A Detailed Review Work on the Existing Animal Detection System

Dechen Doma Bhutia Miss
North Bengal University,West Bengal,India, dechendomabhutia@gmail.com

Swarup Das Dr.
North Bengal University,West Bengal,India, sd.csa@nbu.ac.in

Rakesh Kumar Mandal Dr.
North Bengal University,West Bengal,India, rakeshmandal@nbu.ac.in

Recommended Citation

A Detailed Review Work on the Existing Animal Detection System

Cover Page Footnote

A Detailed Review Work on the Existing Animal Detection System

Dechen Doma Bhutia[1]
Department of Computer Science and Application,
North Bengal University,
Rajaramohanpur, West Bengal, India.
e-mail:dechendomabhutia@gmail.com

Swarup Das[2]
Department of Computer Science and Application,
North Bengal University,
Rajaramohanpur, West Bengal, India.
e-mail: sd.csa@nbu.ac.in

Rakesh Kumar Mandal[3].
Department of Computer Science and Application,
North Bengal University,
Rajaramohanpur, West Bengal, India.
e-mail: rakeshmandal@nbu.ac.in

*Abstract -*Technology plays a very important part in today's world, the simplest of tasks demands technology and we as humans crave every day for better technology to make our lives easier, with the help of technology that saves us valuable time and energy which can be utilized to do more productive work, amongst technological advances expert system plays a very important role in every field and the major field where expert systems can be employed in is animal detection for the welfare of animals and the people who need to interact and at times avoid interaction with these animals. The review paper outlines the different animal detection systems in different areas like farmland and offshore turbines and also compares the different technologies presently in use for the detection of wild animals, farms animals as pests, wild birds. The outcome of this review is going to help the researchers to use the best equipments, right sensors, microcontrollers and other networking devices that are less expensive, having higher detection range and less maintenance requiring for the better detection of animals, without causing harm to them and effectively and safely warding off the animals.

Keywords: *Animal Detection, PIR Sensors, Ultrasonic Devices, Thermal Cameras, UAV, RFID, Motion Sensors, Wireless Sensor Networks.*

I. INTRODUCTION

Several attempts and various methods have been adopted in the past for the proper, accurate and unharmed detection of wild animals that cause havoc to the human populace in various ways, either by eating up the valuable crops or damaging the important equipment installed for sustainable living. Various methods have been devised, using sensors [5, 6,9,10], high definition cameras, infrared and thermal cameras [1,2] as well as drone operated aerial cameras [7], some methods gave desired results and some failed miserably, due to high maintenance and expensive gears. Some methods involved installing detection chips in those wild animals [4], the total feasibility of these methods seemed bleak. Some have been proved to be harmful endangering the lives of domestic animals and kids. But in the attempts made above for the detection of animals, the gears used had to be manually handled or a person had to be stationed for the proper working of the equipment. The main purpose of this paper here is to provide some experimental evidence based on the experimental results from recent primary literature articles and explain how those results shape our current understanding of the topic. Further the approach also mentions the types of experiments done and their corresponding data and also points out an address any controversies in the field.

The work has been divided into four sections. In section I the existing systems to detect animals with their experimental evidence are discussed in detail. In section II a detailed comparative analysis has been done in order to explain how the results shape our current understanding of the topic. In section III different types of experiments done and their

corresponding data are discussed. In section IV different controversies in the field of animal

II. REVIEW OF THE EXISTING SYSTEMS

A. *Animals Detection in Mowing Operations Using Thermal Cameras*

Here the detection of animal who have their nests in the ground and lie low in the grass for protection are detected with the help of infrared thermal imaging with digital image processing, in a grassland habitat but failed in densely covered habitat due to low detection rate. Forward Looking Infrared Thermal (FLIR) camera which works on long wave Infrared Band (LWIR) was placed in front of the tractor. The disadvantage in thermal detection was due to the insulative property of the bird feathers so a false positive data was given. The experiment was performed on one crop type using a single camera position [1].

B. *Thermal Animal Detection System*

A remote controlled thermal camera and its related hardware and software was positioned for recording the collision between the migrating birds and the rotating blades of the offshore wind turbines in a terrestrial habitat [2].

C. *W-CoHOG*

The system uses W-CoHOG feature vector to implement animal recognition. The images are captured at a fixed time interval, preprocessed and then processed using sliding window technique to identify the animal on a static image and not in a moving video [3].

D. *Animal Intrusion Detection System using Raspberry Pi*

This utilizes the RFID Radio Frequency Identification Device module and a GSM modem to protect farmland from wild animals that are capable of crop damage. Here the animals are detected by

detection are pointed out and addressed.

RFID injector LF tag under the animal skin. The authorities are alerted and animals are ward off by using sounds that irritate them and fog machine smoker [4].

E. *Animal Detection System using Motion Sensor*

Animal Intrusion is detected using motion (HR,HC-SR501) sensor, the camera captures the image which is classified by processing the image then the animals are ward off with the help of light emitter or sound generator and the GSM module alerts the authorities and the farm owner [5].

F. *Animal Detection System using PIC16F877A, PIR sensor, Ultrasonic Sensor, APR Board*

Here the animal intrusion is detected by the PIR and Ultrasonic Sensor and send signals to the controller which in turn will switch the APR (Audio Voice Recorder and Playback) board which produces sounds to divert animals and a message is sent to the forest officials and farmers. The source of power is solar panel or regular electricity. Electric fences are used which causes animal deaths, pets and sometimes even humans, sometimes when there is a voltage drop on these fences to keep a check on the adequate voltage human presence becomes necessary as these fluctuation in voltage cannot be remotely controlled or monitored. The PIR sensor or Passive Infrared sensor has limitations of 10m radius and the ultrasonic sensors work only from 2cm to 400 cm radius hence large areas cannot be covered [6].

G. *Animal Detection Using Aerial videos*

The animals are detected by highlighting the movement patterns of the animals against a fixed background using UAV, however there are certain limitations to this animal detection method as the method is sensitive only to the animals in motion and not stationary animals and ignores other

important features such as colors and overall appearance of the animals [7].

H. Detection of Animals using Intelligent Surveillance System

Here the moving Image or videos of the animals are captured using cameras then image processing is done, and the foreground objects are extracted by frame differencing followed by thresholding to produce binary image followed by feature extraction using SIFT (Scale Invariant Feature Transform)algorithm and finally using Euclidean Distance, the object of interest is recognized by comparing it with database, the output is sent to a microcontroller via GSM module and alarm is raised and an SMS is sent to the owner of the field but the system fails when the distance of an object is far due to small size and lack of info [8].

I. Animal Intrusion detection using wireless sensor networks

Here the motion sensors are used to detect the presence of animals in the farms using wireless sensors and buzzers. The motion sensors sense movement and pass it to a centralized sensor connected to an Arduino with a GSM module interfaced with buzzers and RIFD transmitters which activates the system to produce sound and give a minor shock to the animals due to which they fall and GSM sends a mobile alert to the farm owners [9].

J. Design of Wild animal Detection and Rescue System with Passive Infrared and Ultrasonic Sensor based Microcontroller

Here the PIR sensor detects the animals that are destructive to the crops in a farmland and an ultrasonic device that produces ultrasonic disturbing frequency is used to repel them as they approach nearer to the farmland [10].

TABLE 1. EXPERIMENTAL EVIDENCE

Sl.No	NAME OF THE METHOD	EXPERIMENTAL EVIDENCE
1.	Automatic Detection of Animals using thermal cameras.	Experiments conducted at different driving speeds to find out the presence of rabbits and chicken in order to find out the number of true and false positives, frames with animals present by means of visual inspection. The number of frames were detected by video recording. According to the approach the detection rate was almost 100 percent.
2.	Animal Detection System using Thermography.	Experiments conducted to detect the frequency of collision between the offshore wind turbines and migrating birds under poor visibility using thermographs. This is a method where the object images are measured by their own and the reflected radiation. For the experiments thermal cameras were used.
3.	Wild Animal Recognition Using W-CoHOG method.	No experimental Evidence was found, this paper proposes a method to recognize wild animals with the help of image captured by camera and W-CoHOG oriented gradients.
4.	Wild Animal Detection Using Raspberry and RFID tags.	No experimental Evidence was found, this paper proposes a way to detect wild animals by tagging them with the RFID injector and detect and inform using GSM and prevent the entry of animals and irritants like sound and fog are also used.
5.	Animal Detection using IOT.	Experiments conducted had some flaws enumerated as below. i) It is very difficult to create and maintain a database of pictures of all the animals. ii) There is no concrete technology to identify an unknown animal image with the contents of the database. iii) The experimental evidence depicts mere visual comparison to identify the presence of an animal. iv) The repellent system to be applied in this proposed methodology is always not

6.	Animal Detection Using PIR Sensors.	In the experiments conducted, there were some flaws. i) The PIR Sensors and Ultrasonic sensors detect motion and presence of animals but are not able to differentiate between a wild animal and or a human being or a domestic animal. ii) As soon as motion is detected by the sensors, alert is sent to the framers and forest officials but not specifically define which animal. iii) All wild animals are not afraid of bright light and some animals are not afraid of loud sounds.
7.	Animal Detection Using Image Processing.	Optical Flow Theory has been used here to detect animals. UAV has been used to capture animal images. Concept of motion velocity has been used here. The experiment has been conducted on zebras and antelopes where false positives and false negative values of zebras are calculated as 2.03% and 17.97% and for antelopes the values of false positive and false negative are calculated as 12.05% and 11.39%
8.	Animal Detection Using Image Processing and Back ground subtraction.	In the proposed methodology, background subtraction model is used. The image of the mobile animals is captured using cameras and extracted using image processing, the main flaw of this method is that only animal images captured near the camera are taken into account and far away images are ignored. The images of animals in motion are taken into consideration provided the background was static.
9.	Animal Detection Using Motion Sensors.	In the proposed methodology wireless motion sensors are used to detect the RFID tagged animals entering the farmland. Acoustic sounds are produced and animals are given a minor shock on detection and an SMS is sent as an alert but the major flaw of this system is that untagged animals will go undetected and the system is not weather proof.
10.	Animal Detection Using WSN.	In the proposed methodology the researchers proposed a system using low cost wireless sensor nodes to detect the presence of animals. In the system physical or environmental conditions such as temp, sound vibration, pressure, pollutants or motion can be monitored. The system also proposed to use Arduino Uno, Raspberry or Mega 2560 and Bluetooth modem HC-05/06.

(The top partial row reads:) successful. It is very difficult to drive away elephants with the use of bright light alone similarly irritating loud noise is not enough to drive away the leopards.
v) Mobile SMS is sent to forest officials as alert information but it is very difficult to find mobile networks in dense forest areas.

This study is essential to bring to light the most effective way of animal detection without causing any harm to the animals to be detected as well as the detecting side. It is not time consuming and laborious but automatic and exact. There are many possibilities of refinement in the existing system like in the Animal Detection System in mowing operations using thermal cameras by Kim Arild S et. al the major drawback of the animal detection system was that the thermal and digital image processing failed to detect animals in very dense grass cover as well as due to the insulative property of the feathered animals a false positive result was detected.

The paper on the Thermal Animal Detection System TADS by Desholm M. which was towards the development of a method for estimating collision frequency of migrating birds at offshore wind turbines. The instruments needed various extra equipment to save it from freezing and to provide a water proof environment. The camera on a steel device had to be rotated manually in order to view different directions and a shield to protect the equipment from lightening added to the high cost for just the upkeep of the instruments and also the detection could only be done in terrestrial habitat and no preventive measures were taken, further the detection was good weather dependent and failed in foggy and snowy weather.

The paper by Nagaraju Andavarapu and Valli Kumari Vatsavayi, "Wild Animal Recognition in Agriculture Farms using W-COHOG for Agro- Security. Images are captured using installed cameras in the farms and then those images are processed to detect whether the animals exist in the library images. So it is limited only to

the animals that are present in the image repository and only works on static images and does not recognize in video format.

In the paper by S. Santhiya, Y. Dhamodharan, NE. Kavi Priya, CS. Santosh and M Surekha, " A Smart Farmland Using Raspberry Pi Crop Prevention and Animal Intrusion Detection System the proposed method uses RFID injector to inject the RFID tag under the animal skin, therefore the detection capability of this system is only limited to the tagged animals and other that are untagged go undetected.

In the paper by Divya, Usha Kiran and Praveen M, "IOT- Based Wild Animal Intrusion Detection System, motion sensors and camera is used to capture images and then these images are again compared with the stored library images here to the problem of limited image repository occurs and animals outside the image library will go undetected.

In the paper by Vikhram B,Revathi.B, Shanmugapriya.R,Sowmiya.S and Pragadeeswaran. G, "Animal Detection System in Farm Areas, the range of area covered by PIR sensors is only about 10m from the sensor and the whole module is not based on wireless networks. The maintenance and upkeep of various sensors is not automatic, is expensive and needs constant attention in case of malfunction.

In the paper by Yunfei .F, Shengzhi .D, Rishaad . A, Karim .D and Coneth .R, " Motion Based Animal Detection In Aerial Videos, the animals close to the camera are better recognized than the ones that are further away from camera, this system is only sensitive to animal movements

and takes little account of other distinguishing features like size, color and shape therefore failing dearly to recognize one type of animals from another. Maintenance of UAV is another problem.

In the paper by Mriganka .G,Savio Raj .P, "Protection of Crops from Animals Using Intelligent Surveillance System, use cameras to detect animals, the cameras are not automatic, they need maintenance and equipment are expensive to get better image of the object to be detected further only animals closer to camera are detected and those that are far away are ignored therefore some animals that are further away from the camera focus go undetected.

In the paper by K.Jai Santoshi and Bhavana.S, " Intruder Recognition In A Farm Through Wireless Sensor Network, the RIFD transmitters which activates the system to produce sound and give a minor shock to the animals due to which they fall and GSM sends a mobile alert to owners. The drawback however of this system is that the electric shock is harmful to the animals and if any disease bearing animal die in the field the crops can be contaminated.

In the paper Yusman et al , " Design of Wild animal Detection and Rescue System with Passive Infrared and Ultrasonic Sensor based Microcontroller." The PIR sensor is used to detect animals that are pest to the farmland crops and an ultrasonic sound producing device toward them off from the farmland the drawback of this system is that the sensor can detect to a maximum distance of 5 m therefore the damage will have already been done in the areas that are further from the PIR sensor.

IV CONCLUSION

The different systems used for the animal detection were reviewed with experimental evidence as done in TABLE I and a comparative analysis was done and it was found that thermal cameras failed to detect in certain conditions like dense grass cover, some of the equipment used were

expensive and high maintenance as extra equipment were required to upkeep of the instruments employed for the purpose of animal detection ,all equipment were not automatic like some manually handles mounted cameras, some systems were weather dependent, some systems were limited due to limited image reference repository for

comparison, some animal detection systems were limited to detect only RFID tagged animals and untagged animals went undetected. Some sensors had very less range for detection and some systems used minor shock that could harm sick animals and sometimes may be cause death. After review of the above mentioned animal detection systems, it has been concluded that there is a need for an automatic, timely, unmanned and an inexpensive animal detection system which is not weather dependent, does not need a limited image library and has a higher range for detection

REFERENCES

[1] Kim Arild Steen, Andres Villa- Henriksen, Ole Roland Therkildsen and Ole Green," Automatic Detection of Animals in Mowing Operations Using Thermal Cameras," Sensors 2012,12,pp 7587-7597; doi: 10.3390/s 120607587,ISSN 1424-8220.

[2] Desholm M 2003: "Thermal Animal Detection System (TADS)," Development of a method for estimating collision frequency of migrating birds at offshore wind turbines. National Environmental Research Institute, Denmark, 27oo-NERI Technical Report No.440. http://falige-rapporter.dmu.dk.

[3] Nagaraju Andavarapu and Valli Kumari Vatsavayi, "Wild Animal Recognition in Agriculture Farms using W-COHOG for Agro-Security," International Journal of Computational Intelligence Research, ISSN 0973-1873 Volume 13,Number 9(2017),pp.2247-2257,Research India Publications, http://www.ripublications.com.

[4] S. Santhiya, Y. Dhamodharan, NE. Kavi Priya, CS. Santosh and M Surekha, "A Smart Farmland Using Raspberry Pi Crop Prevention and Animal Intrusion Detection System," International Research Journal of Engineering and Technology, Vol:05, Issue :03/Mar2018,e-ISSN: 2395-0056,p-ISSN: 2395-0072.

[5] Divya,Usha Kiran and Praveen M, "IOT- Based Wild Animal Intrusion Detection System," International Journal on Recent and Innovation Trends in Computing and Communication,Vol 6, Issue 7,ISSN:2321-8169,06-08.

[6]Vikhram B, Revathi.B, Shanmugapriya. R, Sowmiya.S and Pragadeeswaran.G, "Animal Detection System in Farm Areas," International Journal of Advanced Research in Computer and Communication Engineering, Vol6, Issue 3,March 2017,ISSN(online) 2278-1021,ISSN (print) 2319-5940.

[7] Yunfei .F, Shengzhi .D, Rishaad . A, Karim .D and Coneth.R, "Motion Based Animal Detection In Aerial Videos," Procedia Computer Science 92 (2016)13-17, doi: 10.1016/jprocs.2016.07.316.

[8]Mriganka G, Savio Raj P, "Protection of Crops from Animals Using Intelligent Surveillance System," Journal of Applied and Fundamental Sciences,ISSN 2395-5554(Print),ISSN 2395-5562 (online), 2015, 1 (2), 200-206.

[9] K. Jai Santoshi and Bhavana. S, " Intruder Recognition In A Farm Through Wireless Sensor Network," International Journal of Advance Research, Ideas and Innovations in Zonal Seminar, Recent Trends In Engineering & Technology,2017,Special Issue of International Journal of Electronics, Communication & Soft Computing Science

and Engineering, ISSN: 2277-9477,pp. 57 to 60.

[10] Yusman, Aidi Finawan and Rusli, "Design of Wild animal Detection and Rescue System with Passive Infrared and Ultrasonic Sensor based Microcontroller."1 Editors(s): ISBN: eISBN: 978-1-78756-793-1