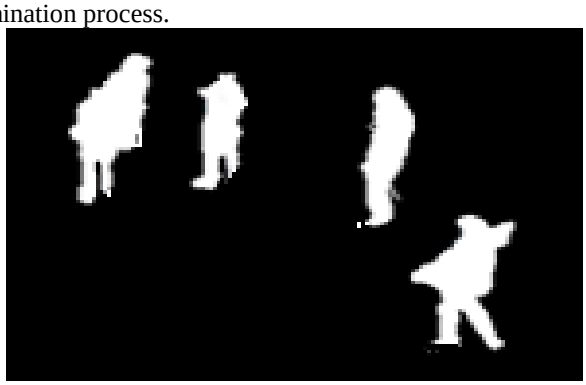

Fig. 9 Noise and Shadow Elimination

Fig. 10. Human object template database

The object classification is an essential steps that was carried out to separate moving human object from other non-human objects [9]. Figure 10 shows the template data base that were used in our work to classify human objects. Crowd was detected using a rectangular model along with central vertical line model [16]. The result is shown in figure 11. The distance between the central vertical lines of each object in an image frame was frequently checked to detect formation of crowd. If this distance is less than a minimum threshold or zero, we have decided that crowd was happened. Immediately after detecting the formation of crowd we have apply green colour value to all the crowd forming pixels in the frame. Figure 12 shows this result.

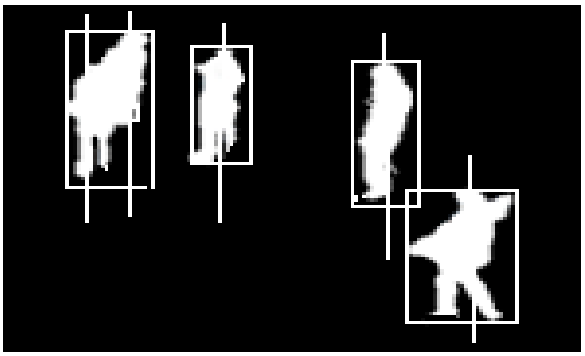

Fig. 11. Rectangle with vertical line model

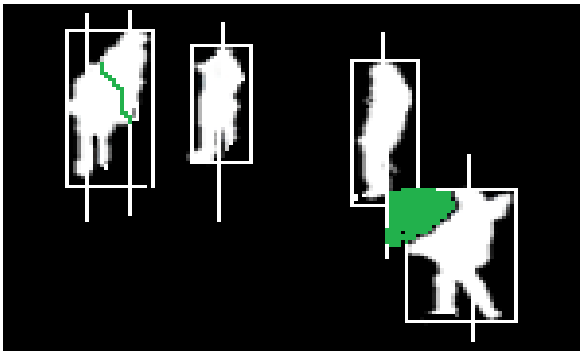

Fig. 12. Crowd detection

IV. ANALYSIS

Analyzing our models by comparing it with the existing models is a time consuming and useless process. So this section give a focus to analyze and evaluate the principal model which is developed for object detection and is highly needful to separate the moving human objects from the background. It is the most accuracy deducting factor in crowd detection algorithm. If the object detection has been done accurately in all the video image frames, all other steps will performed as better. From this point we have concentrated deeply to in the selection of a suitable object detection algorithm. After the proper analysis, it is found that GMM gives high PSNR value than other methods in different video data sets. Higher PSNR usually indicates that the reconstruction is of higher quality. Comparison of commonly used background subtraction methods for different videos is given in the table 1.

Comparison Based on PSNR					
Video Clip	Video 1	Video 2	Video 3	Video 4	Video 5
Adaptive Background	28.75	25.62	32.1	35.33	22.5
Frame Differencing	40.17	38.14	42.34	45.55	28.34
Average Filter	42.35	40.35	45.25	46.28	30.1
GMM	52.58	45.52	48.5	50.12	35.12

Table 1. The performance of human detection in video images using PSNR

Researchers are commonly used the PSNR to measure the quality of reconstructed or modified images. All picture element (pixel) has a color value that can be varied when an image is reconstructed or modified. The Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR) are the two error measures used to equate image excellence. The MSE represents the collective squared error between the compressed and the original image. But the PSNR represents a measure of the peak error. The lower the value of MSE, the lower the error.

The PSNR computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality depth between the original and a compressed image [10]. To compute the PSNR, the mean-squared error must be calculated using the following equation (1)

$$MSE = \sum_{M,N} [I_1(m,n) - I_2(m,n)]^2 / (M * N) \quad (1)$$

In the above equation, M and N are the number of rows and columns in the input images, respectively. Then the block computes the PSNR using the following equation (2)

$$PSNR+10\log10 \{[R2]/MSE\} \quad (2)$$

In the above equation, R is the maximum variation in the input image data type. For example, if the input image has a double-precision floating-point data type, then R is 1. If it has an 8-bit unsigned integer data type, R is 255, etc. [10]

V. CONCLUSION

Our main contribution in this paper is to implement some innovative general frameworks for animal detection in image frames, from palm print images and human crowd detection in video images. Animals was detected in video image frames and in palm print image. This paper was also focused on human crowd detection and this model can detect the crowd well in advance. The animal and human detection have done using the image processing principles. We have studied different algorithms for animal detection and our method is a simple image processing technique. In crowd detection we have compared our method with others and from these studies we have found some suggestions to develop a new crowd models and also found that our prior detection of crowd is very useful in human anomalies happened in crowd.

ACKNOWLEDGMENTS

I thank all the persons who have supported me mentally, physically and financially during my research period. I express my sincere gratitude for the blessing of my mother and father towards me. I am indebted to my mother in law for her constant support and inspiration for the successful completion of my research. Finally, I thank the God almighty for giving a chance to develop a system for serving the society.

REFERENCES

1. Waqas Sultani and Chen Chen," Real-world Anomaly Detection in Surveillance Videos", IEEE, 2018.
2. Seung You. et. al., "Protection of Orchard from Wild Animals and Birds Using USN Facilities", IEEE, 2010.
3. Debao Zhou. et. al., "Tracking-Based Deer Vehicle Collision Detection Using Thermal Imaging", IEEE, 2009.
4. Deepak P. et al., "Tiger Census Using Low Quality Foot Print Image", IOSR, ISSN: 2278-8735, 2016.
5. A. Fackelmeier et. al. " A Multistatic Radar Array for Detecting Wild Animals During Pasture Mowing", 6th Radar conference, EuMA, 2009.
6. Sehchan Oh. et. al., "A Platform Surveillance Monitoring System using Image Processing for Passenger Safety in Railway Station", International Conference on Control, Automation and Systems, 2007.
7. Ayesha Choudhary et. al., "A Framework for Analysis of Surveillance Videos, Sixth Indian Conference on Computer Vision, Graphics & Image Processing" , IEEE, 2008.
8. Teddy Ko, "A Survey on Behavior Analysis in Video Surveillance for Homeland Security Applications".
9. Deepak P. et al., "Prior Detection of Crowd in Monocular Video Surveillance Environment", International Journal of Pure and Applied Mathematics, ISSN: 1311-8080, 2018.
10. www.mathworks.com

11. Muhammad Umer Farooq and Najeed Ahmed Khan, "Unsupervised Video Surveillance for Anomaly Detection of Street Traffic", International Journal of Advanced Computer Science and Applications, Vol. 8, No. 12, 2017.
12. Yuan-Kai Wang et. al. "Real-Time Camera Anomaly Detection For Real-World Video Surveillance", International Conference on Machine Learning and Cybernetics, IEEE, 2011.
13. Vasanth P.C et. al.," Facial Expression Recognition Using SVM Classifier", Indonesian Journal of Electrical Engineering and Informatics (IJEEI), March 2015.
14. Kamal Sehairi et. al. " A Real-Time Implementation of Moving Object Action Recognition System Based on Motion Analysis", Indonesian Journal of Electrical Engineering and Informatics (IJEEI), March 2017.
15. Kurniabudi et. al. "Network anomaly detection research: a survey", Indonesian Journal of Electrical Engineering and Informatics (IJEEI), March 2019.
16. Deepak P. et al., "Design and Utilization of Bounding Box in Human Detection and Activity Identification", Springer International Publishing Switzerland 2015.
17. Deepak P. et al., "A Study on Video Surveillance using Image Processing", IEEE,2014.

AUTHORS PROFILE

Deepak P., is graduated his Bachelor degree in Engineering from Madras University, Chennai in 1999. He has completed his Master degree in Engineering from Anna University, Chennai in 2008. Carrying Diploma in Biomedical Engineering with two years of Industrial experience in this field. Pursuing Doctoral research in Image Processing at M.G University research Centre, Edappally, Cochin. Nearly 20 years of teaching experience includes 16 years at B.Tech. , M.Tech. Level and 4 years at Diploma level. Currently working at Sree Narayana Gurukulam College of Engineering, Kolenchery, Ernakulam. Has many publications in the refereed National, International conferences and journals are the added credits in the career. Still acting as an ISO certified auditor and performed as IEEE branch Counsellor since 2008-2016. His research interests are in the field of development of automatic Visual Surveillance systems.

Dr. S. Krishnakumar completed his M.Sc. in Physics with Electronics specialization in 1987 from Mahatma Gandhi University, Kottayam. He was awarded Ph.D. in Thin Film Devices in 1995 from Mahatma Gandhi University, Kottayam. He got M.Tech. in Computer Science from Allahabad Agricultural Institute – Deemed University (renamed as Sam Higginbottom Institute of Agriculture, Technology and Sciences) in 2006 and also obtained MCA from IGNOU in 2010. He qualified AICTE-UGC special examination for PG Engineering in 2018. He has 24 years of teaching experience in Electronics and Computer Science subjects for graduates and post graduates. He served as the Regional Director at the School of Technology and Applied Sciences (STAS), during the period 2013-17. Currently he is working in the STAS, Mahatma Gandhi University Research Centre, Edappally, Kochi-24, Kerala, India. His research interest fields include ANN, Analog circuit design and Image processing.

Dr. S. Krishnakumar is an Associate member of Institute of Engineers, India. He was a member of Board of studies of University of Calicut and a member of Academic council of Mahatma Gandhi University, Kottayam.