Forest Guard-A Smart and Scalable Solution to Antipoaching

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Abstract— Poaching in today's world is a significant threat to wildlife. Different methods were pursued to capture animals. Many commercial poachers use military-grade weapons along with arrows and spears to hunt wildlife. Sometimes, objects called snares are also implemented. Our aim here is to provide a new and profitable solution that operates in real-time to pursue the cause of wildlife conservation by preventing the poaching of endangered animals by profit-hungry poachers and thereby preventing man-animal conflict. The solution involves an edge computing unit and camera sensors. Object detection is done on the live -image feed captured by the cameras deployed on the forests by Raspberry Pi which acts here as an edge computing unit. If the weapons used by the poachers are detected on the images, a message alert can be immediately sent to the patrolmen and to the concerned officials via mobile app or via social media platforms like twitter and telegram thereby alerting forest authorities to any suspicious crime.

Keywords – Antipoaching, Raspberry Pi, Camera module

1. I.INTRODUCTION

In today's world, poaching is one of the biggest threats to wildlife. Here, a new solution based on Internet of Things (IoT) is proposed to prevent profit-hungry poachers from poaching animals - endangered or non-endangered - in real-time. In contrast to previous methods in the same domain, it offers an alternative approach in the form of a monitoring system that can detect poaching activity, predict poacher behavior, and alert forest authorities to suspicious activities.There is presented a new system of anti-poaching involving image sensors (i.e. RGB cameras) and a remote computing unit (i.e. Raspberry Pi) to process complex machine learning computation on the unit itself and a central computer system to transmit data. If any suspicious activity is detected, a machine learning algorithm is implemented on the device, which triggers three actions.

The first action is that the computing unit will send a notification to the central computer system, the second action is that through internet medium, a text notification will be sent to wildlife conservation officers alerting them about illegal events in the area and the third action is that the frames will also be sent to the central computer system to be transmitted to the wildlife conservation officers and hence providing them with the live stream of the events.To prevent poaching incidents due to a lack of security and

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ignorance and to create a safe haven for wildlife, this proposed method is brought into the picture. Complete poaching prevention is unavoidable but at least the impacts can be reduced. Usually poaching is prevented by the constant vigilance of the forest guards both at the restricted zones and also at the borders. One cannot always prevent poaching in real time as poachers are elusive to catch. Even if the poachers are caught, sometimes it may be too late to save the wildlife.

To prevent such incidents, additional technologies can be used. The sensors and the edge computing unit can help us in providing prevention from poaching incidents. Provided the preventive measures, if theactivity occurs, it could be detected and reported to the patrolmen and department officials nearby. This would automate the detection of poaching incidents and thus help in saving life of animals.

2. LITERATURE SURVEY

Mate Kristo[1] et.al in this the system is able to detect the object such as weather conditions during night with the help of thermal images by using deep learning. Due to the ability to use at night and in weather conditions where RGB cameras do not perform well, thermal cameras have become an important component of video surveillance system.In this paper, investigated the task of automatic person detection in thermal images using convolutional neural network model originally intended for detection in RGB images

In comparison to other object detectors such as R-CNO,SSND in RGB images ,the YOLOV3 gives best performance as the video was also recorded at night in weather rain ,fog at different ranges with different movement types. YOLO object detector uses single pass to detect the potential region in the image where certain objects are present and classify those regions into object class. Finally in this paper, among the performance of common deep learning methods successful suitable for object detection in RGB visual images on thermal surveillance by using proper detector for detection of humans in thermal images , we selected YOLOV3 because the YOLO V3 model achieves excellent detection in RGB images.

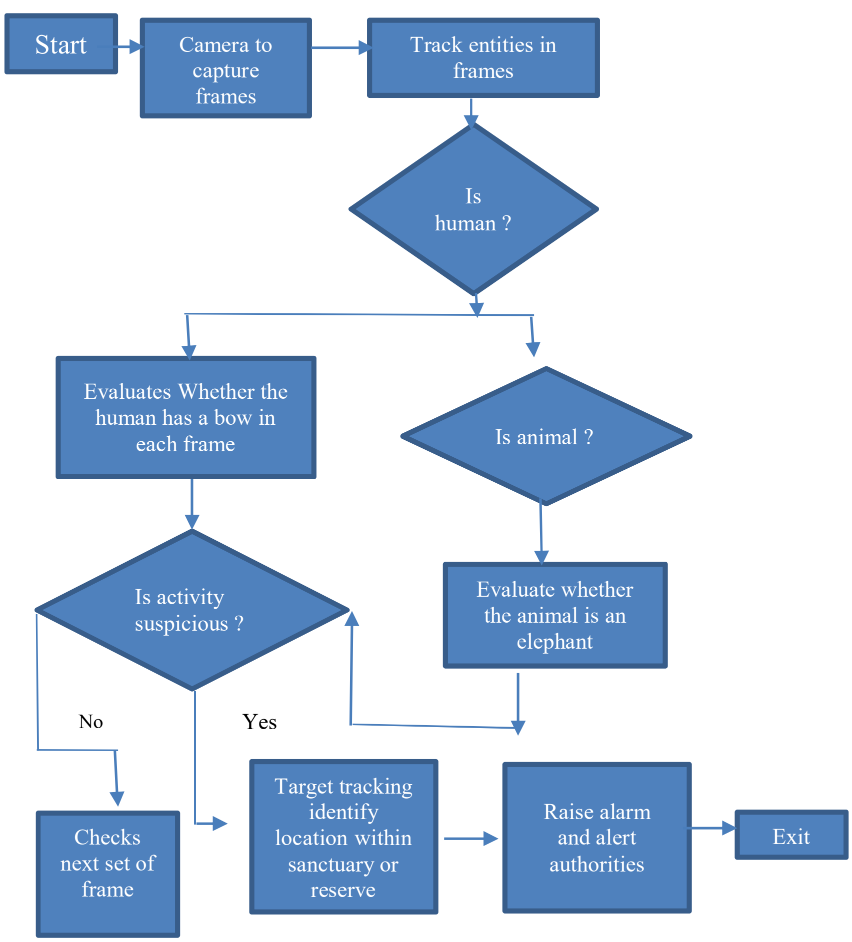
Prof Shilpa K,C[2] et.al in this uses the discipline of Internet of things and wireless sensor Network to obtain client-server module. It represents two different real time entities as “Tree” and “Animal” section with similar working but with different sensors. In case of “Tree” section, DHTII which is both humidity and Temperature sensor, vibrate and tilt sensors is used to identify the motion of tree during sawing using MEMS and flame sensors to identify forest fire. In “Animal” section, RFID tag to track the object attached to it, temperature sensors for reading the health of animals are all connected to node MCU. All the sensors are connected to this module and data received by the client can be processed to produce message. Node connects with the nearest server, at last sending the collected data to the concerned authorities along with the node location using GPS module via the internet

W Rahmaniar[3] et.al In this human detection is carried out using deep learning that has developed rapidly and achieved success in various object detection and implementations. NVIDIA Jetson was chosen as a low-power system designed to accelerate deep learning applications. This review highlights the performance of human detection models such as Ped Net, multiplied, SSD Mobile Net V1, SSD Mobile Net V2, and SSD inception V2 on edge computing. This survey provides an overview of these methods and it compares their performance in accuracy and computation time for real-time applications. The results show that the SSD Mobile Net V2 model provides the highest accuracy with the fastest computation time compared to other models in our video datasets with several scenarios.

Vidya Zope[4] et.al this paper suggest a new solution that operates in real time to pursue the cause of wildlife conversation by preventing the poaching of any species of animals with the help of artificial intelligence and the internet of things. It presents in the form of a monitoring system that can track and predict the poacher's behavior and alert forest authorities for suspicious crime. In this paper, they are using a computing module to receive the data (video frames) from the camera module and detect whether the person is in a poaching state or not. Here Raspberry Pi version 3 toolkit and Intel Movidius Neural Compute stick which is the vision processing unit is used so that the model performs computation on real-time data and alerts the forest rangers to immediately monitor the area.

Finally, the system is trained using machine learning and can detect the poachers in live video feed that allows a live action recognition of the poachers. This method provides a better solution than rangers personally patrolling the area.In the Prevention of elephants from entering in to farms, detection of elephant sounds plays an important role. From the research made, it is clear that elephant sounds are infrasonic sounds. Therefore, here elephant signals are considered as infrasound and hence infrasonic detectors and acoustic sensors are used for detection. Once the elephant is detected, the system will be switched ON and the sounds like honeybee sounds and natural calamities sounds can be propagated through air and ground. Bees are known to be attracted to the water around elephant's eyes and when they get into their trunks, elephants can go berserk.

3. BLOCK DIAGRAM OF THE PROPOSED SYSTEM



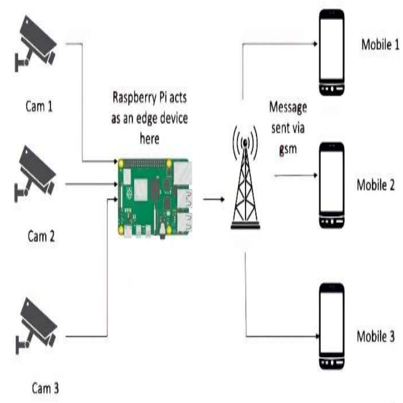


Figure 1. (a) and Figure 1. (b) The Block Diagrams of The Proposed System.

4. SYSTEM DESIGN AND DESCRIPTION

4.1 RASPBERRY PI

In the popular Raspberry Pi range of computers, the most recent model is the Raspberry Pi 4 Model B.It offers ground- breaking increase in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PCs. This product's key features include a high-performance 64-bit quad-core processor, dual-display support at a resolution up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on). The dual-band wireless LAN and Bluetooth have modular compliance certification, allowing the board to be designed into end products with significantly reduced compliance testing, improving both cost and time to market. Raspberry Pi support various programming languages such as Python, C, C ++. BASIC, Perl and Ruby. It has 8 GB LPDDRA3200 SDRAM, Cortex-A72(ARM v8) 64 bit at 1.5 GHZ, Bluetooth 5.0, BLE, Wi-Fi: 2.4 GHz and 5.0 GHz IEEE 802.11ac ,2 USB 3.0 ports;2 USB 2.0 ports, gigabit ether net and 2x micro - HDMI ports (up to 4kp60 supported), pi micro SD Card slot storage and 5.1V3A USB type c power supply.

4.2 CAMERA MODULE

Raspberry Pi Camera Module it has high definition camera module compatible with all Raspberry Pi models. This ultra-small, lightweight device captures images with high sensitivity, low crosstalk, and low noise. Camera modules are connected to Raspberry Pi boards using the CSI connector. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the processor.Fig.2 shows the camera module.

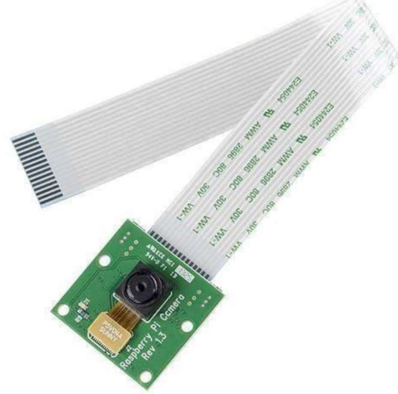


Figure 2. Camera module

5.RESULT

The hardware setups of Raspberry pi to detect the poacher and animals will be discussed here. The observed results and circuit connection will be mentioned here. The assistant system will help patrol authorities to detect the illegal activities thereby preventing poaching.The hardware setup shown in Figure.3

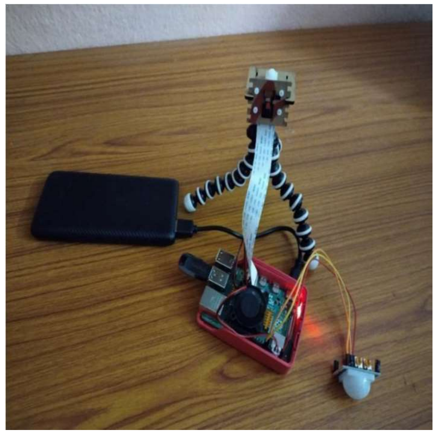


Figure 3. Hardware setup

Images of guns, humans and animals like elephant are taken and labelled accordingly. These images will help train the image recognition model for the specific use case.As the goal here is to detect the presence of a person or an animal or a weapon in the picture, the image data set must contain weapons like guns, humans and animals. For this purpose, about 200 photos of a toy gun, humans and an elephant are taken and downloaded and an image dataset is created as shown in Figure.4.The image dataset is split into training and test dataset by 80:20 ratio.

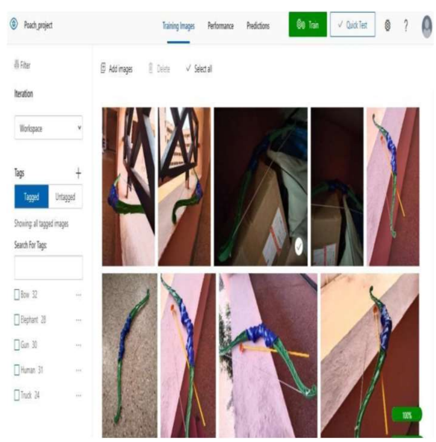


Figure 4. Training Dataset

The procedure is repeated for the rest of the photos. The model takes some time to train. Once the training time is complete, the model performance is evaluated and deployed to the edge device which is Raspberry Pi. Based on the performance statistics the model can be retrained and re-tested its shown in Figure.5

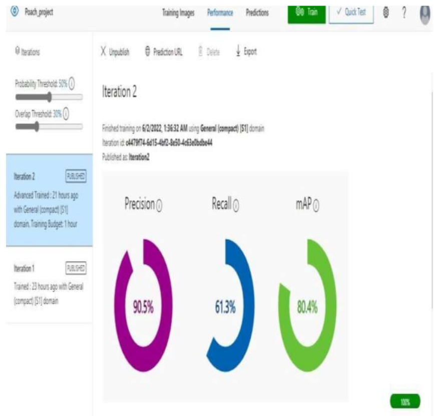


Figure 5. Performance statistics

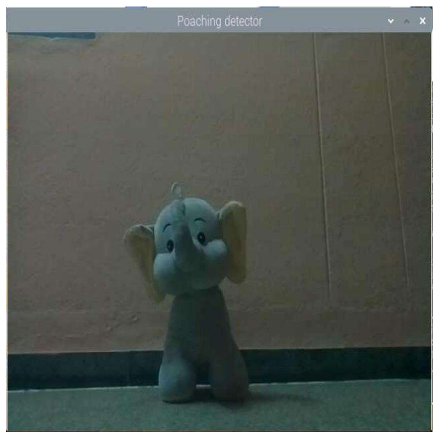


Figure 6. Image of an Elephant

Figure.6 shows the image of an elephant captured by the Pi Camera. Capturing the frames from Pi camera and fed into the model. Mobile-Net SSD algorithm is used to identify the parameters such as pixel value, size and location of the objects detected and locating the centroid of the bounded object in the image. After evaluating the parameters, the probability of occurrence of the object is calculated and the probability of the object along with the tag ID and the boundary of the object i.e the distance of the object from the centroid of the object is measured and displayed in the below Fig.7.

Figure 7. The output that detects it is an elephant

Figure 8. Image of a Human

Figure.8 shows the image of a human captured by the Pi Camera. The image is captured by capturing the frames from the Pi Camera and it is fed into the model. After evaluating the parameters, the probability of occurrence of the object is calculated and the distance of the object from the centroid of the object is measured and displayed in the below Figure.9

Figure 9. output that detects it is a Human

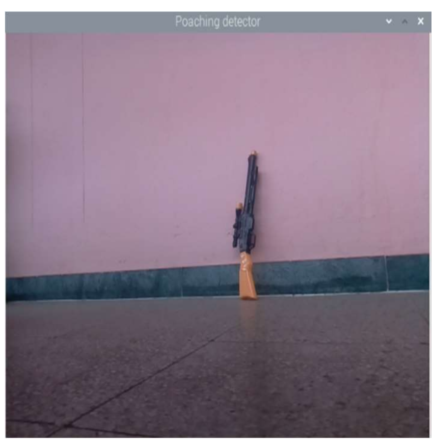


Figure 10. Image of Gun

Figure.10 shows the image of a gun captured by the Pi Camera. The image is captured by capturing the frames from the Pi Camera and it is fed into the model. After evaluating the parameters, the probability of occurrence of the object is calculated and the distance of the object from the centroid of the object is measured and displayed in below Figure.11

Figure 11. The output that detects it is a Gun

Figure 12. Image of a Bow

Figure.12 shows the image of an elephant captured by the Pi Camera. The image is captured by capturing the frames from the Pi Camera and it is fed into the model. After evaluating the parameters, the probability of occurrence of the object is calculated and the distance of the object from the centroid of the object is measured and displayed in below Figure.13

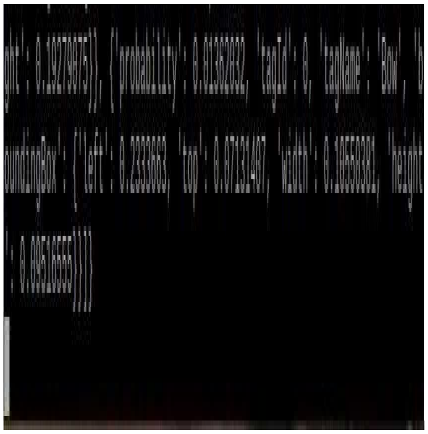


Figure 13. The output that detects it is a Bow

The Hardware setups of poaching detection and finding location are discussed. The observed results and circuit connections are mentioned. We had done the intelligent system which will help to detect the poachers and to find the location of the person.

5. CONCLUSION AND FUTURE SCOPE

The proposed system in this paper endorses a system that is far more real-time in the given situation. Many ideas and attempts worked into the system to provide the sort of performance that verifies and validates it. The scope of this project can be further extended to be Predictive analysis for determining vulnerable areas within a forest and analyzing poaching patterns. Surveillance over flocks of farm animals. Collaborate with drones for efficient tracking of poachers. Detect the person in the forest when they are lost and also speech recognition can be added. Used in detecting landslides and forest fire. The process of sending SMS alerts to the officials can also be moved to better technology.

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