

Species Classification Wireless Camera for Forest Survey and Monitoring

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ABSTRACT-Continuous hunting as driven a lot of animal species to extinction and the Government has brought about little change apart from introducing a few laws and conducting a few surveys. But conducting surveys is an exceptionally difficult task, especially without the help of technology. To remedy this, we are going to make a prototype Species Classification wireless camera that can help us in the monitoring and surveillance of forests. Our smart camera uses a python-based code that consists of pre-trained TensorFlow models. The pre-trained tensor models help us in matching and mapping the image in frame with the model's trained data to detect the image in the frame. The system will be equipped with a Raspberry Pi Single Board Computer, RPi cameramodule and a power bank for the power source. The complete system can be mounted on drones for survey or multiple systems can be mounted on different locations in the forest and can be connected to a centralized system for remote survey data acquisition via the Raspberry Pi's built in WiFi module.

I. INTRODUCTION

The system is based on Raspberry Pi 3 B+ Single Board Computer Module designed and manufactured by Raspberry Pi Foundation U.K., which is a credit card sized SBC equipped with an ARM CPU and can run various operating systems such as Raspbian, Ubuntu, Windows 10, Android etc.

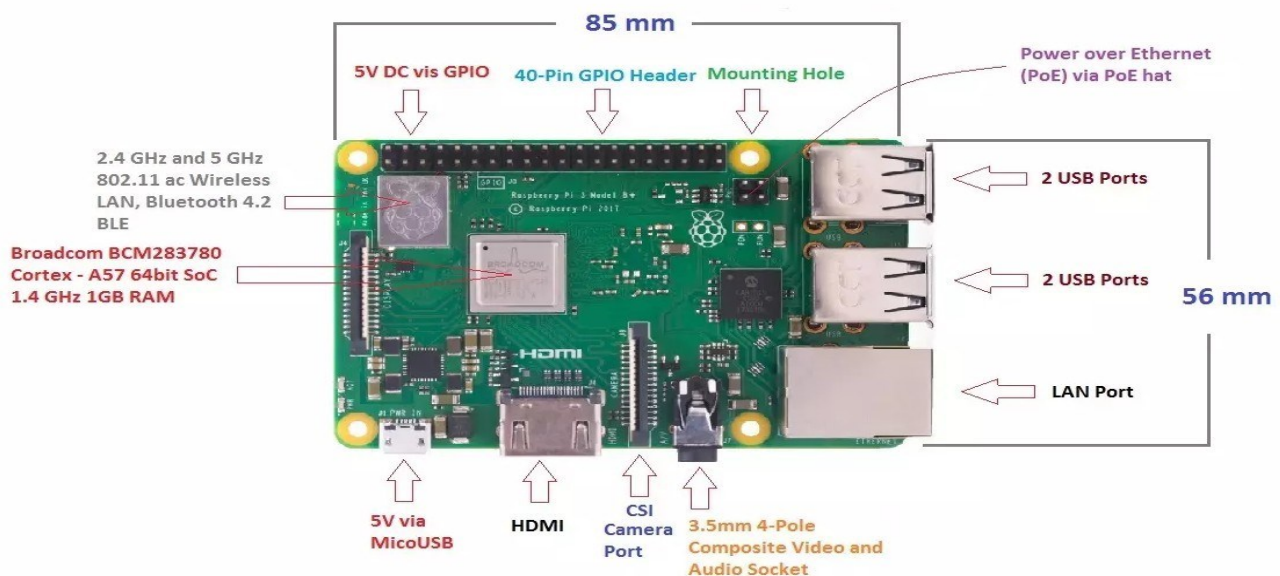


Fig. 2 Raspberry Pi 3 B+ Single Board Computer [1]



Raspberry Pi 3 B+ was introduced by Raspberry Pi foundation on 14th March 2018. It is an advanced version of Raspberry Pi 3 B model that was introduced in 2016. It is a tiny computer board that comes with CPU, GPU, USB ports, I/O pins, WiFi, Bluetooth, USB and network boot and is capable of doing some functions like a regular computer. Features of the B+ version are almost same as B model; however, USB and Network Boot and Power over Ethernet facility only come with B+ model. Also, two extra USB ports are added to this device. The SoC (system on chip) combines both CPU and GPU on a single package and turns out to be faster than Pi 2 and Pi 3 models. The model B+ stays ahead in terms of processing speed and comes with an improved wireless capability. The dual-band WiFi 802.11ac runs at 2.4GHz and 5GHz and provides a better range in wireless challenging environments and Bluetooth 4.2 is available with BLE support. The top side is painted with metal shielding, instead of plastic in the earlier models, that acts as a heat sink and drains the excessive amount of heat if the board is subjected to the high temperature or pressure.

2. LITERATURE SURVEY

[1] **Wildlife Animal Location Detection And Health Monitoring System** - The system consists of a PIC microcontroller (PIC 18F452) in the heart of the circuit, connected to the GPS module for the location of the animal and to the Pulse and Temperature sensors for its health. Also, a battery is connected for the supply of power and a Wi-Fi module which will send data to the Android application on the phone.

[2] **Wildlife monitoring system using zigbee** - The main objective of this project is to protect wildlife within park boundaries. To passively support the conservation of native animals using low cost engineering technology and animal welfare. In this project temperature sensor used to monitor health of animals. To track the location of animals GPS system used. Temperature and location will be display on LCD and also this data send to particular mobile using Bluetooth.

[3] **Drone-Assisted Aerial Surveys of Large Animals in Siberian Winter Forests** - The research objective was to study the potential of drone planes equipped with thermal infrared imaging cameras. Drone planes proved effective in covering large areas, while thermal infrared cameras provided accurate statistics in the harsh winter conditions of Siberia. The research featured the population of the European elk (*Alces alces*), which is gradually deteriorating due to poaching and deforestation. The surveyed territory included the Salair State Nature Reserve in the Kemerovo Region, or Kuzbass (Russia). The authors developed an effective methodology for processing the data obtained from drone-mounted thermal infrared cameras. The research provided reliable results concerning the changes in the elk population on the territory in question. The use of drone planes proved an effective means of ungulate animal survey on large areas of Siberian winter forests.

[4] **Surveying Wild Animals from Satellites, Manned Aircraft and Unmanned Aerial Systems (UASs): A Review** - This article reviews studies regarding wild animal surveys based on multiple platforms, including satellites, manned aircraft, and unmanned aircraft systems (UASs), and focuses on the data used, animal detection methods, and their accuracies.

[5] **IOT BASED ANIMAL TRACKING AND MONITORING SYSTEM IN ZOO** - The goal of this project is to track the location of Animal in the zoo or national parks. This system would include a temperature sensor and PIR sensor. The temperature sensor senses the temperature of

each animal and PIR sensor senses the human presence inside the animal boundaries or restricted areas. Generally every animal having particular range of body temperature. If the animal having any wounds or fever, the body temperature will be automatically increased. To monitor this, we are using temperature sensor. It continuously monitors the animal's temperature. If any variation in the temperature, It will be displayed on the LCD. The PIR sensor is used to monitor the human presence in restricted areas or nearby the animal boundaries. When the human presence is detected, the voice processor will give alert to the people through the pre-recorded voice. The GPS receiver send the location, animal temperature to the controller and it is interfaced with the IOT, It will give the complete information to the website on PC or laptop.

3. METHODOLOGY

The Raspberry Pi gets the video using the camera, then using the OpenCV module it cuts the video in frames. Next, using OpenCV and TensorFlow modules it process the image detection of the species in the image and it tries to map it with a category and pre-trained detection model. It then shows the result of the detected species. If the detected species in the image is not available in category list then it gives the output as {none} and save that image with data and timestamp in database folder so that it can later be studied. If the detected species is available in the category list, it gives the output with name and ID of detected species and saves that data in a MySQL database and at the same time saves the image with detected named label in a specified folder for reference. An additional VPN service called – Pi-Tunnel is used to remotely connect to the system from anywhere subject to internet connectivity availability at the system. So, in this way, our smart camera keeps track and creates a database with pictures of all species present in the forest. It can also be helpful in studying animal behaviour and can help us in studying the growth and flow of flora and fauna in the forest.

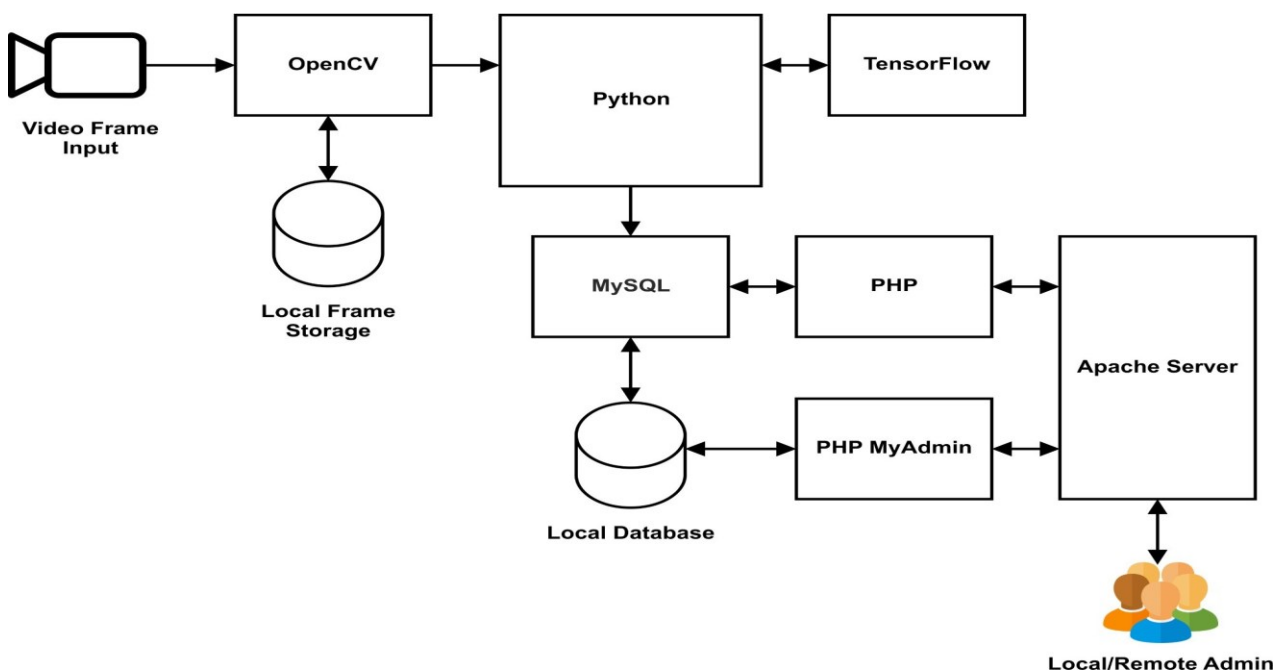


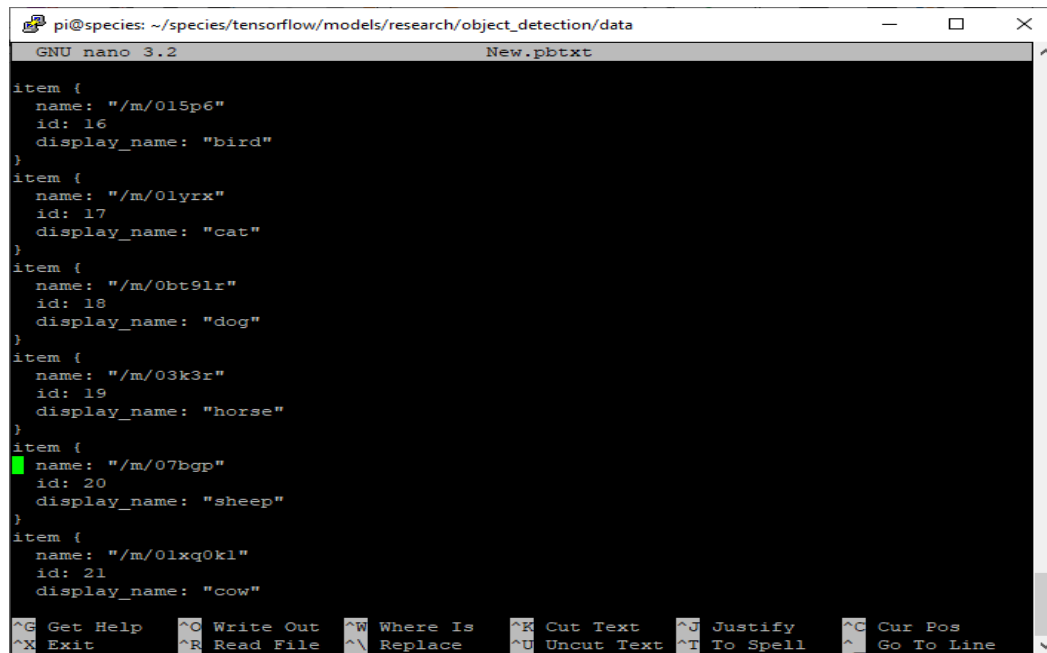
Fig. 4 Recognition, processing and output methodology.

4. PROGRAMMING

The complete system programming can be split in two different parts:

1. Python program used for species detection, classification and storage.
2. Web interface using PHP for administration and monitoring.

The python program uses the ‘picamera’ library to get video stream from the raspberry pi camera and capture a single frame which is further processed by OpenCV and TensorFlow to classify the detected object or species in the frame. We have used the `ssdlite_mobilenet_v2_coco_2018_05_09` dataset which has 90 object categories. We need to define a label file so that we can restrict the classification to our requirements, for this purpose we use `New.pbtxt` file with list of species and objects we are interested in classifying. Figure shows the contents of this file. The file should be created `/home/pi/species/tensorflow/models/research/object_detection/data` folder.



```
pi@species: ~/species/tensorflow/models/research/object_detection/data
GNU nano 3.2 New.pbtxt
item {
  name: "/m/015p6"
  id: 16
  display_name: "bird"
}
item {
  name: "/m/01yrx"
  id: 17
  display_name: "cat"
}
item {
  name: "/m/0bt9lr"
  id: 18
  display_name: "dog"
}
item {
  name: "/m/03k3r"
  id: 19
  display_name: "horse"
}
item {
  name: "/m/07b9p"
  id: 20
  display_name: "sheep"
}
item {
  name: "/m/01xq0k1"
  id: 21
  display_name: "cow"
}
```

Fig.. New.pbtxt file contents

we use the OpenCV `vis_util.visualize_boxes_and_labels_on_image_array()` function to create a boundary around the detected object or species and label the classification with detection score in % where 0 being the lowest and 100 being the highest. The detected and classified images are stored in Apache server’s root directory which is located at `/var/www/html/detected/` in JPEG image format with filenames as – `MonthName-Date-Year Hour:Minutes:Seconds (AM/PM) .jpg` e.g. - `July-28-2022- 09:53:02AM.jpg`. Fig. 30 and 31. shows the folder listing and classification result.

```
pi@species: /var/www/html/detected
pi@species: /var/www/html/detected $ ls
July-28-2022-09:53:02AM.jpg  July-28-2022-09:53:04AM.jpg
July-28-2022-09:53:03AM.jpg  July-28-2022-09:53:05AM.jpg
pi@species: /var/www/html/detected $
```

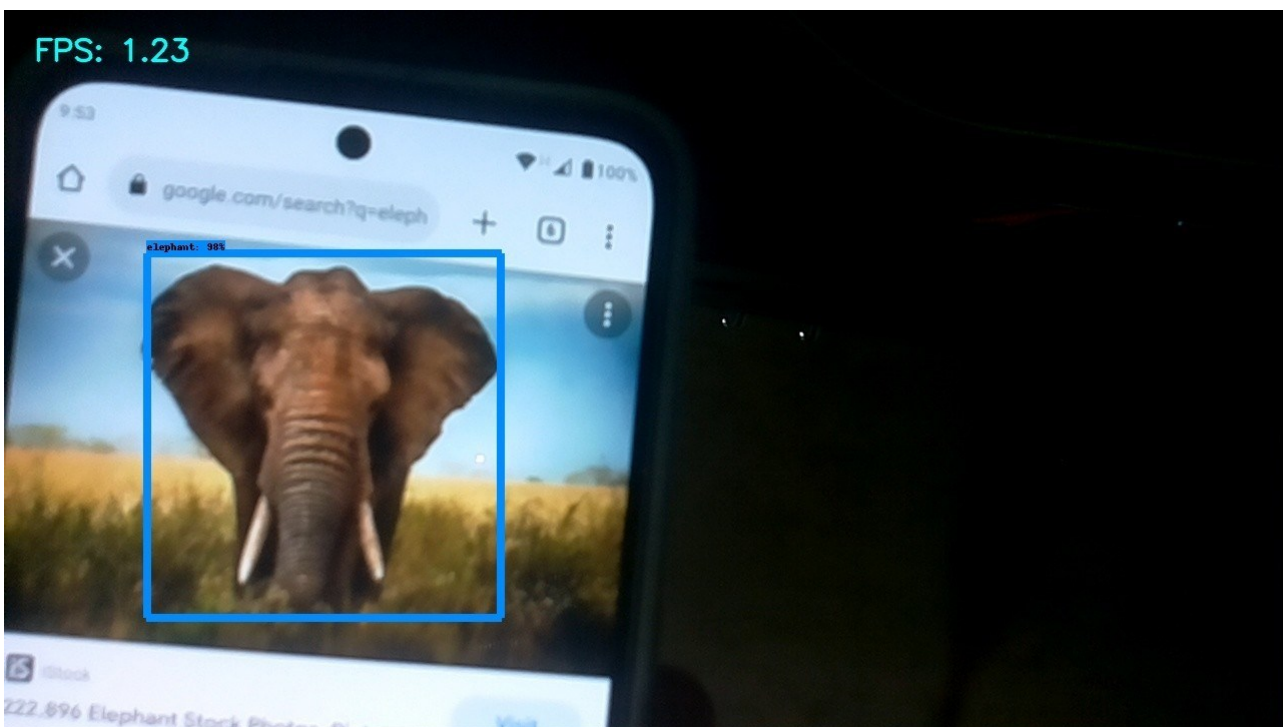


Fig. Detected and classified image of an Elephant with 98% detection score.

Before we can start storing the detected and classified images to the Apache's root directory we need to modify the folder permissions as the folder will be owned by user – www-data and we want to enable read and write access by our python program. The same is done by changing folder permissions to 777 by executing following command in the terminal.

CONCLUSION

The system designed will facilitate remote survey, classification and monitoring in a forest stand can be installed at different locations for remote survey and monitoring. Also the system can be



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installed on a drone, making it easier for wild life surveys and animal behavior studies.

FUTURE SCOPE

The system design uses a power bank for providing required DC power to the RaspberryPi SBC and the same can be upgraded to a solar powered battery backup system wherein the system will utilize solar power for its operation in the day time and as the sun light availability becomes low will get the power from backup battery which will be charged using the solar panel at day time.

The RPI camera module used currently is equipped with a standard lens and the same can be upgraded to a Tele-Lens type RPI camera with PTZ support (Pan, Tilt and Zoom), which will further make the system cover a large geographical area



REFERENCES

1. Wildlife Animal Location Detection And Health Monitoring System - ISSN (e): 2250-3021, ISSN (p): 2278-8719 Volume 6, PP 05-08, <http://www.iosrjen.org>
2. Wildlife monitoring system using zigbee - International Research Journal of Engineering and Technology (IRJET). e-ISSN: 2395-0056, p-ISSN: 2395-0072, www.irjet.net
3. Drone-Assisted Aerial Surveys of Large Animals in Siberian Winter Forests - Research Square, <https://orcid.org/0000-0002-7424-5604>
4. Surveying Wild Animals from Satellites, Manned Aircraft and Unmanned Aerial Systems (UASs): A Review - Remote Sens. 2019, 11, 1308; doi:10.3390/rs11111308 www.mdpi.com/journal/remotesensing
5. IOT BASED ANIMAL TRACKING AND MONITORING SYSTEM IN ZOO - SouthAsian Journal of Engineering and Technology Vol.3, No.2 (2017) 162–168,
6. Introduction to Raspberry Pi 3B+ - <https://www.theengineeringprojects.com/2018/07/introduction-to-raspberry-pi-3-b-plus.html>