SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF NETWORKING AND COMMUNICATIONS
18CSP107L - MINOR PROJECT

ANIMAL INTRUSION DETECTION SYSTEM

Mini Project

Dakshata (RA1911003010115)
Paridhi Talwar (RA1911003010116)
Batch ID: **B109**
Guide name and Designation: **Dr C Vijayakumaran,** Associate Professor, C Tech

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Project Title:

ANIMAL INTRUSION DETECTION SYSTEM

ABSTRACT

- Our solution to the problem is to build a 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 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 specie of animal like elephant

PROBLEM STATEMENT

- 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 come out of their enclosure in search of food.
- These incidents almost always end up with 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.

Proposed Methodology

Mask R-CNN

- Mask R-CNN, or Mask RCNN, is a Convolutional Neural Network (CNN) and state-of-the-art in terms of image segmentation and instance segmentation. Mask R-CNN was developed on top of Faster R-CNN, a Region-Based Convolutional Neural Network.

Working

Fast R-CNN is an improved version of R-CNN architectures with two stages:

- Region Proposal Network (RPN): RPN is simply a Neural Network that proposes multiple objects that are available within a particular image.
- Fast R-CNN: This extracts features using RoIPool (Region of Interest Pooling) from each candidate box and performs classification and bounding-box regression. RoIPool is an operation for extracting a small feature map from each RoI in detection.

- In the second stage of Faster R-CNN, RoI pool is replaced by RoIAlign which helps to preserve spatial information which gets misaligned in case of RoI pool. RoIAlign uses binary interpolation to create a feature map that is of fixed size for e.g. 7 x 7.
- The output from RoIAlign layer is then fed into Mask head, which consists of two convolution layers. It generates mask for each RoI, thus segmenting an image in pixel-to-pixel manner.

RoI Align

- Another major contribution of Mask R-CNN is the refinement of the ROI pooling.
- In ROI, the warping is digitalized. Therefore, each target cells may not be in the same size.
- Mask R-CNN uses ROI Align which does not digitalize the boundary of the cells and make every target cell to have the same size.

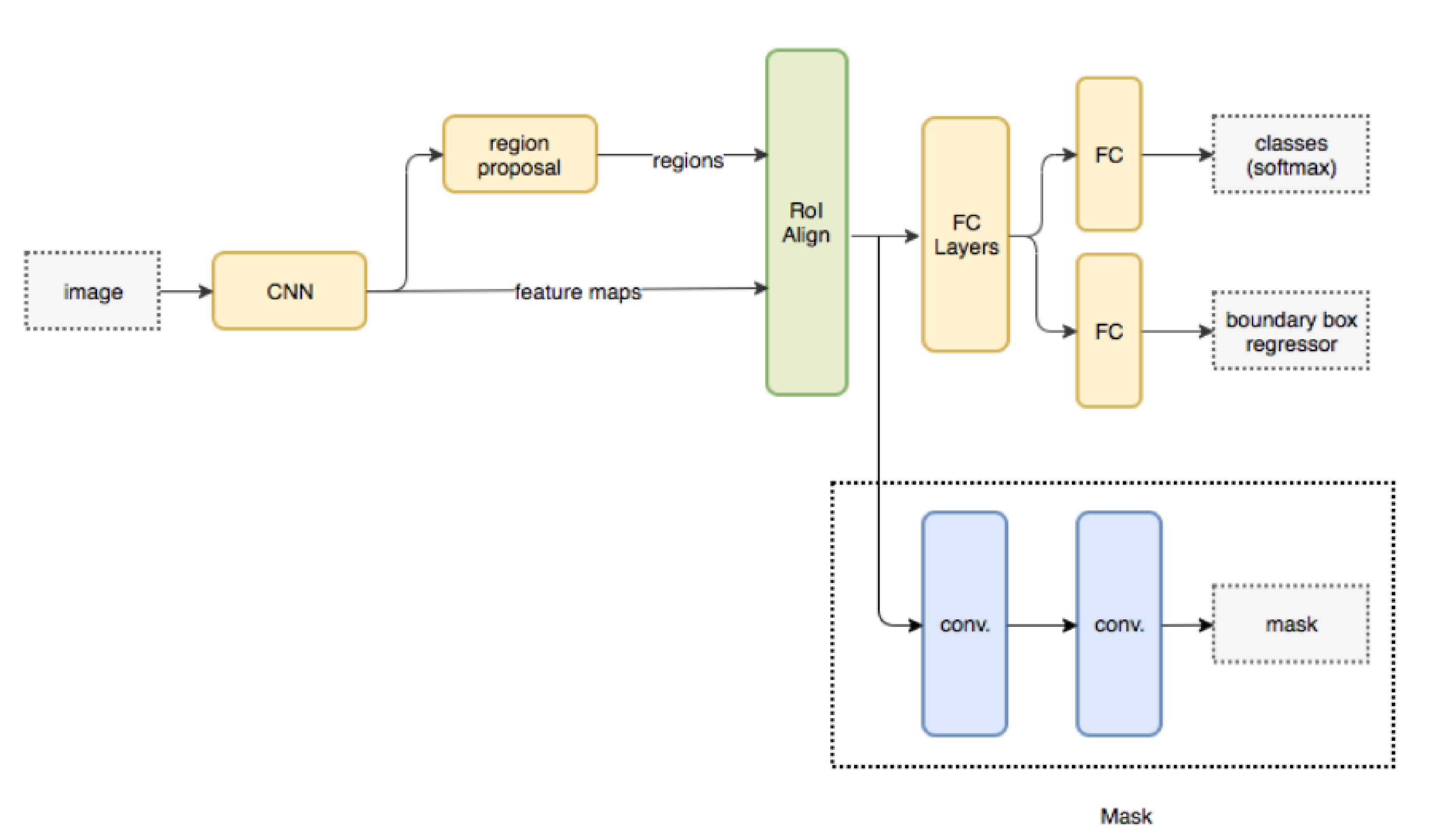
Advantages of Mask R-CNN

- Simplicity: Mask R-CNN is simple to train.
- Performance: Mask R-CNN outperforms all existing, single-model entries on every task.
- Efficiency: The method is very efficient and adds only a small overhead to Faster R-CNN.
- Flexibility: Mask R-CNN is easy to generalize to other tasks. For example, it is possible to use Mask R-CNN for human pose estimation in the same framework.

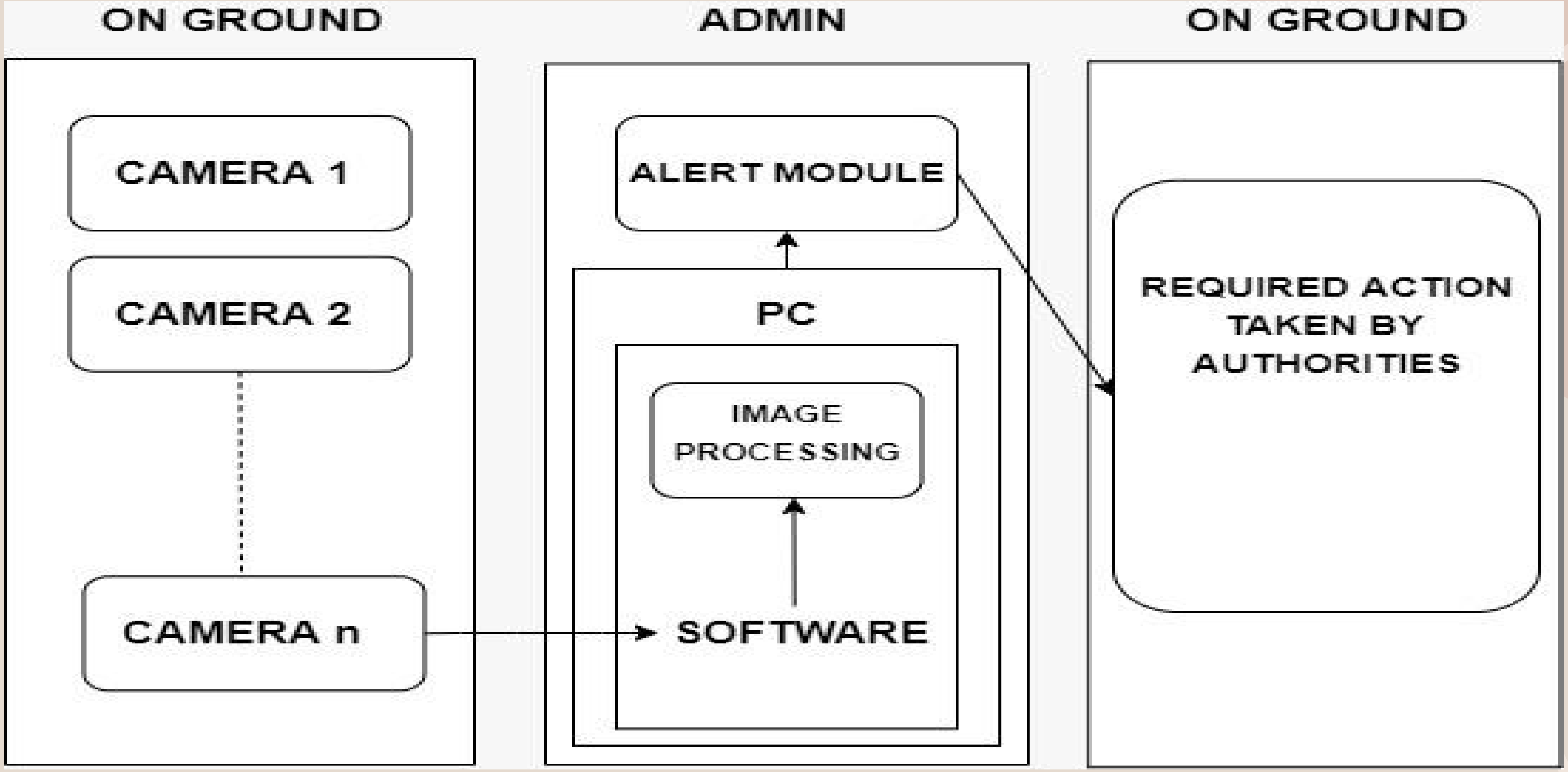
Block Diagram of the Proposed Model

Mask R-CNN

After the ROI Align, we add 2 more convolutional layers to build the mask



Working


ON GROUND
ADMIN
ON GROUND
CAMERA 1
CAMERA 2
CAMERA n
ALERT MODULE
PC
IMAGE PROCESSING
SOFTWARE
REQUIRED ACTION TAKEN BY AUTHORITIES

Hardware Specifications

We have kept the hardware requirements to minimum to minimize 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 (graphics card)
- 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(secure digital) or SDHC(high capacity): up to 32GB (storage cards)
- LCD: Yes
- Power: AA batteries
- Wireless: Yes/No

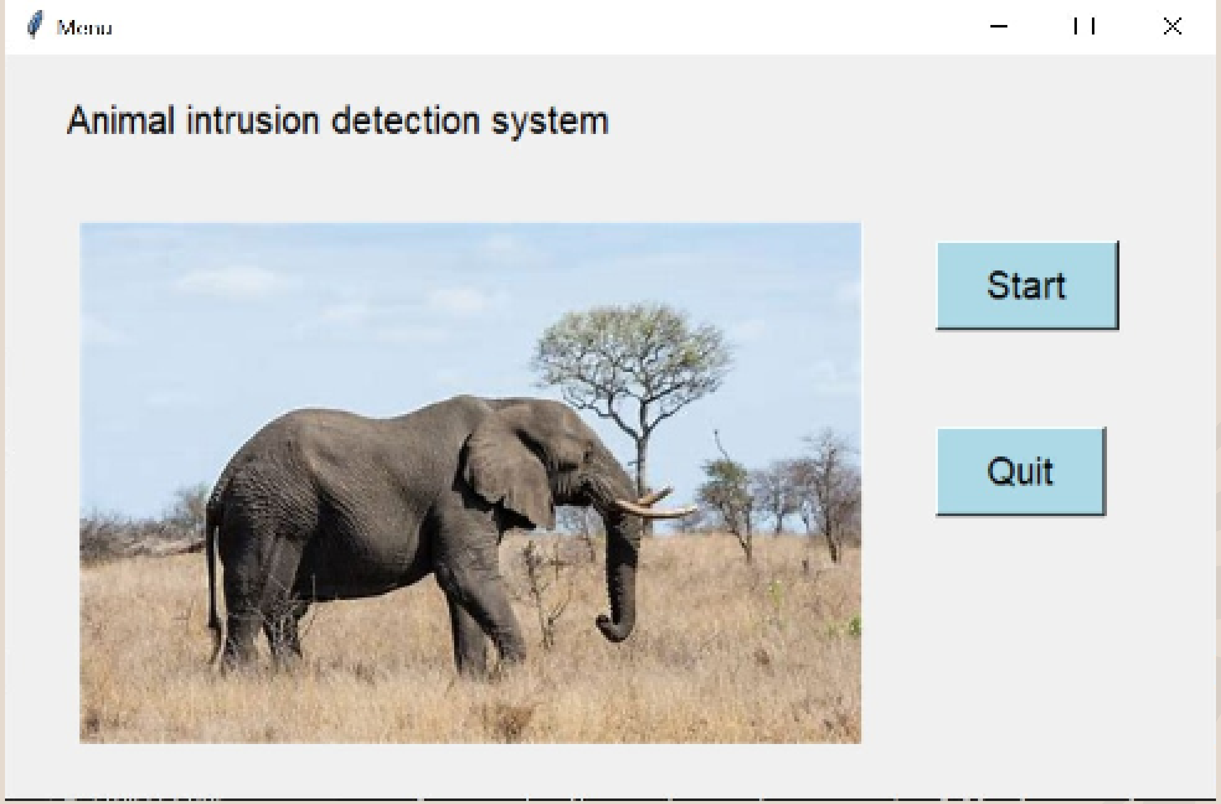
Software Specifications

1. **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.
2. **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.
3. **Python**: Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language.

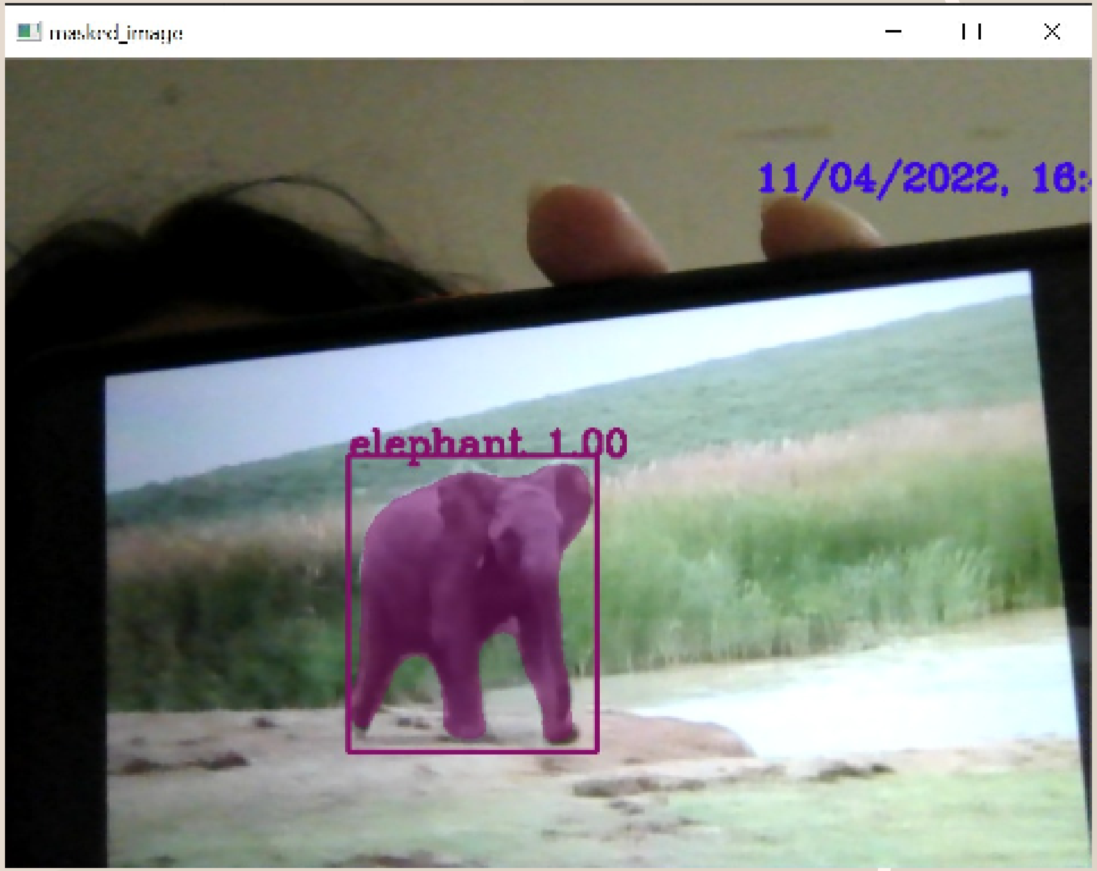
Module Implementation

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

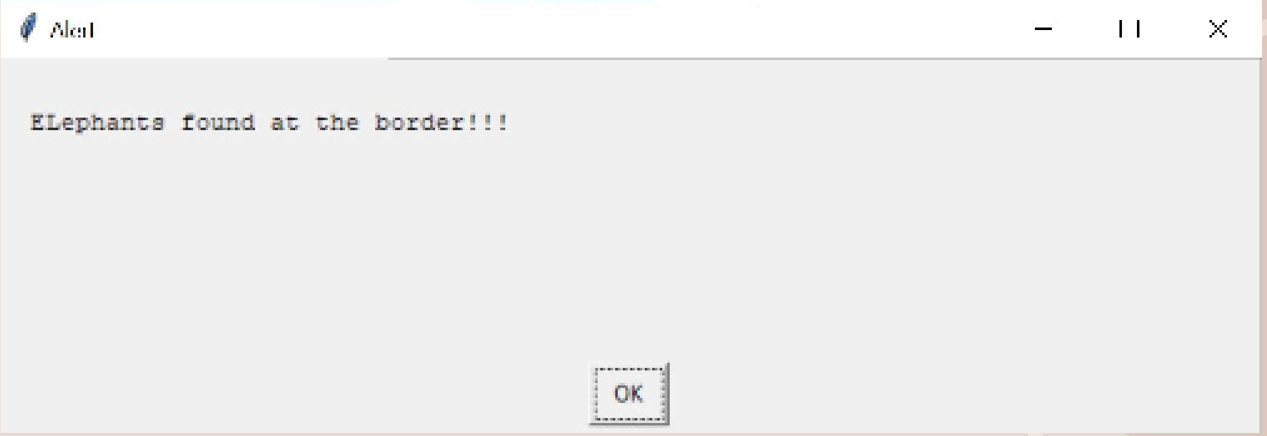
1. **<u>Capture Module:</u>** On clicking on the start button in the front end interface, all the laptop camera linked to the software will get activated. They will simultaneously be continuously capturing scenes from the environment that they are placed in which may or may not capture any elephant approaching the boundaries, assuming the cameras are placed in the boundary perimeter of the forest region.



2. **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 system. The 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.



3. **Alert Module:**
   Once the elephant is detected the program also throws an alert box on the screen to notify the front user.

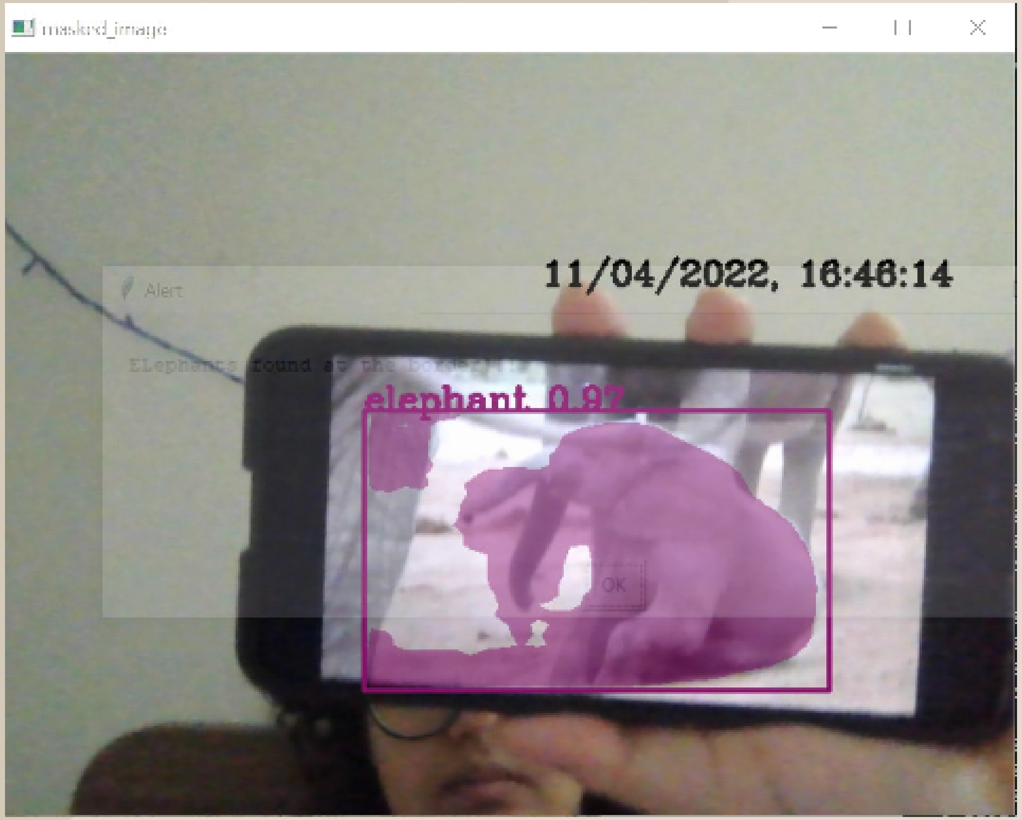


ELephants found at the border!!!

Results

- 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 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.

Output Screenshots



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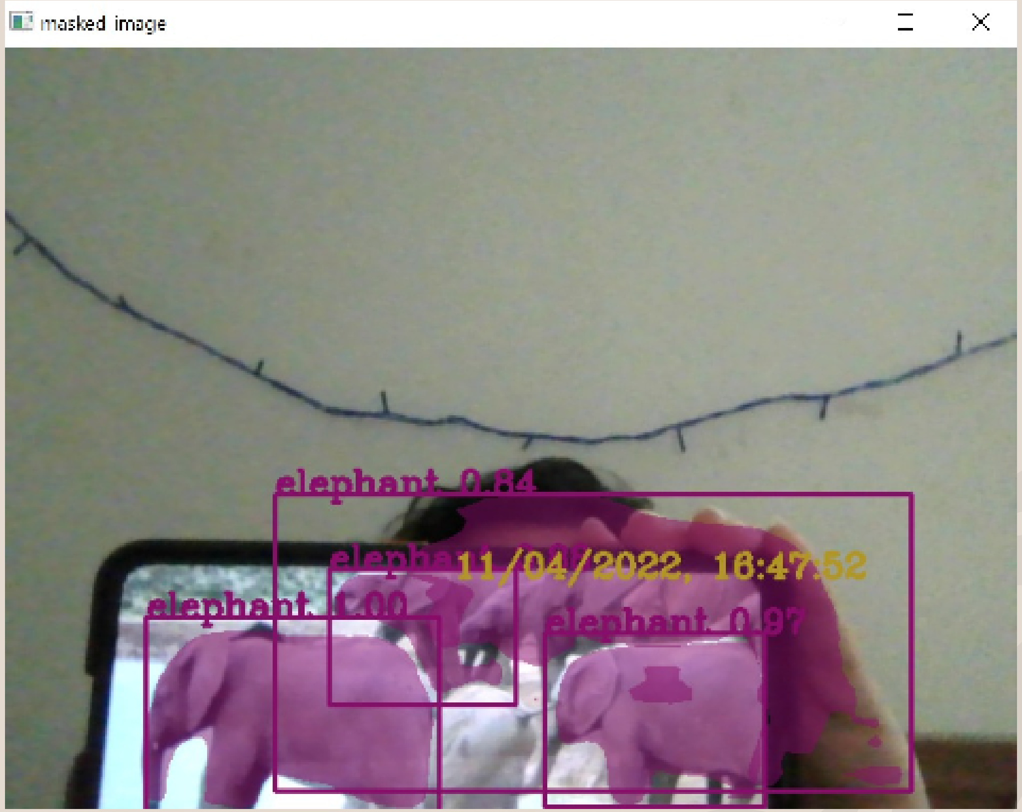
ELephants found at the border!!



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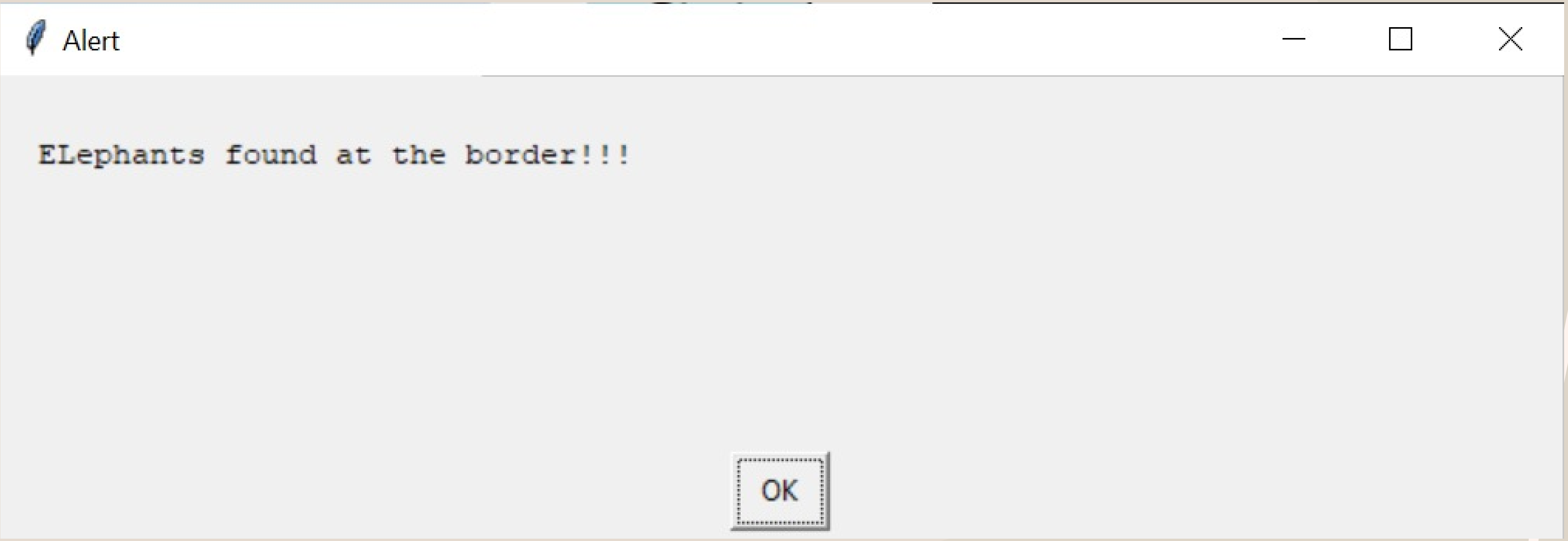
Output



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ELephants found at the border!!!
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References

1. https://jonathan-hui.medium.com/image-segmentation-with-mask-r-cnn-ebe6d793272
2. 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
3. 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.
4. https://www.academia.edu/download/63543892/a-review-of-animal-intrusion-detection-system-IJERTV9IS05035120200606-13077-16t1bbl.pdf
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
6. 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)
7. http://www.ijfcc.org/papers/7-T024.pdf

8. Angadi, S., Katagall, R.: Agrivigilance: a security system for intrusion detection in agriculture using raspberry pi and openCV. Int. J. Sci. Technol. Res. 8(11), 1260–1267 (2019)
9. Körschens, M., Denzler, J.: Elpephants: a fine-grained dataset for elephant re-identification. In: 2019 IEEE/CVF International Conference on Computer Vision Workshop (ICCVW), pp. 263–270, October 2019. https://doi.org/10.1109/ICCVW.2019.00035
10. Körschens, M., Barz, B., Denzler, J.: Towards automatic identification of elephants in the wild. arXiv preprint arXiv:1812.04418 (2018)
11. Ravoor, P.C., Sudarshan, T.S.B.: Deep learning methods for multi-species animal re-identification and tracking - a survey. Comput. Sci. Rev. 38, 100289 (2020). https://doi.org/10.1016/j.cosrev.2020.100289
12. Xue, W., Jiang, T., Shi, J.: Animal intrusion detection based on convolutional neural network. In: 2017 17th International Symposium on Communications and Information Technologies (ISCIT), pp. 1–5 (2017). https://doi.org/10.1109/ISCIT.2017.8261234
13. https://www.researchgate.net/profile/Simantika-Choudhury/publication/344665715_Recent_Trends_in_Learning_Based_Techniques_for_Human_and_Animal_Detection/links/5f87f70c299bf1b53e28e794/Recent-Trends-in-Learning-Based-Techniques-for-Human-and-Animal-Detection.pdf

Thank you