Real Time Animal Repellent System using Image Processing

Mrs. S. Jalaja[1] Abel Daniel T[2] Gowtham Shankar B[3] Kaliraj M[4] Yuthish Khanna J[5]
[1]Assistant Professor [2,3,4,5]Student
[1,2,3,4,5]Department of Electrical & Electronic Engineering
[1,2,3,4,5]Vel Tech High Tech Dr.Rr Dr.Sr Engineering College, Avadi, Chennai

Abstract— In forest zone and agricultural field human animal conflict is a major problem where enormous amount of resources is lost and human life is in danger. In recent times the numbers of these kinds of conflicts are increasing. So this zone is to be monitored continuously to prevent entry of this kind of animals or any other unwanted intrusion. In our proposed project we have designed a system which detects motion using PIR sensors. After detection of motion the camera in that area is triggered to take an image of the intrusion. Then the image is sent to the image processing processor and algorithm to classify the kind of animal or human is applied. The algorithm used here is Content Based Image Classification which gives the result as to which animal has intruded and in some cases if it be a false alarm no alert is given and all further processes are not done. If detected as a threat the location and type of danger intruded is sent as an SMS to the field owner and also to the forest officials as a alert message using GSM technology. Also animal repellent techniques such as irritating noise in the range of ultrasonic frequencies and Bright ,light which repels most of the animals are used .This is a way of making the animal uncomfortable so that it retreats back from the agricultural field and also it would be easy for the humans to scare them away.

Key words: Animal Repellent, Image Processing

I. INTRODUCTION

Human-animal conflicts arises due to encroachment and poaching, humans move into the forest to satisfy their livelihood, for claiming of land for agricultural practices and rapid industrialization causes spreading of urban ground. And animals enter the nearby villages for water during summer due to dryness in water body. Elephants or wild boar tramp the vegetation in farm land in need of nutritious food. Need of the animal or human put the other in real danger, in this process, resources are spoiled and sometimes even the life is lost. Human- elephant conflict is more in south Asia and in Africa. Usually farms are protected with electrical fence, animal which tries to enter field suffers electrocution with intense pain cause animals to behave in abnormal manner. The problem of improper electrocution is predominant in the community. There is practice of usage of cracker to alarm animals in India and Africa. In this process it requires human for locating animal and lighting crackers. In Africa they practiced Bee craft because elephants fear bee sting and sound. Due to deforestation even wild cats enter villages. These cats start hunting cattle, goats and human. More humans are attacked because they are an easy prey. Human-animal conflicts occur when animals enter the zone of human. This project aids us to notify the intrusion and repel the animal. In this project monitoring is done by sensors and cameras. The images obtained are processed in Mat Lab CBIC algorithm for classifying animal so a suitable repellent such as ultrasonic sound is emitted for herbivores animal and bright light in case of carnivores' animal.

II. EXISTING APPROACH

A. Detect Motion and Differentiate Between Human and Animal

This is a simple approach where PIR sensors are placed in the place which has to be monitored. The sensor is placed in a tower arrangement. This system is one way implementation of our job. The main objective of this system is to monitor the area and find any unauthorized entry into that area. Also the end result of this system is an output which either denotes the entry of an animal or human. Even an object with similar kind of characters are not classified, because the entire system is only reliant on sensor tower which differentiates between the two classes based on the IR rays emitted by the object. Also the output data is to be continuously monitored by a human, else there will be no action taken against the intrusion. This is not an autonomous system since no corrective action is taken for the problem.

B. Animal Tracking with the Use of GPS Device

In this approach a GPS tracking device is to be placed in the leader of the group of animal. A virtual border is created around the protective zone. These signals are to be continuously monitored in a base station and when the leader crosses the border an alert message is generated. Note that here the leader of the group is assumed to lead a batch of animals and also these animals always approach human area in groups. This is not the case with most of the animals. The group may be split; the animals may not follow the animal which was identified as the leader; Also finding the animals' leader is a tedious task.

C. Bee Hives along the Border

Another oldest system in which bee hives are placed along the border and due to this, animals fear of bee stings and sounds and leave the place when sound of bees are heard. The system is costly and setting up real bee hives incur maintenance costs

III. PROPOSED SYSTEM AND ITS COMPONENTS

We are using PIR sensor combined with a camera Any intrusion (Movement) can be sensed using PIR sensor and images taken using camera. Further processing is done on the image and the exact threat is classified using CBIC(Content Based Image Classification) algorithm .Accordingly animal repellent techniques can be used such as ultrasound for some herbivorous animals ,Bright light repel some of the animals ,Huge noise can be produced using speakers hidden in tree trunks.

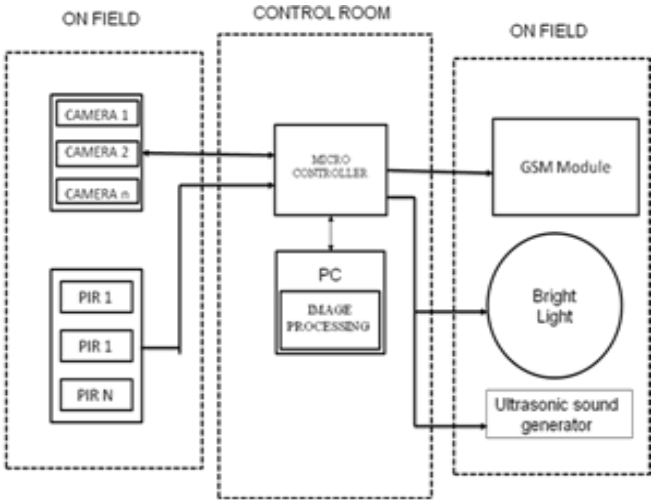

Fig. 1: System Overview

Owner and forest officials are alerted about the intrusion immediately.

An intelligent system with a centralized control room which can sense movement and activate devices located across the field using wireless systems. The components used and their placement and usage in our project are explained below

A. PIR Sensor

is pole mounted around the field for monitoring, if there is intrusion in that area the sensor in that area switches the camera ON in that particular area, so there is no wastage of power and extra requirement of memory. Along the border of monitoring, first the field is surrounded by sensor which is the first layer and followed by camera which is the second layer. The number of sensors is relatively twice the number of camera. Each sensor has a range of 30metres, depending on the threshold set up on the PIR sensor it is able to detect both the hot body and cold body intrusion. In most part of world intrusion that is threat to a crop field is warm blooded such as elephants, boar and rabbit. In certain places like Australia and river basin crocodile are meter getting into stagnant water in the field, even though they do not harm crop alarm has to be raised because it attacks human. For a field of 200 acre we would require 108 sensors in total, with 27 sensors on each side with a sensor monitoring range of 30 meters.

Fig. 2: Sensor arrangement plan

B. Camera

Camera is placed in the second layer, which is pole mounted around the field. Number of camera monitoring the field is equal to half of the number of PIR sensors. Camera is switched ON by sensor. Series of images or video is taken for processing. Each camera has a range of 50 meter. The image of intrusion in far end has lower quality; these images are enhanced using image processing. In case of breeze all the vegetation in a particular zone has a same kind of movement noted to avoid false alarm due to this motion this is taken as clutter. For processing image of raw format is preferred over jpeg (if needed). The power for working of camera is obtained from solar panel and battery. Once the picture is captured it is sent for proceeding and stored. Transmission of image is transferred via RF Transmitter to the computer where image is stored and analyzed with the predefined data in database of MATLAB depending on its feature animal is displayed.

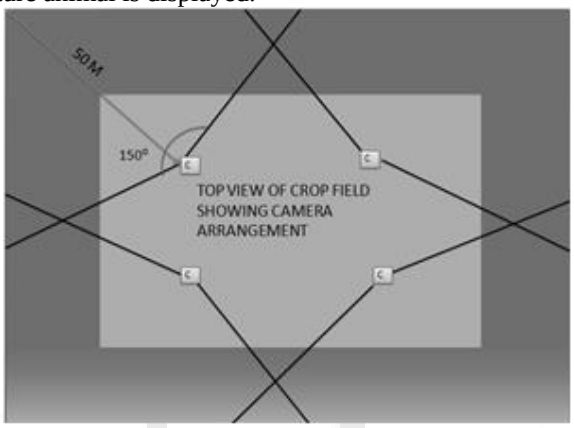

Fig. 3: Camera Arrangement Plan

C. Microcontroller and GSM

Before and after image processing certain control in equipments is required, before image processing control of camera is needed for incoming intrusion. After image processing and classification of animals it requires control of repellent system and GSM module. So we opt for ARM controller, because it is a controller with two input and output port. As soon as the threat is classified through algorithm, this information is intimated to forest authority and owner of field. Followed by this repellent for the specific species is applied. GSM module is used for sending SMS to the authority and owner. In remote area there is a problem with network coverage which can be increased to a larger extent by increasing the size of the tower. In this project the connection are wired but in real time all the components are connected via wireless network for reliability and all of such equipment are controlled through a central control room. The range of GSM tower is not less than 31km.

IV. IMAGE PROCESSING SYSTEM

A. Content Based Image Classification

The detection of object and classification of it into specific object class is our aim. Once the sensor detects motion it gives the signal to the nearby camera through RF transmitter placed in the sensor. Then the camera starts recording video of the current activity in that place. This recorded video is sent to the control room placed in the range of these devices. The control room has a hardware device known as FPGA which does the work of image processing. The Field Programmable Gate Array is a device which performs the

operations through hardware (Gate Pulses). Since our project should produce real time results FPGA reduces the computation time. The FPGA runs on VHDL programmable language. We write the code for image processing in MATLAB and finally convert the code into VHDL language using MEX file in built in MATLAB. So, when we use MATLAB the programming user interface is also simpler to understand and easier to program. The algorithm used here is Content Based Image Classification. The block diagram of the algorithm is as follows.

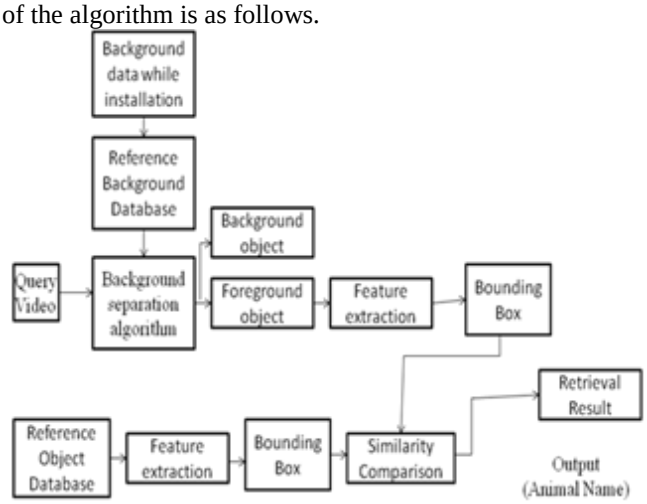

Fig. 4: Image Processing Algorithm (CBIC)

B. Background Separation Algorithm

Background in many cases means stationary part of a video frame. But in outdoor areas the background can be moving due to wind. Tree branches, Vegetation in crop land can be background, but it would be continuously moving. To detect the foreground from a video frame these clutter must be eliminated efficiently. Conventional methods use non adaptive background separation algorithms where the background data or background pixels are not included in the algorithm. But ADAPTIVE Background separation uses the background data in the algorithm and is constantly updated each time processing is done on it. If a video is given as a query to the algorithm it extracts the feature of each frame in it. The frames in a video are analyzed and histograms are created. From this data the image is divided into Gaussian mixture models also called as Mixture of Gaussians (MOG). Each image has some data which is irrelevant to our application. In our case it is background data.

After feature extraction it compares the pixels of current frame and next frame. Then if there is a variation of pixels it is first classified as a motion. Then the motion may be actual object or it may be clutter due to variation in wind. At this stage the motion of a new intrusion would be moving from one place to other in any one direction. This variation would be very large and it is easy to classify this as a motion. On the other hand the motion of background clutter would be alternate in consecutive frames, since the motion of vegetation would be confined to a particular place in the video. The algorithm differentiates between these two and extracts the actual object (animal or human in our case).

C. Updating Background database with Feedback features

As said before this is adaptive background separation algorithm. So there must be a closed loop learning kind of mechanism for eliminating errors. The features are updated periodically after each processing stage is complete.

D. Creating a Bounding Box and Extracting Features

Now that the foreground object has been extracted this object has features such as color, texture, shape etc., A bounding box is drawn around the foreground object and the features of the bounding box object are extracted and stored in a separate database.

E. Creating a Feature Database of Reference Objects

After creating the feature vectors that define the query object it has to be compared with a reference image to get the output. The reference object is having some features. These features are to be extracted and separately stored as a Gaussian model. The feature vectors have information regarding the colour, Texture, Shape etc., MATLAB uses matrix as the basis of any operation. So storing the values of the features is easier with mat lab.

F. Similarity Comparison and Retrieval Results

Now that we have reference object data and query object data the next step is to compare these features and produce the desired output. The area inside the bounding box has feature vectors which are stored as a Gaussian mixture of Colour, Shape, Texture etc., If the query object vectors have similar feature vectors the distance vector between the two is updated . The closest possible match found in the database is retrieved as result image. This image falls under a particular class of animals. Based on this class name the output is given as a name to the microcontroller in an understandable manner. This is also sent to the forest officials and also to the field owner as alert information. If the detected object is not a threat then no SMS is sent. By this way false alarm can be prevented.

V. ANIMAL REPELLENT SYSTEM

Animals can be repelled by sound, odour, taste and colour .Repellent is sprayed over plants when the farmer does not want the animals to consume the plants, thereby causing loss of resource. With repellent sprayed on these crops, animals stop feeding on those crops. Odour and taste are dependent on climatic condition. Sound can be projected at the intruded animal. Most of the animals especially crocodiles fear of ultrasound. Bright light can be focused on the animal which is an attempt to make the animal retard back.

A. Repelling With the Use of Odour

In the first approach, a liquid or gas of specific smell is sprayed over the plants to avoid animals consuming it. Also animal specific spray can be ejected at the scene of intrusion to repel the animal more efficiently in real time. To repel animal through odour, dry chilly are smoked. In our proposed project an automated way of spraying can be employed. A motor which can store many kind of repellent is used. Each animal is repelled of different kind of smell. Some animals are even not repelled by any odour. After the image processing system gives the output as a specific animal or human the corresponding spray is sprayed over that area. The range of spray is predefined and the spraying motor placed in the particular area of intrusion is triggered by the microcontroller.

B. Sound as A Repellent

Sound can be made irritating thus it can act as a very efficient repellent. Generating sound can be done with the aid of man. But with technology we can generate almost any kind of sound using speakers and other sound generating circuits. Depending on frequency of sound waves animals are repelled; there is a practice of lighting crackers in farm to get rid of animal. In this project ultrasonic sound is used to repel animal. Frequency range from 16 KHz-25 KHz are used to repel animals such as elephants, deer, wild boar, monkey and rabbits. Reports show that most of the animals mentioned above become irritated by these sounds and retreat back. So employing sound as a repellent is a very good approach as far as these wild animals are concerned.

C. Bright Light as a Repellent

The methods mentioned above, can be used by knowing the animals' weakness over specific odour or specific frequency of sound. But bright light is naturally an irritation to the eyes. So the use of bright light to repel animals is used here. Knowing the position of intrusion on the field we can project light on it to make it go away from our protected area

VI. SIMULATION AND RESULTS

The simulation was carried out on test images with similar vegetation back ground and the output showed 98% accuracy with 3 classes of animals and 89% accuracy with 6 classes of animals. We hereby show the results of the simulation for 2 animals namely cheetah and elephant which are more predominant wild animals which have conflicts with human in India and southern Asia.

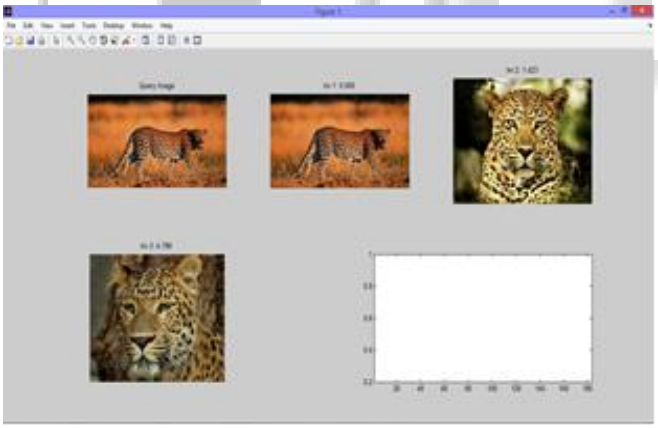

Fig. 5: Simulation Results for Cheetah as a Query

Fig. 6: Simulation Results for elephant as a Query

VII. ADVANTAGES OF PROPOSED SYSTEM

Many animals can be repelled; Classification of threat using image processing; Low energy usage because camera is triggered only after motion is identified by the PIR sensor; Solar energy can be used to charge rechargeable batteries placed in all devices across the field; False alarm is prevented due to Image processing techniques and clutter avoidance technique;

VIII. CONCLUSION

By Our project we find a solution to the ongoing problem in many places of India. A novel solution to the problem of human animal conflict by the process of detection, classification, comparison and repellent is given. We have added animal repellent system which is not present in existing system; we send Alert messages to owner and forest official.

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