Animal Intrusion Detection System

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Abstract—.Our solution to the problem is to build an animal intrusion detection system that alerts the user of sightings of animals in real time if it has entered the village or locality. We plan to achieve this by training the model with a Mask RCNN algorithm.

Which is fed animal photos with labeling.This will enable the model to detect and recognize an animal. In this project we will be concentrating on a single species of animal like elephant.

Since elephants are poached on the regular basis for the trading, meat, tusks, industry and the entertainment uses, it is necessary to take required precautions and the prevention measures to save the elephants from the poaching and the species like elephant to prevent it from the extinction

Detecting animal intrusion using image processing will help the system to send out an alert to the residents nearby and take precautions. This kind of real time alert can avoid animal accidents and also can help the residents take quick actions to solve the situation.

Keywords—Animal-intrusion- Mask R CNN- detection-human -animal-conflict.

I. Introduction

With rapid increase in deforestation and depletion ecosystems animals are finding it hard to live in its natural habitat, there are numerous incidents that take place where animals get out of their enclosure in search of food.

These incidents almost always end by the animals getting hurt due to the voluntary action by the humans or by the animals getting in the middle of a dangerous human activity. So, we came up with the idea of creating an animal intrusion detection using image processing as a solution.
With growing security systems, it is easy to find cctv cameras in every establishment. Even if there are no cameras, installing one does not cost you much. These optical systems capture intrusion and keep your belongings safe. But along with capturing intrusion it can also be made to detect animal or human intrusion.

Detecting animal intrusion using image processing will help the system to send out an alert to the residents nearby and take precautions. This kind of real time alert can avoid animal accidents and also can help the residents take quick actions to solve the situation.

II. Literature survey

1. Mark O. Afolabi, Idowu and A. Olalekan, “Design and Implementation of Farm Monitoring and Security System”, International Journal of Computer Applications (0975 – 8887) Volume 181 – No. 9, August 2018

In this Project, the author proposed an alarm system which mainly scares ruffians to leave the field. If the ruffian is present for more period by GSM message is sent to glazier by saying that some ruffian or fowl is in the field. The other attribute is that metallic sensor which provides information to glaze those who invade the field.

2. S Jeevitha and Dr. Venkatesh Kumar, “A Review of Animal Intrusion Detection System”, International Journal of Engineering Research **&** Technology (IJERT) Vol. 9 Issue 05, May-2020.

In this Project, the author proposed an animal intrusion alert system that can be used with wireless sensors and sends an automatic alert message to the landowner also to forest officials with an image. This can make early warning notification to take a suitable action depending on the type of intruder. The sensor will detect the movement of the animal and the camera will capture the image, using image processing techniques the captured image is classified via a

microcontroller, then GSM module will send the alert notification SMS to the forest department or the landowner.

3.Saieshwar Radhakrishnan, Ramanathan.R, “A Support Vector Machine with Gabor Features for Animal Intrusion Detection in Agriculture Fields”, 8th International Conference on Advances in Computing and Communication (ICACC-2018)

In this project, the author suggested an image processing and machine learning approach for detecting animal infiltration. A picture of an animal is divided using a watershed approach to obtain various elements from the image and to see if any threat animals are discovered during segmentation. Once the specified zone meets other markers does this algorithm build a barrier, which is the contour. The Gabor filter is widely employed in extracting a text-rich region in order to recognise facial expressions at different frequencies. The supervised learning algorithm Linear SVM is used to train the dataset and classify text and hypertext. This technique of animal infiltration detection has a 54.32 percent overall success rate.

4. K. Jai Santhoshi, Bhavana. S, “Intruder recognition in a farm through wireless sensor network”, International Journal of Advance Research, Ideas and Innovations in Technology et al 2018 (Volume 4, Issue 3)

The author proposed using wireless sensor network (WSN) technology to detect intrusions in agriculture in this project. The motion sensor is installed in different places to detect movement and communicate with the organiser through radio frequency transceiver. When the detection level rises, the organiser uses the Global System for Mobile (GSM) module to send an alert call to the farm owner's mobile phone. An Arduino board is mounted near the centralised sensor, and the GSM module, along with buzzers and an RFID transmitter, will serve as the interface. Radio-frequency identification (RFID) tags are used to distinguish between allowed and unlawful access in agriculture.

5. Sahane Pradnya Sambhaji, Salunke Nikita Sanjiv and Shirsath Vitthal Somnath, “Early Warning System for Detection of Harmful Animals using IOT”, International Journal of Advance Research and Innovative Ideas in Education Vol-5 Issue-3 2019

The author proposed an IOT-based dangerous animal early warning system in this project. To begin, keep the database of dangerous animals in a computer system or cloud that is already attached to an IoT model with various sensors. Only if there is any movement of animals in the school area, images are collected with a web camera, and the computer system compares the moving image to a database image, triggering the Arduino Uno programming procedure. After the animal is spotted, it sounds the alarm and sends an SMS to the user's phone.

6. Sheela., Shivaram. K. R, Chaitra, Kshama, Sneha , Supriya, “Low Cost Alert System for Monitoring the Wildlife from Entering the Human Populated Areas Using IOT Devices” International Journal of Innovative Research in Science, Engineering and Technology Vol. 5, Special Issue 10, May 2016

The author proposed a low-cost alert system for monitoring animals using IOT devices in this project. The PIR sensor tower is made up of a Raspberry Pi module attached to a USB camera that captures photos when motion is detected and broadcasts them over the internet to a web server. On the Raspberry Pi, OpenCV is installed for image processing. to lower the cost of electric lines, as well as in this study Each sensor tower has solar power installed; the solar panel will charge the battery from the sun and power the sensor tower. This reduces power usage and allows battery power to be stored even at night.

7. Tibor Trnovszky, Patrik Kamencay, Richard Orjesek, Miroslav Benco, Peter Sykora, “Animal Recognition System Based on Convolutional Neural Network”, Advances in Electrical and Electronic Engineering Volume:15|Number:3|2017|September

The author proposed an animal recognition strategy based on CNN in this project. A range of pre-processing methods can be used to reduce the effect of factors on the input image. Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Local Binary Pattern Histograms are examples of well-known image recognition methods that are used to distinguish calculated phases (LBPH). The proposed CNN and SVM classification methods successfully identified animal faces from the produced animal database. Convolutional Neural Networks (CNNs) are a type of Neural Network that has performed better than SVM classifiers in recognising animal faces. Various evaluated methods were implemented in MATLAB and C++/Python Programming language, and CNNs obtains overall best precision accuracy of 97 percent..

III. Proposed Work

Our solution to the problem statement which we have chosen is to build an animal intrusion detection system that alerts the user of sightings of animals in real time if it has entered the village or locality.

In this project, we have used the machine learning model which is trained using the Mask RCNN algorithm.Here the Mask RCNN is one of the region based convolutional neural networks with respect to the image segmentation and it was developed on the top of Faster RCNN. And the multiple classes can be accommodated by the Mask RCNN algorithm. And a simple working of the system is given below. As said earlier, the model is trained using the mask RCNn network Then the video is captured frame by frame.

If the animal is detected in the video , we will be receiving a warning message via call, which is implemented with the help of Twilio. Basically it is a communication API which is used to send SMS, Voice and Video alerts. This is the basic working methodology behind this intrusion detection system and the sub topic of the project implementation is given below

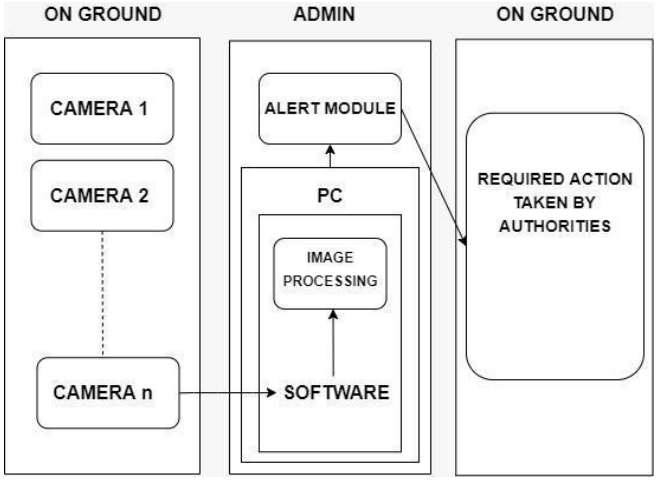


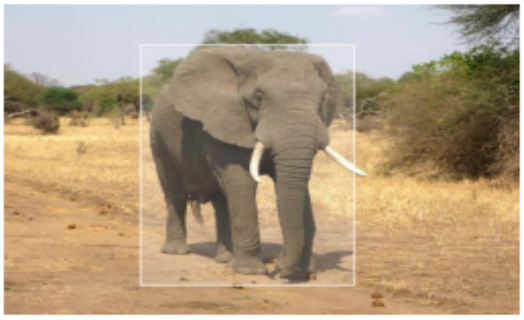
Fig 1: Proposed Methodology For Animal Intrusion Detection System

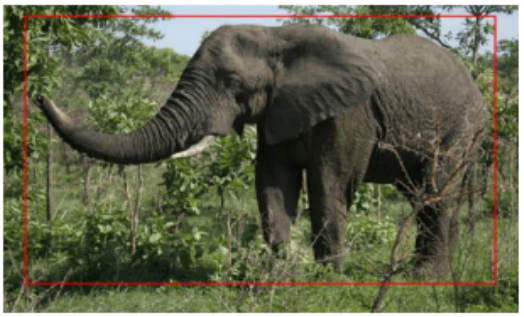
Data Collection:

To facilitate the large number of training images needed, a combination of static images were used. Video captured directly using a webcam, then it is processed frame by frame.

Labelling bounding Boxes:

Annotation was done using a heavily modified version of an open-source.The image annotation tool called make sense. This tool takes a sequence of images as
input and allows the users to annotate bounding boxes with class labels over them.





IV. EXPERIMENTAL SETUP

Hardware Specifications:

We have kept the hardware requirements to minimum to minimise the complexity of the system and also to make the project economically feasible.

1. Main System
   The computer's required specification will depend on the number of optical sensors it needs to handle. In our case the system's specification was:
   - Ram : 16 GB
   - Intel core i7 10th gen
   - Nvidia Geforce MX250

   This system was enough for a single optical sensor and a single thread program but in real time scenario, we will require multiple optical sensors that will execute a multithreaded program since we will be working with multiple cameras.A main frame like system would be ideal to handle the same.

2. Optical Sensor:
   Basic camera trap features:

- Still resolution: 30MP
- Video resolution: 4K
- Video length: Up to 180 seconds Data storage:
- SD or SDHC up to 32GB
- LCD: Yes
- Power: AA batteries
- Wireless: Yes/No

Software Specifications:

The software requirements for this animal intrusion detection system is listed below:

1. Twilio

Twilio is a messaging API to send and receive SMS, MMS, OTT messages globally. It uses intelligent sending features to ensure messages reliably reach end users wherever they are.

2. MATTERPORT:

This is an implementation of Mask R-CNN on Python 3, Keras, and TensorFlow. The model generates bounding boxes and segmentation masks for each instance of an object in the image.

3.TKINTER:

The user interface for this project is done using the tkinter. Tkinter is a graphical user interface (GUI) module for Python. We can make desktop apps with Python. We can make windows, buttons, show text and images amongst other things.Tk and Tkinter apps can run on most Unix platforms.

4.PYTHON:

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language

V. IMPLEMENTATION OF THE SYSTEM

In the proposed system the implementation can be understood in three different modules or stages. They are as discussed below:

Capture Module:

On clicking on the start button in the front end interface, all the CCTVs linked to the software will get activated. They will simultaneously be continuously capturing scenes from the environment that they are placed in which may or may not capture any elephant approaching the boundaries, assuming the cameras are placed in the boundary perimeter of the forest region.

Detection Module:

The matterport (Mask RCNN) model loaded with pretrained ms coco weights successfully recognizes the elephants that are captured in the frame that is capable of recognizing 80 classes and elephant is one of them..Opencv is used for capturing frames or images of environment through an optical systemThe captured frames are then checked for elephant using the model's built in function "detect".The detect function provides us with bounding boxes, masks, class id and other information from the image. The result is checked for the class labels found in the frame, if it contains elephants the image is masked and given as output.On detection of the elephant by the application the alert module will be triggered.

Alert Module:

Once the elephant is detected the twilio api is called to initiate a call to the respective authority, the call plays a recorded message which was passed to the api function in the form of a cloud hosted xml file. THe program also throws an alert box on the screen to notify the front user.

VI. RESULTS AND DISCUSSION:

From a technical point of view the results obtained are the alert messages and the calls and the captured images getting stored in the logs(in the local device) on detecting an elephant.The Application will continue to run until its stopped manually (by clicking on the quit button) or forced quit.The frames are captured with a lag of maximum of 5 secs. In comparison to the studied research papers and published works we have proposed to eliminate the two dependent sensors that are not continually functioning and are triggered by the movement of the animal or by any other form of gesture. Since we propose only a single detection mechanism that will be functioning continually without the trigger we would like to primarily focus on the accuracy aspect.The results we would like to notice on a larger scale in improvements made to get better results and actually make a difference socially.

VII. CONCLUSION AND FUTURE WORK:

The proposed solution for the Animal intrusion detection system presents a cost-effective, reliable and technically simple solution. This approach believes that by eliminating sensors that add no value to the system and by keeping the optical sensor active all the time the environmental balance can be achieved by saving the wild animals from getting harmed. The proposed method is also easy to implement and environment friendly. It can save human life and property. In the future we aim to expand this project by adding more training classes that will help increase the accuracy. We are also looking to use the captured masked images of elephants detected from the live feed which we are now storing in the logs, to train the model to get better results. We would also like to dive into the math of how long it takes for the alert message and call to reach the authorities via the network and propose a camera positioning design while considering the capturing range.

References

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[3] Saieshwar Radhakrishnan, Ramanathan.R, “A Support Vector Machine with Gabor Features for Animal Intrusion Detection in Agriculture Fields”, 8th International Conference on Advances in Computing and Communication (ICACC-2018)

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