

A REAL TIME RECORDING AND MONITORING OF HUMAN ACTIVITIES AND ANIMAL MOVEMENTS IN PROTECTED AREAS

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Information Technology

By

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**DEPARTMENT OF INFORMATION TECHNOLOGY
SCHOOL OF COMPUTING
SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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MARCH 2021



SATHYABAMA

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of MUTHUMULA SREELATHA(37120050) who carried out the project entitled “ A REAL TIME RECORDING AND MONITORING OF HUMAN ACTIVITIES AND ANIMAL MOVEMENTS IN PROTECTED AREAS” under my supervision from November 2020 to march 2021.

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DECLARATION

I MUTHUMULA SREELATHA (Reg. No. 37120050) here by declare that the Project Report entitled “A REAL TIME RECORDING AND MONITORING OF HUMAN ACTIVITIES AND ANIMAL MOVEMENTS IN PROTECTED AREAS” done by me under the guidance of Dr.S.GOWRI, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Information Technology.

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SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to Dr. T. Sasikala M.E., Ph.D, Dean, School of Computing ,Dr.R.Subhashini M.E., Ph.D., Head of the Department of Information and Technology for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide Dr.S.Gowri., for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Information Technology who were helpful in many ways for the completion of the project.

ABSTRACT

Wildlife is important for human life because it is the animals and the ecology that sustain life on the planet. There was a time when human interference was minimum the number of wild animals was quite high and there was no problem of their protection or conservation. But, with the expansion of agriculture, settlement, industrial and other developmental activities and mainly due to greed of man, the number of wild animals gradually became lesser to lesser. It is necessary to know the current scenario about wildlife protection and conservation at national and international level. The project comprises of three parts:

1. Deep Learning Techniques
2. UI Map
3. GPS Location

Deep Learning section to detect and track animals YOLOv3 is used for object detection, VGG16 & ResNet60 was trained on COCO and ImageNet for image classification, Audio in frequency image forms to track animals via sensors was trained on ESC-60 & ESC-10 datasets and classified into different categories of animals. Image processing and predictive analysis based on solution to predict and find shortest path was established.

By using way2sms request API If any object is detected means the web server we sent an alert message to the client. Google Maps Services is a python client library. For finding shortest path we use the following API keys Directions API, Maps Static API, Time Zone API, Elevation API, Places API, Distance Matrix API, Geocoding API, Roads API, Geolocation API, and using A* search algorithm. The shortest path will be found within hazy and broken paths within jungles with A* Search just like that of implemented in Uber and some fine tunings.

Collecting data from past or reports of different research papers and base papers, National parks and wildlife sanctuary of tackling this by tracking the GPS locations them to patrol the sanctuary via tunnels. By creating a dummy dataset report for poaching with huge amount of data, we analyze them and predict some of the features. This is the way we track the shortest paths within jungles.

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CHAPTER -1

INTRODUCTION

Poaching, conservation, protected areas, sub problems which need to be resolved or from key part of the challenge. The increasing demand for wildlife meat, fur, layer of the skin and bones demanding the poaching across the world. India supports a great majority of biodiversity. Shortage of human resources especially the field of animals and scarce availability resources make wildlife preservation a tremendous task. A cost-effective and intelligent end to end solution with Android and web services to stop poaching. Deep Learning based solution to tackle poaching several features like object detection, Image classification, audio classification, Image processing etc are being heavily used to track activities in a wildlife sanctuary. This will help stop poaching and will help in tracking animals in wildlife.

Poaching is a major problem for wildlife managers across the world. The increasing demand for wildlife meat, fur, skin and organs increases the poaching across the globe. India supports a great majority of biodiversity. Protection and conservation of this biological wealth is a challenging task for many wildlife managers. Shortage of human resources especially the field staff and scarce availability of logistics and resources make wildlife preservation a daunting task. Hence we seek to develop a user friendly application for wildlife managers and field level staffs to record and communicate the field level information during patrolling and surveillance movements in the forest. The wildlife sightings, deaths, wild life crime and ecological observations, human presence can be recorded with GPS coordinates while patrolling. The patrol routes of forest guards can be recorded using the mobile application. Producing a map after each patrol will help to understand the overall picture of the day's work. A timely consolidation of these maps will help to get an overall idea of the animal movements and human activities in the protected area and hence the managers can develop strategic plans for reducing the poaching. Associated Terminology that needs capture or tracking or smart linking Wildlife movement, Poaching, Conservation, protected area

Sub problems, which need to be resolved, or form key part of the challenge. Developing a mobile application for collecting the data from the field and online reporting during the patrolling has to be made. The maps and trekking routes can be linked with google maps for better understanding about the landscape. Users who are facing the challenge/sub-problem could use data Forest department, wildlife managers, wildlife researchers Any record keeping databases/ legacy systems or integrations that need to be considered NA Required channel – mobile app, responsive web, web application, desired Mobile App, Web application Desired outcome if the challenge is addressed Monitoring the animal movements and intensity of human activities can be recorded and managed on a real time basis. This will make the information of the intensity of chances all activities including poaching in a forest. Hence the wildlife managers can take precaution for reducing the managing the activities and controlling poaching in those prioritized area. Details pertaining to the scale of the problem The software will be useful for all the protected areas across the country.Shelf solutions or legacy solutions partially / fully addresses the challenges.

Even though poaching of wild animals and the trade of animal parts is banned in India but there are a number of majestic animals being poached to bring the best out of the animal products like ivory, horn, teeth, skin and bone. Of all the animals the major ones include Tiger, Elephant, Rhino, Leopard, Indian Pangolin, Monitor Lizard, Indian Star Tortoise and more. A real time recording and monitoring of human activities and animal movements in Protected Areas can help in rectifying this problem.

Wildlife conservation and the management of human–wildlife conflicts require cost-effective methods of monitoring wild animal behaviour. Still and video camera surveillance can generate enormous quantities of data, which is laborious and expensive to screen for the species of interest. In the present study, we describe a state-of-the-art, deep learning approach for automatically identifying and isolating species-specific activity from still images and video data.

Conservation and monitoring of endangered wildlife is great challenging task in developing country. Different body parts of wild animals are used as raw material for making pharmaceutical products, cosmetic, and other purpose; hence their value increased in the international market, as a result poaching and trading activities of

endangered wild animals has been increased rapidly at protected areas. This project will provide detailed information about different population monitoring techniques being applied for different endangered wild animals in protected areas. Techniques like camera trapping, radio collar, noninvasive methods, mobile application, GPS, GIS, direct head count, etc. are commonly used for monitoring wildlife. Since conservation of endangered wildlife species has become very much crucial more advance technologies and social network analysis will be also used to determine the monitoring of wild animals at protected areas.

The conservation of endangered flagship species is a major challenge to government conservation of endangered wild animal species is a major threat as well as a challenge to government in developing countries particularly Nepal & Kazakhstan to protect the loss and degrading of natural habitats, poaching and illegal trade activities of their crucial body parts for making pharmaceutical products, cosmetic and other purpose. Therefore monitoring tools can be helpful to minimize the risk of possible human animal conflict and also above described conditions especially to extinction of endangered wild animals in protected areas.

However, the Government has already successfully used the modern technologies such as radio collars and camera trap to monitor and conserve some endangered species like tigers and vulture at protected areas. In the other hand, monitoring technologies have also several limitations for examples like camera trapping and radio collar require a long period of time as well as high costs. Because animal movements is linked to many important ecological processes, disruptions to movement can cascade through technologies.

CHAPTER-2

LITERATURE SURVEY

1.TITLE: Wildlife surveillance using deep learning methods

The dataset contains 8368 of wildlife domestic animals in farm building and they are used two deep learning technique with that they archived 98% accuracy. Using CNN1 and CNN2 the accuracy of CNN2 is better than CNN1 .[Chenetal, 2021].

2.TITLE: Deep Learning for Wildlife Conservation and Restoration Efforts

A new Deep Learning framework has been introduced by clementduhart named “Tidzam” it’s a new deep learning framework mainly used for wildlife detection, identification and Geolocalization for Tid-Marsh wildlife sanctuary. It is located in Massachusetts. [Gershon Dublon, 2020].

3.TITLE: Coupling visitor and wildlife monitoring in protected areas using camera traps

Using Camera traps they have taken pictures and recorded some videos by this they have conclusion that camera traps can accurately quantify human trails based activities. By using speed of movement(khp), Orientation of camera(degrees) and Distance from trail edge(m). By this they can reducing the cost of collection visitors producing high resolution and human-wildlife recorded data. [Roland Kays, 2019].

4.TITLE: Surveying Wildlife Animals using Satellites

Using satellites images and aircraft system and some fine tning machine leaning algorithm was used to recognize wildlife trackling system. By using platforms, Sensors, Resolution, Coverage Cost, Surved species images was used to find out the surveying wildlife activities.[Dongliang Wang 1,2,* , Quanqin Shao 1 and Huanyin Yue 3 2019].

5.TITLE: Conservation of Wildlife from Poaching by using Sound Detection and Machine Learning

Using Machine Learning algorithm to recognize species by voice in forest areas. By detecting the foot sound of various human and animals in survival area we can makes an appropriate action by using alarm sounds may raised when animals or human presence in that areas. By this we can make a safer habit for wild animals. [Ms. Vaidehi Fulzele, 2020].

6.TITLE: Insights and approaches using Deep Learning techniques to classify wildlife report

To produce an visual similarity images by using hierarchical clustering vectors with the state of convolutional neural network layers we can get cutting edge images of wildlife species from dendrogram identified species. By this they conclude that non-trained images data was classified through using CNN. [Zhongqi Miao, 2019].

CHAPTER-3

Aim and Scope

Aim:

Poaching is a major problem for wildlife managers across the world. The increasing demand for wildlife meat, fur, skin and organs increases the poaching across the globe. India supports a great majority of biodiversity. Protection and conservation of this biological wealth is a challenging task for many wildlife managers. Shortage of human resources especially the field staff and scarce availability of logistics and resources make wildlife preservation a daunting task. The wildlife sightings, deaths, wild life crime and ecological observations, human presence can be recorded with GPS coordinates while patrolling. Poaching, Conservation, protected area Sub problems, which need to be resolved, or form key part of the challenge. Developing a mobile application for collecting the data from the field and online reporting during the patrolling has to be made. The maps and trekking routes can be linked with google maps for better understanding about the landscape. Users who are facing the challenge/sub-problem could use data Forest department, wildlife managers, wildlife researchers Any record keeping databases/ legacy systems or integrations that need to be considered NA Required channel – mobile app, responsive web, web application, desired Mobile App, Web application Desired outcome if the challenge is addressed Monitoring the animal movements and intensity of human activities can be recorded and managed on a real time basis. This will make the information of the intensity of chances all activities including poaching in a forest. Hence the wildlife managers can take precaution for reducing the managing the activities and controlling poaching in those prioritized area.

SCOPE:

we can avoid the poaching activities. We can implemented this methods in the existing infrastructure of the wildlife sanctuaries/National parks; long with the integrating hardware and software stacks we get a complete solution with the low cost.

CHAPTER- 4

EXPERIMENTAL OR MATERIALS AND METHODS ALGORITHMS USED

4.1 FEATURES OF PYTHON

Python is a dynamic, high level, free open source and interpreted programming language. It supports object-oriented programming as well as procedural oriented programming.

In Python, we don't need to declare the type of variable because it is a dynamic typed language.

For example, x=10

here x can be anything such as String, int etc.

There are many features in Python, some of which are discussed below –

1. Easy to code:

Python is high level programming language. Python is very easy to learn language as compared to other language like c, c#, java script, java etc. It is very easy to code in python language and anybody can learn python basic in few hours or days. It is also developer-friendly language.

2. Object-Oriented Language:

One of the key features of python is Object-Oriented programming. Python supports object oriented language and concepts of classes, objects encapsulation etc.

3. GUI Programming Support:

Graphical Users interfaces can be made using a module such as PyQt6,

PyQt4, wxPython or Tk in python. PyQt4 is the most popular option for creating graphical apps with Python.

4. High-Level Language:

Python is a high-level language. When we write programs in python, we do not need to remember the system architecture, nor do we need to manage the memory.

5. Extensible feature:

Python is a Extensible language. We can write our some python code into c or c++ language and also we can compile that code in c/c++ language.

6. Python is Portable language:

Python language is also a portable language. for example, if we have python code for windows and if we want to run this code on other platform such as Linux, Unix and Mac then we do not need to change it, we can run this code on any platform.

7. Python is Integrated language:

Python is also an Integrated language because we can easily integrated python with other language like c, c++ etc.

8. Interpreted Language:

Python is an Interpreted Language. Because python code is executed line by line at a time. like other language c, c++, java etc there is no need to compile python code this makes it easier to debug our code. The source code of python is converted into an immediate form called bytecode.

9. Large Standard Library:

Python has a large standard library which provides rich set of module and functions so you do not have to write your own code for every single thing. There are many libraries present in python for such as regular expressions, unit-testing, web browsers etc.

10. Dynamically Typed Language:

Python is dynamically-typed language. That means the type (for example- int, double, long etc) for a variable is decided at run time not in advance. Because of this feature we don't need to specify the type of variable.

4.2 ADVANTAGES

- 1) Easy to code
- 2) Contains rich libraries and are easy and direct to implement
- 3) Easily compatible on any os
- 4) Reduces the size of code

4.3 SOME OF THE PACKAGES USED

1. absl -py ==0.11.0
2. appdirs ==1.4.4
3. asgiref ==3.3.1
4. astunparse ==1.6.3
6. attrs ==20.3.0
6. Automat ==20.2.0
7. cached-property ==1.6.2
8. cachetools ==4.2.0

9. pillow ==8.0.1
10. protobuf ==3.14.0
11. pyasn1 ==0.4.8
12. pyasn1-modules ==0.2.8
13. pycparser ==2.20
14. PyHamcrest ==2.0.2
15. pyOpenSSL ==20.0.1
16. pytz ==2020.6
17. pyYAML ==6.3.1
18. requests ==2.26.1
19. requests-oauthlib ==1.3.0
20. rsa ==4.6
21. scipy ==1.4.1
22. service-identity ==18.1.0
23. six ==1.16.0
24. sqlparse ==0.4.1
25. tb-nightly ==2.6.0a20210102
26. tensor board==2.2.2
27. tensor board-plugin-wit ==1.7.0
28. tensor flow-hub ==0.10.0
29. termcolor ==1.1.0
30. tf-estimator- nightly ==2.6.0.dev2021010201
31. Twisted ==20.3.0
32. typing-extensions ==3.7.4.3
33. urllib3 ==1.26.2
34. werkzeug ==1.0.1
35. wrapt == 1.12.1
36. zipp ==3.4.0
37. zope.interface ==6.2.0
38. virtualenv ==20.2.2
39. matplotlib ==1.2.0

4.4 STUDY OF THE PACKAGES

1. h6py:

The h6py package provides both a high- and low-level interface to the HDF6 library from Python. The low-level interface is intended to be a complete wrapping of the HDF6 API, while the high-level component supports access to HDF6 files, datasets and groups using established Python and NumPy concepts.

A strong emphasis on automatic conversion between Python (Numpy) datatypes and data structures and their HDF6 equivalents vastly simplifies the process of reading and writing data from Python.

2. Django:

Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design.

3. image:

Django application that provides cropping, resizing, thumbnailing, overlays and masking for images and videos with the ability to set the center of attention.

4.importlib-metadata:

This package supplies backports of that functionality including improvements added to subsequent Python versions.

5. Keras:

Keras is a high-level neural networks API for Python.

6. Keras-preprocessing:

Keras Preprocessing is the data preprocessing and data augmentation module

of the Keras deep learning library. It provides utilities for working with image data, text data, and sequence data.

7. Keras-Application:

Keras Applications is the applications module of the Keras deep learning library. It provides model definitions and pre-trained weights for a number of popular architectures, such as VGG16, ResNet60, Xception, MobileNet and more.

8. Kiwisolver:

Kiwi is an efficient C++ implementation of the Cassowary constraint solving algorithm. Kiwi is an implementation of the algorithm based on the seminal Cassowary paper. It is *not* a refactoring of the original C++ solver. Kiwi has been designed from the ground up to be lightweight and fast. Kiwi ranges from 10x to 600x faster than the original Cassowary solver with typical use cases gaining a 40x improvement. Memory savings are consistently > 6x.

9. Numpy:

NumPy can also be used as an efficient multi-dimensional container of generic data. Arbitrary data-types can be defined. This allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

It provides:

- a powerful N-dimensional array object
- sophisticated (broadcasting) function tools for integrating
- C/C++ and Fortran code useful linear algebra, Fourier transform, and random number capabilities and much more

10. Matplotlib:

Matplotlib produces publication-quality figures in a variety of hardcopy formats and interactive environments across platforms. Matplotlib can be used in Python

scripts, the Python and IPython shell, web application servers, and various graphical user interface toolkits.

11. pandas:

Pandas is a Python package that provides fast, flexible, and expressive data structures designed to make working with structured (tabular, multidimensional, potentially heterogeneous) and time series data both easy and intuitive. It aims to be the fundamental high-level building block for doing practical, real world data analysis in Python.

12. Pillow:

The API documentation included with PIL has been converted (from HTML generated by pythondoc) to reStructured text (via pandoc) This is a work in progress: in order to re-generate new API documentation, either pythondoc will have to be run again or the pythondoc functionality must be converted to Sphinx.

13. pycparser:

pycparser is a complete parser of the C language, written in pure Python using the PLY parsing library. It parses C code into an AST and can serve as a front-end for C compilers or analysis tools.

14. pyOpenSSL:

If you are using pyOpenSSL for anything other than making a TLS connection you should move to cryptography and drop your pyOpenSSL dependency.

15. PyYAML:

YAML is a data serialization format designed for human readability and interaction with scripting languages. PyYAML is a YAML parser and emitter for Python. It Unicode support, pickle support, capable extension API, and sensible error messages. PyYAML supports standard YAML tags and provides Python-specific tags that allow to represent an arbitrary Python object.

4.5 ALGORITHM

A* Search Algorithm

Finding the shortest path while searching in the correct direction is where A* is the best choice. A* is expanding the route that keeps the sum of total cost and the distance estimation to the goal to a minimum.

A * algorithm is a searching algorithm that searches the shortest path between node A (initial state) and node B (final state). A* is used to calculate the shortest path between the initial state (source node) and final state (destination node).

Path planner class is defined to get a map, a start node and destination node and method is defined to compute the shortest path between those two while searching in the right direction. An open set and closed set are being kept. The closed set is to keep nodes that have already been evaluated and the open set is to keep nodes that have been discovered but not evaluated yet. The open set is also known to be the frontier of the search.

The distance estimation is called the heuristic. For A* to find the shortest path, the heuristic of each node needs to be optimistic, or to represent an estimation that is shorter or equal than the real distance. This requirement is fulfilled when the heuristic is the straight distance between two points on a map since real roads paths are generally longer.

The algorithm adds the start node in the open set and explores from there. Includes the start node's neighbours in the open set and calculates the gScore for each of them. Since we have latitude and longitude coordinates, the distance between two connected nodes is the straight line between them. The next node that is explored is the one that has the lowest fScore and this is to be done until the goal is found.

A* search algorithm follows three parameters:

1) $g(n)$: the amount of moving from the initial path to the current path i.e; the sum of all the cells that have been visit before leaving the first cell.

2) Heuristic value (h): It is the estimated amount of moving from the present cell to the destination cell. The amount of cost cannot be calculated until the destination cell is reached.

3) $f(n)$: it is calculated by the sum of gScore and hScore.

$$f(n) = gScore(n) + hScore(n)$$

Since $gScore(n)$ gives the path cost from the start node to node n , and $hScore(n)$ is the estimated cost of the cheapest path from n to the goal.

$F(n)$ = estimated cost of the cheapest solution through n .

4) The algorithm makes a decision by f -value. It considered the smallest f -value cell and moves to the remaining each cell.

5) This process continues until we reach we reach the destination cell. The way of how the A* Search works is illustrated in the figure below. Each time, the node having the lowest $f(n)$ value is the node expanded. The targets nodes will be expanded until reaching the goal destination, which is Bucharest.

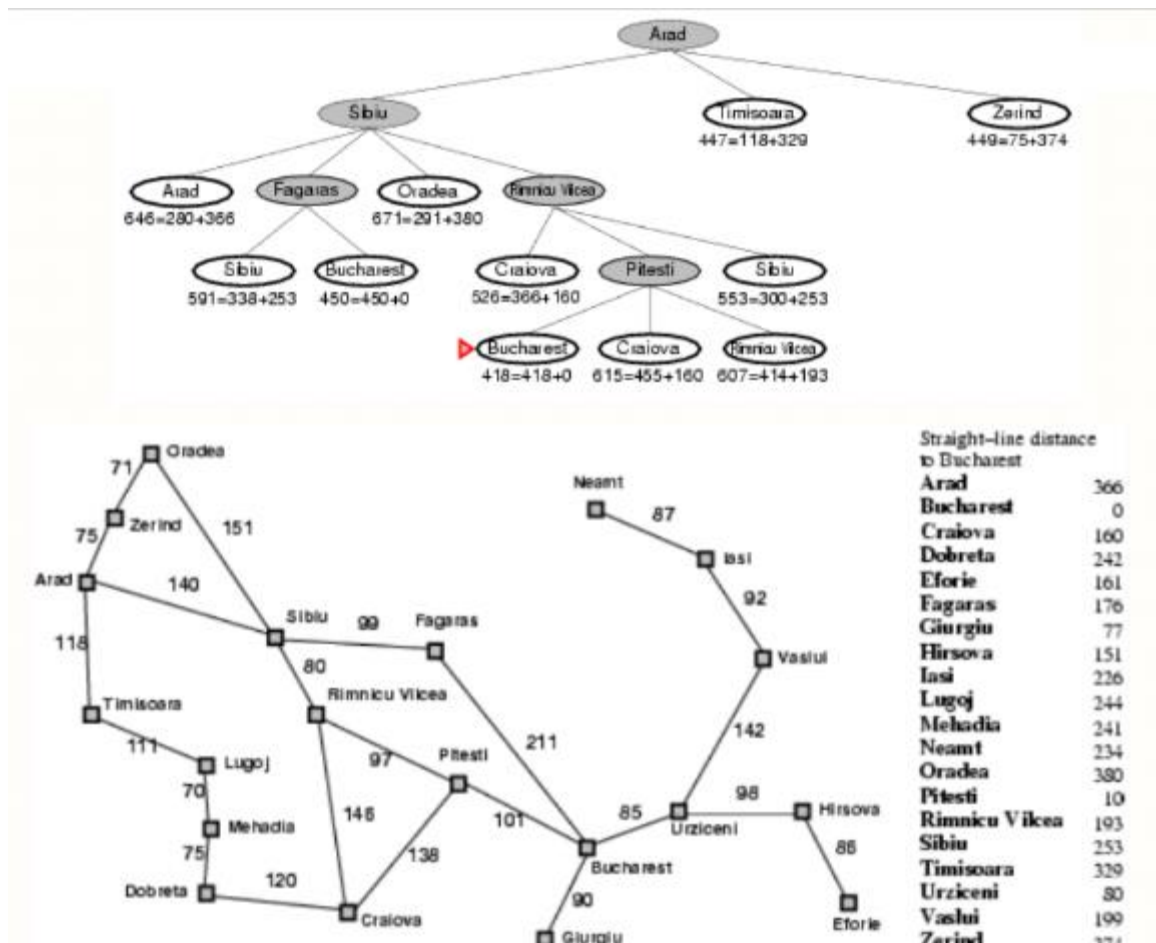


Fig 4.5.1 A* Search Algorithm and Romania's map

4.6 PROPOSED ARCHITECTURES

VGG-16 ARCHITECTURE

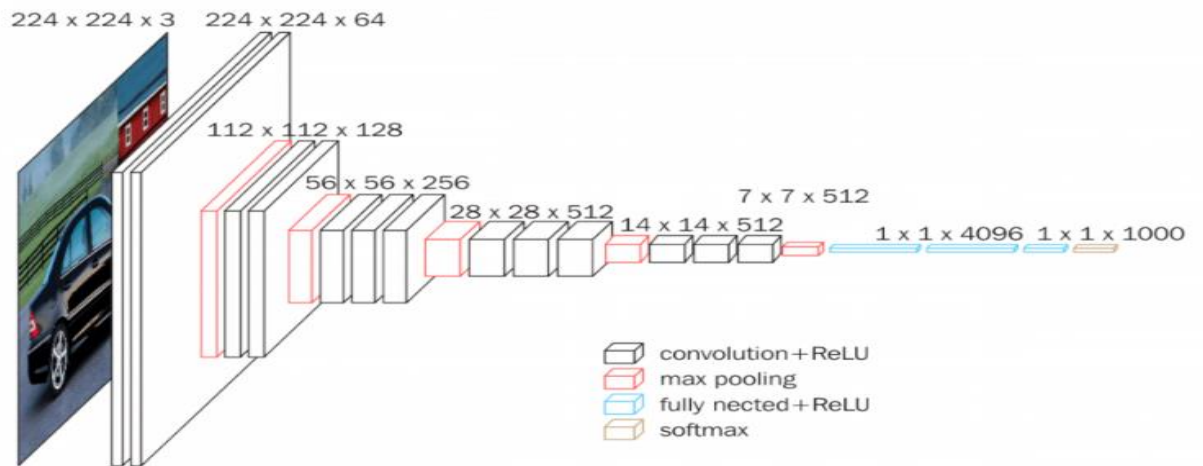


Fig 4.6.1 VGG -16 Architecture

Step 1: The input image get passes through two convolutional layer are comprised of 64 feature kernel.

$$224*224*3(\text{RGB}) \rightarrow 224*224*64$$

Step 2: The Resulting output passe through 1ST max pooling layer with stride-2

$$224*224*64 \rightarrow 112 * 112*64$$

Step 3: The output of 1ST max pooling layer was input to the third & fourth convolutional layer with 128 feature kernel and filter size is 3*3 and followed by a 2ND max pooling layer with stride-2

$$112*112*128 \rightarrow 66 *66*128$$

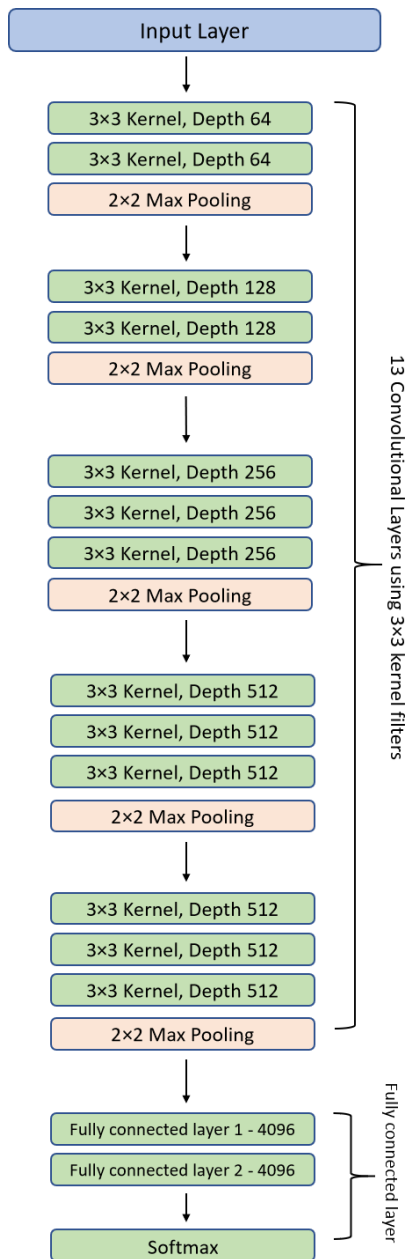


FIG 4.6.1.1 VGG-16 Model

Step 4: The resulting output of 2ND max pooling layer was input to the fifth, sixth & seventh convolutional layer with 266 feature kernel and filter size is 3*3. These layers are followed by a 3RD max pooling layer with stride-2

$$66*66*266 \rightarrow 28*28*266$$

Step 5: The output of 3RD max pooling layer was input to the eight, ninth & tenth convolutional layer with 612 feature kernel and filter size is 3*3. The above 3 layers are followed with a max pooling layer with stride-2

$$28*28*612 \rightarrow 14*14*612$$

Step 6: The resulting output of 4TH max pooling layer was input to the eleven, twelve & thirteen convolutional layer with 612 feature kernel and filter size is 3*3, followed by a max pooling layer with stride-2

$$14*14*612 \rightarrow 7*7*612$$

Step 7: Fourteen & fifteen layer are fully connected layers with 4096 channels

$$7*7*612 \rightarrow 1*1*4096$$

Step 8: The sixteen layer was a softmax output layer with 1000 channels one for each class.

$$1*1*4096 \rightarrow 1*1*6$$

RESNET-50 ARCHITECTURE

layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
		3×3 max pool, stride 2				
conv2_x	56×56	$\begin{bmatrix} 3 \times 3, 64 \\ 3 \times 3, 64 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 64 \\ 3 \times 3, 64 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 64 \\ 3 \times 3, 64 \\ 1 \times 1, 256 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 64 \\ 3 \times 3, 64 \\ 1 \times 1, 256 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 64 \\ 3 \times 3, 64 \\ 1 \times 1, 256 \end{bmatrix} \times 3$
conv3_x	28×28	$\begin{bmatrix} 3 \times 3, 128 \\ 3 \times 3, 128 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 128 \\ 3 \times 3, 128 \end{bmatrix} \times 4$	$\begin{bmatrix} 1 \times 1, 128 \\ 3 \times 3, 128 \\ 1 \times 1, 512 \end{bmatrix} \times 4$	$\begin{bmatrix} 1 \times 1, 128 \\ 3 \times 3, 128 \\ 1 \times 1, 512 \end{bmatrix} \times 4$	$\begin{bmatrix} 1 \times 1, 128 \\ 3 \times 3, 128 \\ 1 \times 1, 512 \end{bmatrix} \times 8$
conv4_x	14×14	$\begin{bmatrix} 3 \times 3, 256 \\ 3 \times 3, 256 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 256 \\ 3 \times 3, 256 \end{bmatrix} \times 6$	$\begin{bmatrix} 1 \times 1, 256 \\ 3 \times 3, 256 \\ 1 \times 1, 1024 \end{bmatrix} \times 6$	$\begin{bmatrix} 1 \times 1, 256 \\ 3 \times 3, 256 \\ 1 \times 1, 1024 \end{bmatrix} \times 23$	$\begin{bmatrix} 1 \times 1, 256 \\ 3 \times 3, 256 \\ 1 \times 1, 1024 \end{bmatrix} \times 36$
conv5_x	7×7	$\begin{bmatrix} 3 \times 3, 512 \\ 3 \times 3, 512 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 512 \\ 3 \times 3, 512 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 512 \\ 3 \times 3, 512 \\ 1 \times 1, 2048 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 512 \\ 3 \times 3, 512 \\ 1 \times 1, 2048 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 512 \\ 3 \times 3, 512 \\ 1 \times 1, 2048 \end{bmatrix} \times 3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9

FIG 4.6.2 RESNET-50 Architecture

we can see in the Architecture the resnet 60 architecture contains the following element:

Step 1: A convoultion with a kernel size of 7 * 7 and 64 different kernels all with a stride of size 2 giving us 1 layer.

Step 2: Next we see max pooling with also a stride size of 2.

Step 3: In the next convolution there is a 1 * 1,64 kernel following this a 3 * 3,64 kernel and at last a 1 * 1,266 kernel, These three layers are repeated in total 3 time so giving us 9 layers in this step.

Step 4: Next we see kernel of 1 * 1,128 after that a kernel of 3 * 3,128 and at last a kernel of 1 * 1,612 this step was repeated 4 time so giving us 12 layers in this step.

Step 6: After that there is a kernel of $1 * 1,266$ and two more kernels with $3 * 3,266$ and $1 * 1,1024$ and this is repeated 6 times giving us a total of 18 layers.

Step 6: And then again a $1 * 1,612$ kernel with two more of $3 * 3,612$ and $1 * 1,2048$ and this was repeated 3 times giving us a total of 9 layers.

Step 7: After that we do an average pool and end it with a fully connected layer containing 1000 nodes and at the end a softmax function so this gives us layer 1.

Step 8: We don't actually count the activation functions and the max/ average pooling layers.

so totaling this it gives us a $1 + 9 + 12 + 18 + 9 + 1 = 60$ layers Deep Convolutional network.

4.7. SYSTEM ARCHITECTURE

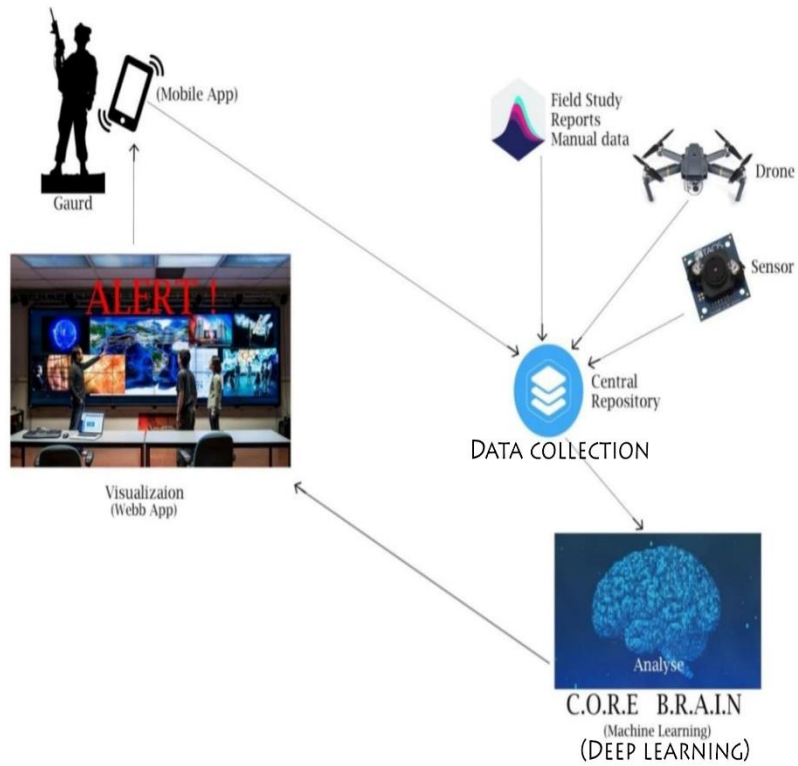


FIG 4.7 System Architecture

CHAPTER-5

RESULTS AND DISCUSSION

PERFORMANCE ANALYSIS

5.1. OBJECT DETECTION

YOLOv3 (You Only Look Once v3) and OpenCV algorithms we are detecting objects from video and images. YOLOv3 is a famous object detection algorithm developed by Washington university, this algorithm generates yolo v3 weight model using python Deep Learning algorithm called CNN (Convolution Neural Networks). This algorithm is pre-trained with all object and assign differ class name to each differ image's and then create a model, the algorithm convert each images into CNN layers and then for each CNN layer extract features and allocate weight to the CNN model, due to all possible features from single image another image with some related features can also be predicted. Whenever we are giving new image then that image object will be applied on pre-trained image weight to get best accuracy for matching object label.

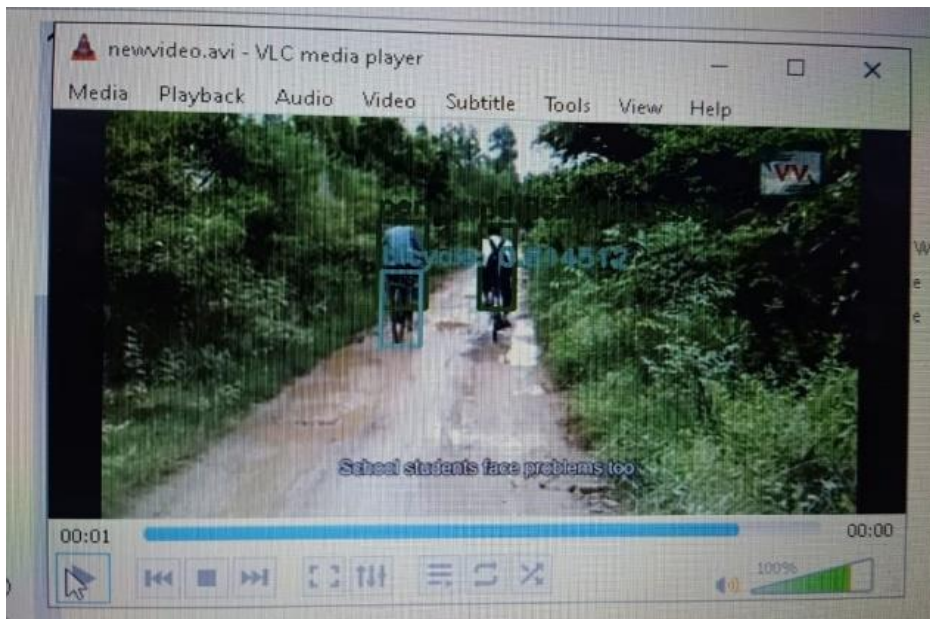


Fig. 5.1.1Object Detection video using YOLOv3

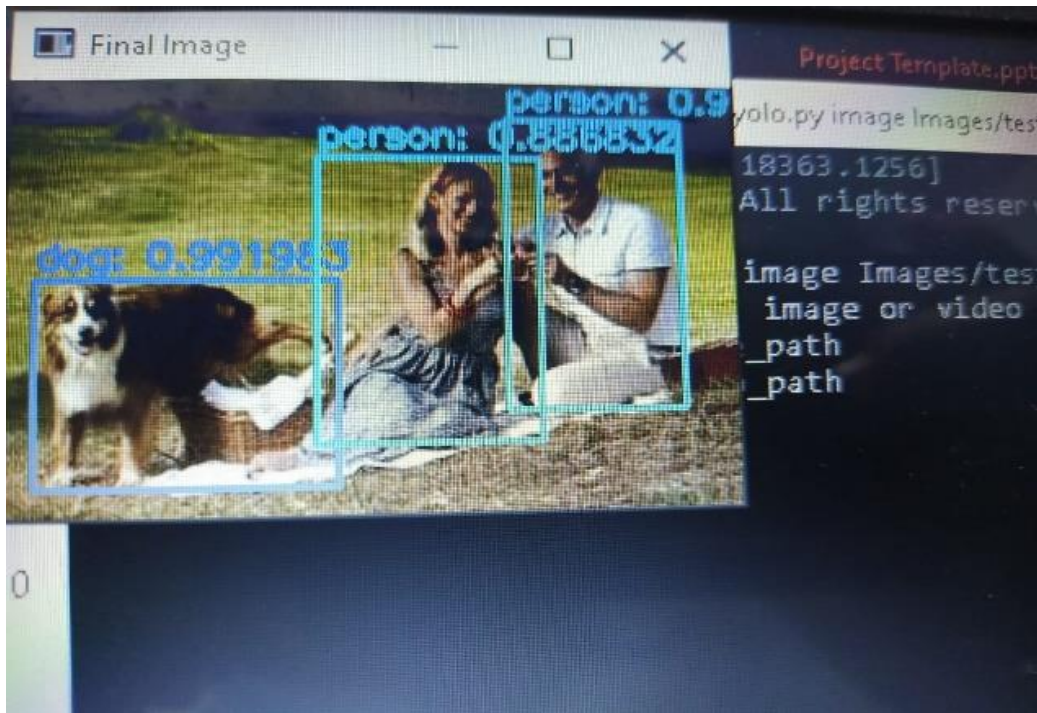


Fig.5.1.2. Object Detection image using YOLOv3

5.2. IMAGE CLASSIFICATION

Classifying any images and having a bounding box is essential for detection. We used both ResNet60 and VGG16, trained on ImageNet and COCO datasets. Since COCO dataset based on real life objects detection but animal classification is a bit hard and inaccurate. It is able to detect & bound the animals images, but not correctly classify it. The COCO outputs are:



Fig 5.2.1. Correct Classification Bounding Box for COCO outputs

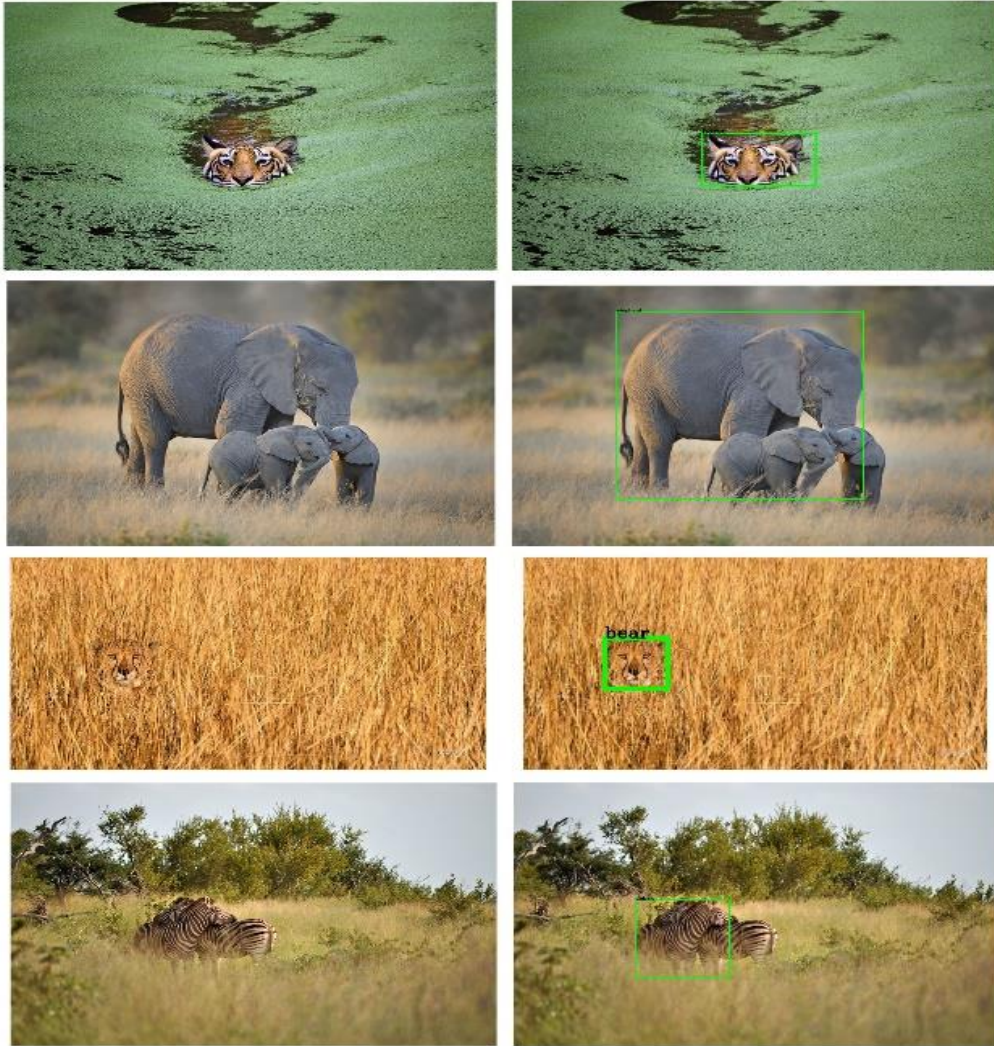


Fig 5.2.2. Incorrect Classification Bounding Box for COCO outputs

The ImageNet classification output classes with different types of Tiger, or Elephants. ImageNet classification is more accurate for animals. But for COCO dataset, the VGG16 and ResNet 16 classifier was confused between a Tiger and a Bear for an image of Cheetah. As we can compare from both the COCO and ImageNet outputs, we can conclude that for more accuracy.



Fig 5.2.3. ImageNet Classification output

[illegible][illegible]

5.3. AUDIO CLASSIFICATION

With Sensors in jungles we intended to classify audio to track and detect animals. The ESC-60 dataset from Harvard University is a collection of environmental sounds. The dataset consists of 6-second-long recordings audio organized into 60 semantical classes with that each class has 40 examples. The ESC-60 dataset is a labelled collection of 2000 environmental audio recordings. The ECS-10 dataset is a labelled set of 400 environment recordings with 10 classes, 40 clips for each class.

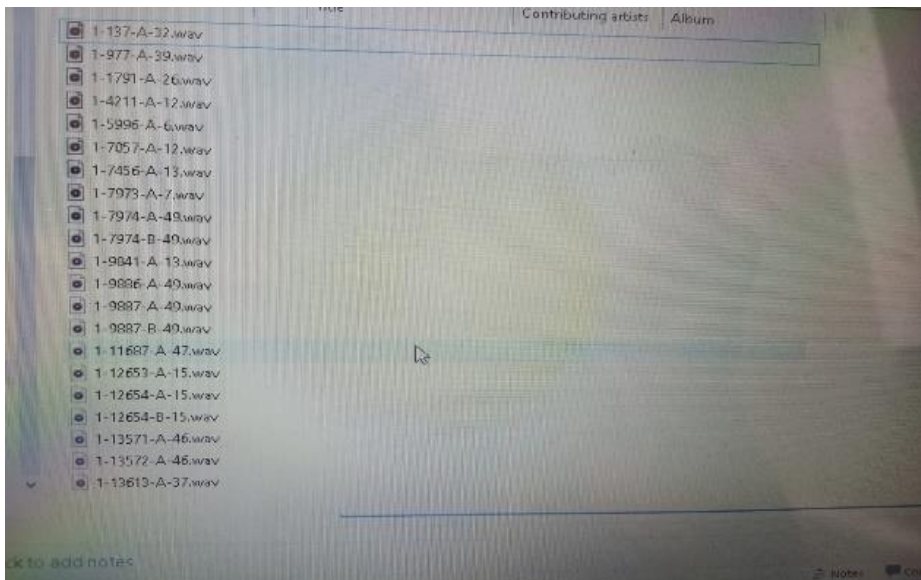


Fig 5.3.1. ESC-60 sound waves

are View

This PC > python (E:) > audioclassification > ESC-10

Name	Date modified	Type	Size
001 - Dog bark	16-Apr-15 6:57 AM	File folder	
002 - Rain	16-Apr-15 6:57 AM	File folder	
003 - Sea waves	16-Apr-15 6:57 AM	File folder	
004 - Baby cry	16-Apr-15 6:57 AM	File folder	
005 - Clock tick	16-Apr-15 6:57 AM	File folder	
006 - Person sneeze	16-Apr-15 6:57 AM	File folder	
007 - Helicopter	16-Apr-15 6:57 AM	File folder	
008 - Chainsaw	16-Apr-15 6:58 AM	File folder	
009 - Rooster	16-Apr-15 6:58 AM	File folder	
010 - Fire crackling	16-Apr-15 6:58 AM	File folder	
ESC-10.png	20-Apr-15 3:09 AM	PNG File	5,756 KB

FIG 5.3.2 ESC-10 SoundWaves

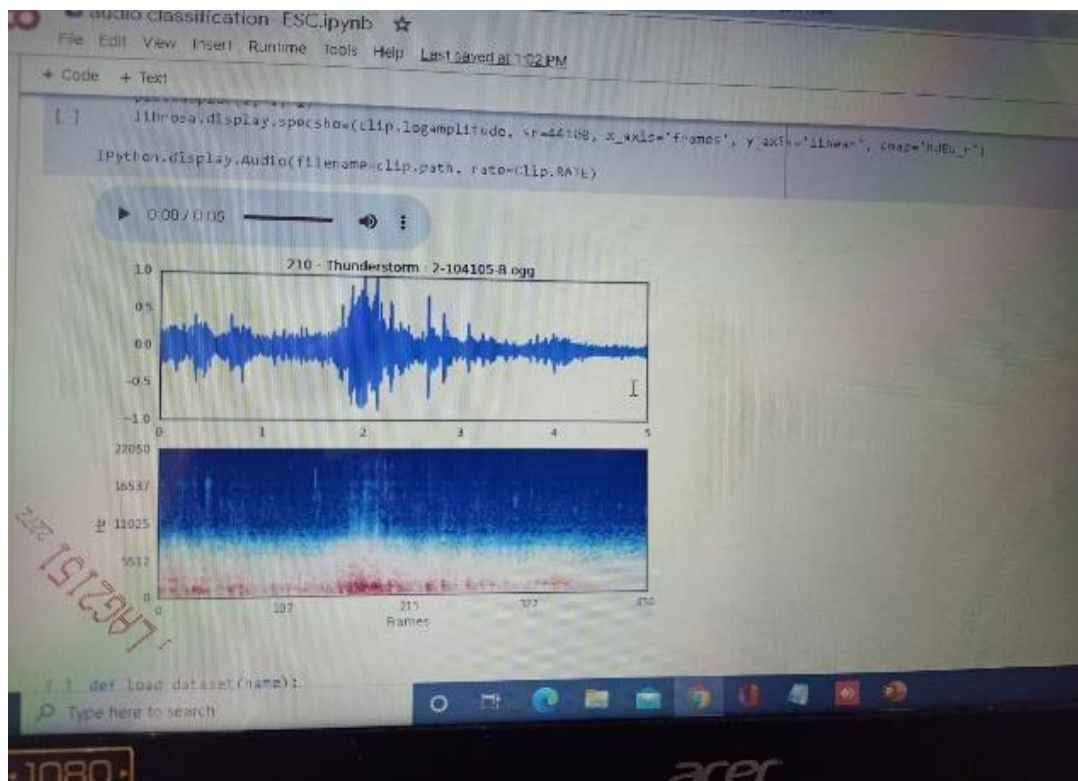


Fig 5.3.3 Audio Classification Output

5.4. IMAGE PROCESSING

If any object(person/animals) is detected means server will send message alert to the client.

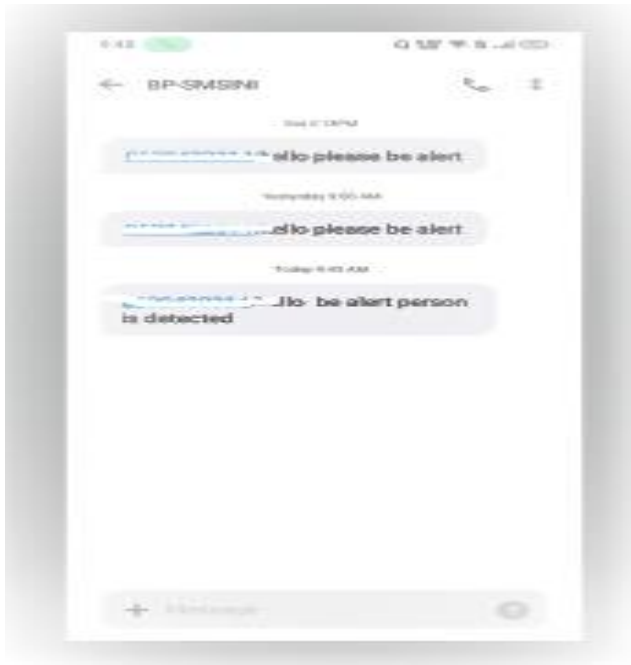


Fig 5.4.1. Alert message from web server

Finding the shortest path between two locations is a key task in path planning especially for self- driving cars to navigate from point A to point B. Finding the shortest path while searching in the correct direction is where A* algorithm is the best choice. A* is expanding the route that keeps the sum of total cost and the distance estimation to the goal to a minimum. The distance estimation is called the heuristic. For A* to find the shortest path, the heuristic of each node needs to be optimistic, or to represent an estimation that is shorter or equal than the real distance. This requirement is fulfilled when the heuristic is the straight distance between two points on a map since real roads paths are generally longer. The algorithm adds the start node in the open set and explores from there. Includes the start node's neighbours in the open set and calculates the gScore for each of them. Since we have latitude and longitude coordinates, the

distance between two connected nodes is the straight line between them. The next node that is explored is the one that has the lowest fScore and this is to be done until the goal is found.

By using A* search algorithm we can find the shortest path from each and every ranger's locations to the danger's location areas.

Clients for google maps service is a python client library for the following Google Maps API's:

1. Directions API
2. Distance Matrix API
3. Elevation API
4. Geocoding API
6. Geolocation API
6. Time Zone API
7. Roads API
8. Places API
9. Maps Static API

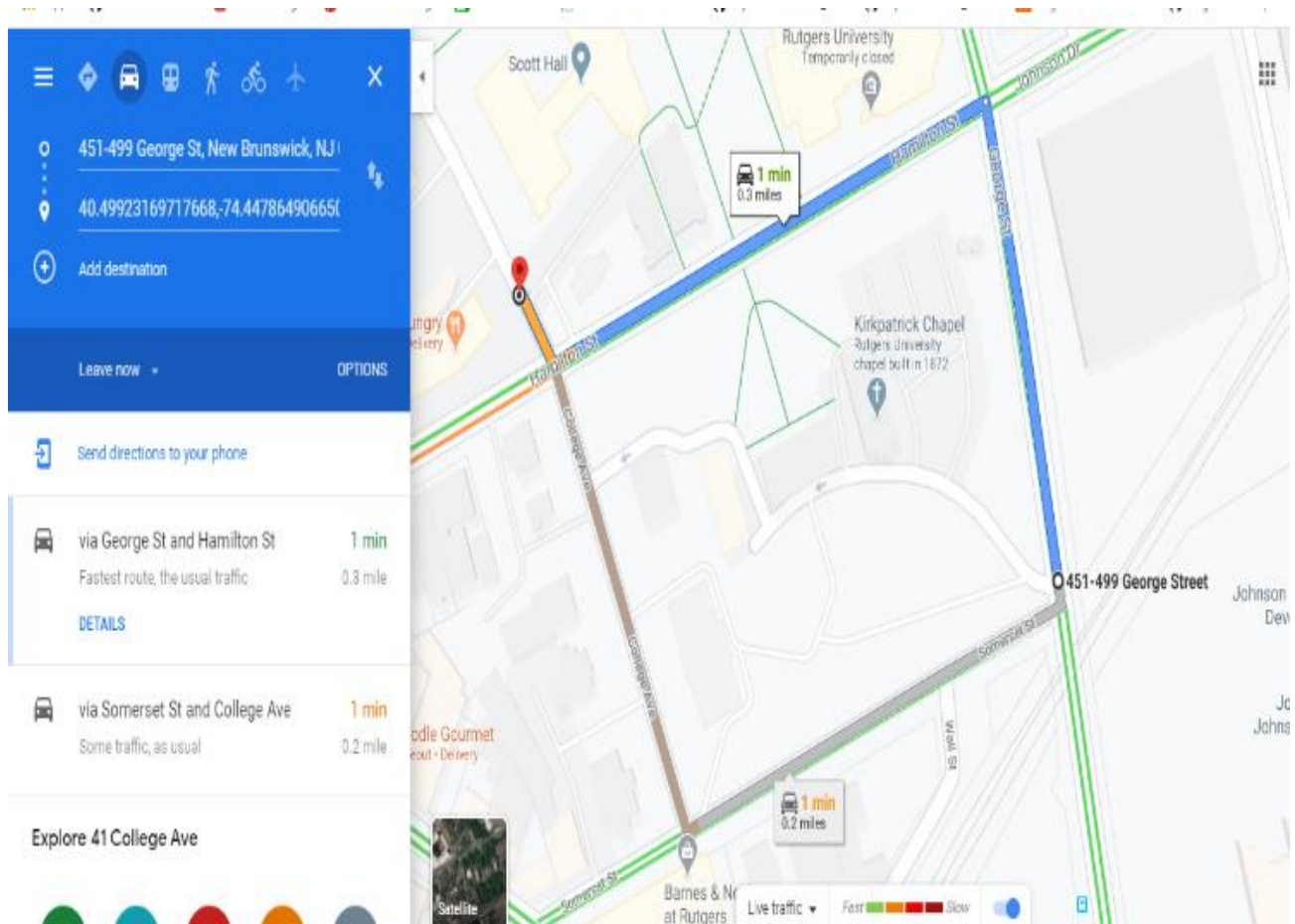


Fig 5.4.2. Image processing output

5.5. PREDICTIVE ANALYSIS

Machine Learning is learning from data right? We can find graphs, patterns and labels within data. For that we can collect data from past field study reports, journals/articles on the wildlife sanctuary/National park or study reports by rangers etc. With this huge amount of data, we made a dummy dataset for analyzing and predict some of the features. We found that the following outcomes via graphs.

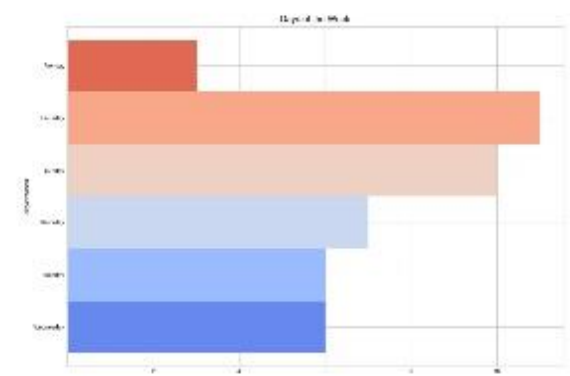
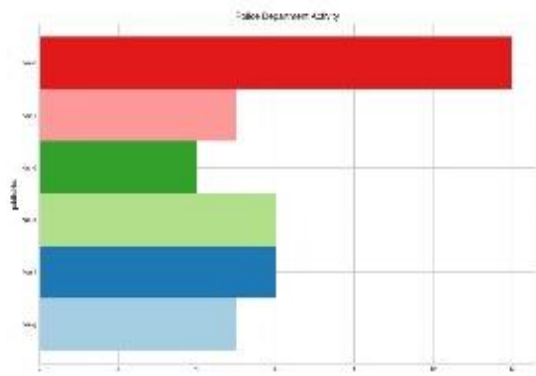
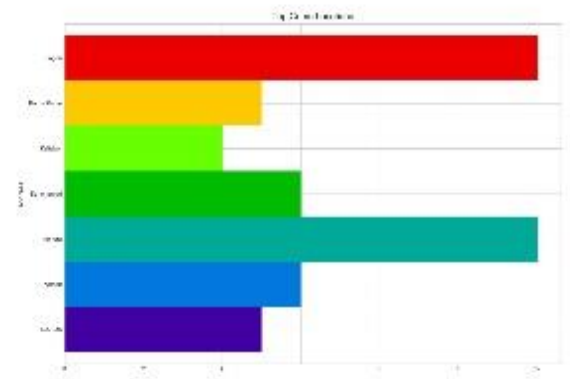
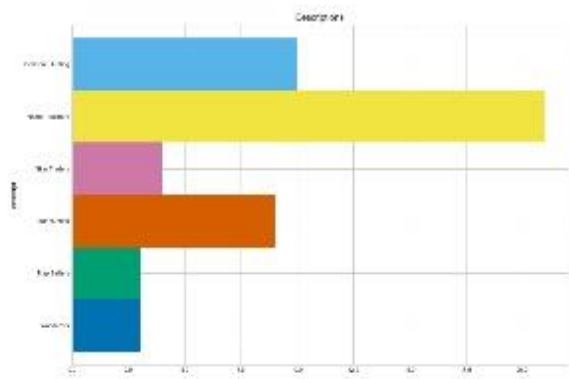


Fig 5.5.1. Predictive Analysis graph

CHAPTER-6

SUMMARY AND CONCLUSION

6.1. SUMMARY

In country like India, where hunting is considered as an act of bravery, animal head and skin are smuggled to other countries at huge price. Some body parts of animals are used in Chinese and Tibetan medicines. Body parts of tiger, lion and black buck are used in marking trophies. Wildlife protection act, 1972 provides protection to wild animals, birds, and plants.

These refer to protected areas set up to prevent the extinction of animals. They primarily protect those endangered species of birds and animals that are under the threat of becoming extinct. There are 610 Wildlife sanctuaries in India.

These are the areas where wild animals and natural vegetation are together preserved. There are 96 National parks in India. Eg; Kaziranga National Park in Assam, Jim Corbett National Park in Uttarakhand.

6.2. CONCLUSION

In this way we can avoid the poaching activities. We can implement this method in the existing infrastructure of the wildlife sanctuaries/National parks; along with the integrating hardware and software stacks we get a complete solution with the low cost.

6.3. FUTURE WORK

There are a lot of ways to approach for saving wildlife sanctuary. By using Sensors, Raspberry pi, Camera configuration, API keys and Audio waves and some of deep learning techniques.

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Protecting wildlife using real time surveillance system

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Abstract—Wildlife is essential because the animals and the ecology system that maintains life on the world. The expansion of the country due to industrial and other developmental activities and mainly due to needs of people, the count of wild animals moderately became minor. It is necessary to know actual and current scenario about wildlife protection and conservation at national and international level. The project comprises of three parts:

1. Deep Learning Techniques 2. UI Map

3. GPS Location

Deep Learning is used to find and track animals using YOLOV3 for object detection. VGG16 & ResNet50 was used on COCO and ImageNet dataset for finding object in image classification. ESC-50 & ESC-10 datasets was used to classify different sound categories of animals. With the help of API Image processing was classified. By creating a dummy dataset was used to find predictive analysis.

By using way2sms request API If any object is detected means the web server we sent an alert message to the client. Google Maps Services is a python client library. For finding shortest path we use the following API keys Directions, Maps Static, Time Zone, Elevation, Places, Distance Matrix, Geocoding, and Roads API's. and using A* search algorithm was used to find the shortest path.

Collecting data from past or reports of different research papers and base papers, National parks and wildlife sanctuary of tackling this by tracking the GPS locations them to patrol the sanctuary via tunnels. By creating a dummy dataset report for poaching with huge amount of data, we analyze them and predict some of the features. This is the way we track the shortest paths within jungles.

Keywords

Wildlife, poaching, tackling, ResNet50, VGG16, CNN, A*search

Introduction

Poaching, conservation, protected areas, sub problems which need to be resolved or from key part of the challenge. The highly increasing needs for humans like clothes, proteins food and layer of the skin for shoes was able to demanding these type of poaching activities across the world. By using some of the deep learning techniques like object detection, image and audio classification we able to figure out some part of the solution to stop wildlife sanctuary.

Literature survey

The dataset contains 8368 of wildlife domestic animals in farm building and they are used two deep learning technique with that they archived 98% accuracy. Using CNN1 and CNN2 the accuracy of CNN2 is better than CNN1 .[Chenetal, 2019].

A new Deep Learning framework has been introduced by clementduhart named "Tidzam" it's a new framework for saving animals and mainly used for wildlife identification and using satelliates for Tid-Marsh animal sanctuary. It is located in Massachusetts. [Gershon Dublon, 2019].

Using Camera traps they have taken pictures and recorded some videos by this they have conclusion that camera traps mostly finding quality of human trails activities. By using speed of movement(khp), Orientation of camera(degrees) and Distance from trail edge(m). By this they can reducing the cost of collection visitors producing high resolution and human-wildlife recorded data. [Roland Kays, 2017].

Using satellites images and aircraft system and some fine tning machine leaning algorithm was used to recognize wildlife trackling system. By using platforms, Sensors, Resolution, Coverage Cost, Surved species images was used to find out the surveying wildlife activities. [Dongliang Wang and Huanyin Yue 3 2019].

Using Machine Leaming algorithm to recognize species by voice in forest areas. By detecting the foot sound of various human and animals in survival area we can makes an appropriate action by using alarm sounds may raised when animals or human presence in that areas. By this we can make a safer habit for wild animals. [Ms. Vaidehi Fulzele, 2020].

To produce an visual similarity images by using hierarchical clustering vectors with the state of convolutional neural network layers we can get cutting edge images of wildlife species from dendrogram identified species. By this they conclude that non-trained images data was classified through using CNN. [Zhongqi Miao, 2019].

Methodology Adopted

Proposed architecture

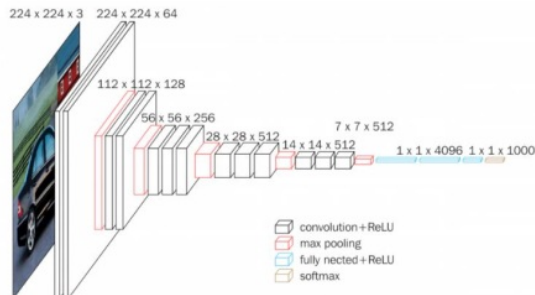


Fig 1. VGG 16 Architecture

Step 1: The input image get passes through two convolutional layer are comprised of 64 feature kernel.

$$224*224*3(\text{RGB}) \rightarrow 224*224*64$$

Step 2: The Resulting output passe through 1ST max pooling layer with stride-2

$$224*224*64 \rightarrow 112 * 112*64$$

Step 3: The output of 1ST max pooling layer was input to the third & fourth convolutional layer with 128 feature kernel and filter size is 3 and follows a 2ND max pooling layer with stride of 2.

$$112*112*128 \rightarrow 56 * 56*128$$

Step 4: The resulting output of 2ND max pooling layer was input to the fifth, sixth & seventh convolutional layer with 256 feature kernel and filter size is 3 and continued by a 3RD max pooling layer with stride of 2.

$$56*56*256 \rightarrow 28*28*256$$

Step 5: The output of 3RD max pooling layer was input to the eight, ninth & tenth convolutional layer with 512 feature kernel and filter size is 3. The above 3 layers are followed with a max pooling layer with stride of 2.

$$28*28*512 \rightarrow 14*14*512$$

Step 6: The resulting output of 4TH max pooling layer was input to the eleven, twelve & thirteen convolutional layer with 512 feature kernel and filter size is 3*3, followed by a max pooling layer with stride-2

$$14*14*512 \rightarrow 7*7*512$$

Step 7: Fourteen & fifteen layer are fully connected layers with 4096 channels

$$7*7*512 \rightarrow 1*1*4096$$

Step 8: The sixteen layer was a softmax output layer with 1000 channels one for each class.

$$1*1*4096 \rightarrow 1*1*5$$

Result and Discussion

1.Object Detection

By using YOLOv3 (You Only Look Once v3) and CNN algorithm we are able to detect real time objects like person/animals in video clip and inputs of the images. The algorithm was already pre-trained with the weight of input layers of CNN.

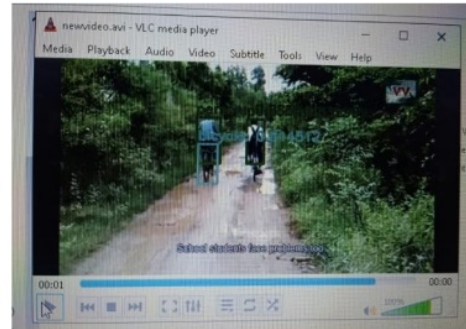


Fig.1. Video clip on YOLOv3

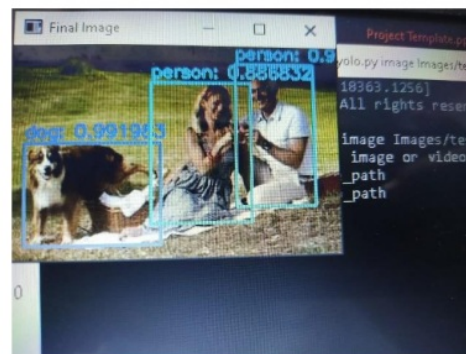


Fig.1.1. Image Detection using YOLOv3

2.Image Classification

Identifying any images we need bounding boxes for detection. We used both the architectures like ResNet-50 and VGG16, to find the correct image for image classification. We trained on ImageNet and COCO datasets. Based on real time detection COCO dataset was unable to classify correct animal accurately. The COCO outputs are:



Fig 2. COCO outputs

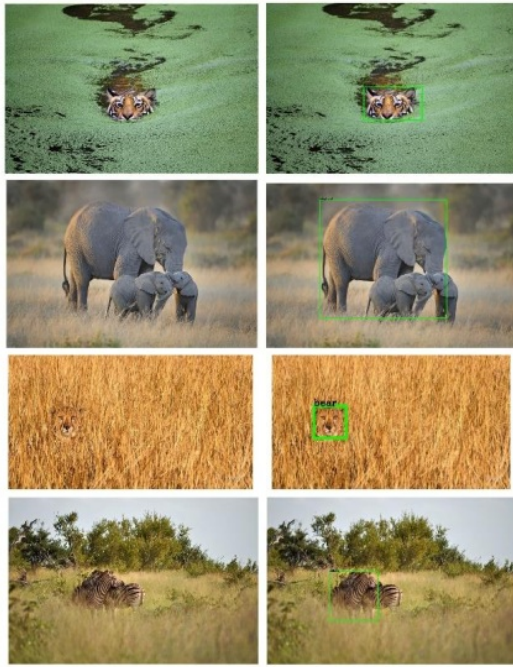


Fig 2.1. Inaccurate Classification for COCO output

ImageNet classification is more accurate for animals. But for COCO dataset, the VGG16 and ResNet-50 identifying between a Tiger, Bear and an image of Cheetah was little bit inaccurate. Now compare the outputs of both we identified that ImageNet outputs was more accurately.

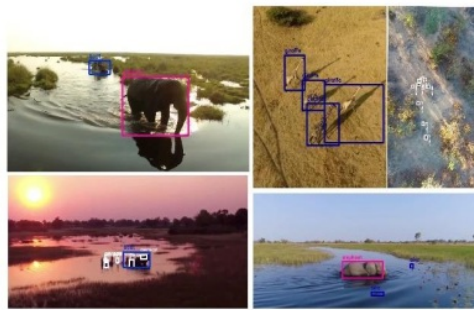


Fig 2.2. ImageNet Classification output



Fig 2.3. VGG16 Architecture output



Fig 2.4. ResNet50 Architecture output

3. Audio Classification

By using ESC-50 and ESC-10 dataset we found the sound waves of the animals in different category. The dataset has 5-second-long recordings audio clip and it's divided into 50 semantical classes for each class has 40 examples. The ESC-50 dataset having 2000 environmental audio clips. The ECS-10 dataset is a labelled set of 400 environment recordings with 10 classes, 40 clips for each class.

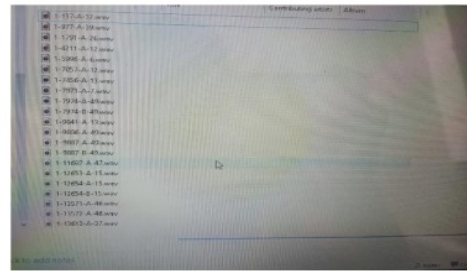


Fig 3. Sound Waves for ECS-10

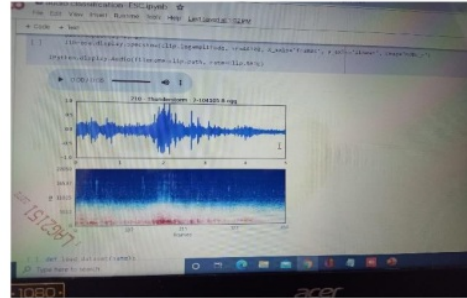


Fig 3.1. Audio Classification for ECS-50

4. Image Processing

If any object is detected means we will get an alert message from web server to the client by using way2sms. For finding the shortest path in the jungles we use API keys and followed by an A* search algorithm we found that the shortest path between current location to the destination location.

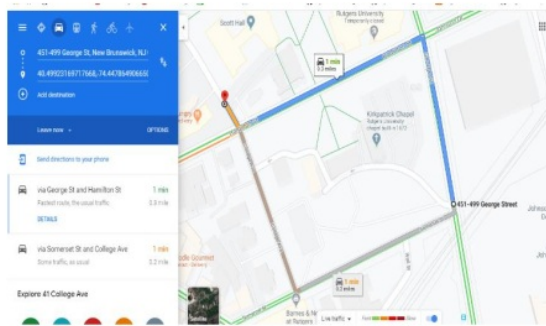


Fig 4. Shorest path using google maps

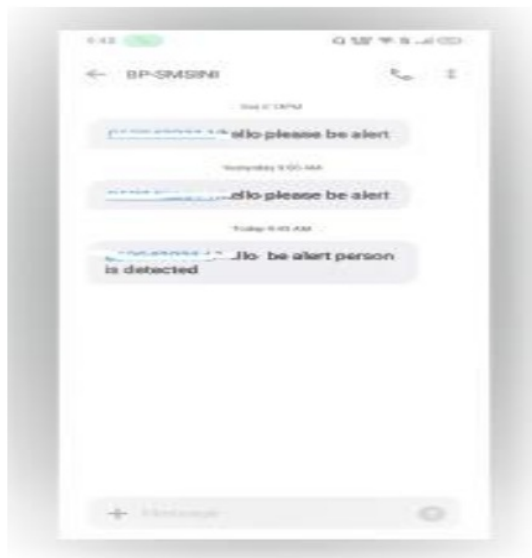


Fig 4.1. Alert message from web server

5. Predictive Analysis

We created a dummy dataset, by collecting data from research and base papers and followed by reports of journals and articles on the wildlife sanctuary and also National park etc. With the large amount of data, We analyse that the predictive graphs.

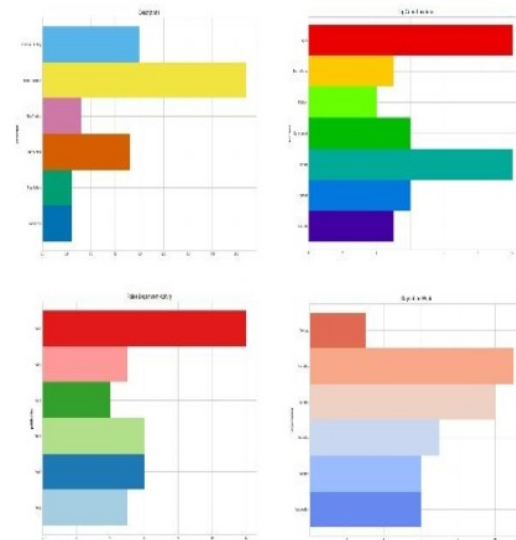


Fig 5. Analysis predictive graph

Conclusion

By using these methods we can implement in the existing infrastructure in the National Parks and forest areas and the wildlife sanctuaries we can track the poaching activities in real time. In this way we can save the wildlife sanctuaries.

Future Work:

There are lot of ways to approach for saving wildlife sanctuary. By using Sensors, Raspberry pi, Camera configuration, API keys and Audio waves and some of deep learning techniques

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