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Design and Development of Deep Learning for Animal Classification.

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Abstract : Deep Learning algorithms are gaining popularity day by day because of its high accuracy compared to other traditional algorithms. Animal classification system is helpful in different fields like in wildlife surveillance, for students and researchers.This paper contains implementation of Deep learning based Convolutional Neural Network(CNN) algorithm using Single Shot Multi-Box Detector(SSD) with MobileNetV2 on Raspberry Pi 3B+ with Picamera interfaced so that to make system real time. Images of cats and dogs were trained on google colab and then trained file is deployed on Raspberry Pi to implement it using TensorFlowLite. Raspberry Pi(RPi) was wirelessly connected to laptop using VNC Viewer so that to access RPi remotely. So, this makes RPi as handy device to observe interested animals in remote areas where humans want to study animals without disturbing animals to capture real data. Experimental results shows that Raspberry pi, an inexpensive way can be used to observe animals from remote areas and classify them in real time using deep learning.

Index Terms — Deep Learning, Raspberry Pi, CNN, SSD with MobileNetV2, Google Colab , TensorFlowLite, VNC Viewer.

I. INTRODUCTION

Animal classification is one of the important task for surveillance of wildlife animals, for students and researchers. Sometimes animal identification is a difficult task for photographers and researchers. From the last few years, there is rapid growth in the deep learning algorithms, which are giving results much greater than other traditional algorithms. The reason behind this is construction of deep learning architectures/models. In Standard machine learning algorithms researchers defined features by hand. First defining features and then applying them to machine learning algorithms most of the time gives inappropriate results at the time of practical implementation, mostly in that case when dataset contains lots of diverse in pictures. Deep Learning algorithms creates features by its own while the training process and that's why they are more accurate. These deep learning algorithms try to define feature by own which is different than defining features in machine learning algorithms.

when observer want to study from remote areas then using deep learning algorithms implemented on Raspberry Pi gives the accurate result and saves the timing as compared to manually searching through all pictures captured from camera and then finding existed animal. SSD with MobileNet model is lightweight by which they can be easily deployed on Raspberry Pi to implement in real-time.

This paper gives implementation of Deep learning algorithms on RPi 3B+ where model was trained and then deployed on RPi for acquiring real time data using PiCamera. Model was trained on Google colab and then it is converted to tflite format so as to deploy deep learning model on embedded device. On RPi model was implemented using TFLite. Laptop was wirelessly connected to RPi using VNC Viewer so that to capture and classify animals from remote areas.

Fig.1. Basic Image Classification Model

II. METHODOLOGY

This section demonstrates flow-wise explanation of implementation of system.

A)Selection of model for system.

There are different models from CNN, but SSD with MobileNet gives high speed detection in real time environment because it takes only one shot for detection.In real time implementation using embedded device like RPi need a light weight structure so SSD with MobileNet architecture fulfils all requirement needed for implementation using RPI.SSD contains two components one is SSD Backbone and SSD head.different architectures can be used in SSD Backbone but MobileNet is lightweight so SSD with MobileNetV2 acrchitecture was selected for this system.

When SSD contains MobileNet as a backbone model for classification then it became lightweight by which there will be easily deployment of this architecture on RPi and this can be useful in real time application.

B)Training of Model on Google Colab

- Labelling of Images:-

Fig.2. Labelling of Cat Image using LabelImg tool

Total 550 Images of cats and dogs were labelled using LabelImg tool. After Labelling of images by creating rectangular box on image it creates .xml file ,which contains details of boundary box of Height, width &Depth of Image and also label of the image

- Training of neural network model on Google Colab:-

Google colab is the cloud platform which provides free GPU access for continually 12 hours so that to train deep learning models easily.It is a cloud-based system where we can train models in jupyter environment. It provides free service for this so that If anyone with less processing power CPU GPU can use this Google Colab.

. so for proposed system model was trained on google colab by keeping step size 100 and batch size 4. At the time of training of neural network Batch size term is used. While doing training, during one iteration how much number of training examples are taken is called as batch size. At the time of Training weights in the neural network are modified, so at what number of steps weights will be modify is called as step size. model was trained upto 1,00,000 steps.

- Converting checkpoints to tflite:-

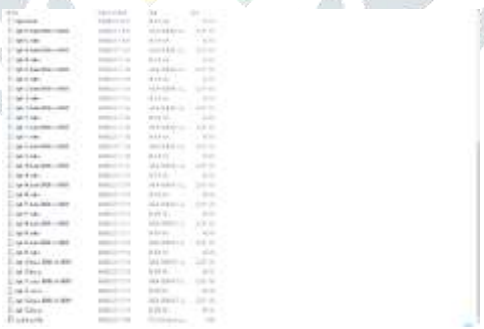

Fig.3. Checkpoints formed at the time of training.

At the time of training checkpoints were created so using these 102 checkpoints, model is converted to tflite format so as to make it compatible for implementation on RPi.Using these checkpoints model can be further retrained.

C)Setting up environment on RPi and deploying trained model on RPi.

Using 16 GB memory card all the installations starting from OS to all libraries like OpenCV and TensorFlowLite were done on RPi 3 B+. Using python, system was implemented by including trained model.

D)System Configuration (Wirelessly)

To access RPi remotely VNC Viewer was used and for Advanced IP scanner is also needed so as to scan IP address of RPi. And then RPi was remotely connected to Laptop. Laptop and RPi was connected to same mobile's hotspot.

Below figure shows screenshot of VNC Viewer after successfully connecting RPi to Laptop.

Fig.4 RPi access through laptop wirelessly using VNC Viewer

Because of VNC viewer, It was very easy to put RPi remotely to check animal existence in that area and finding out animal classification.

III. EXPERIMENTAL RESULTS

All the results were taken from Picamera and taken from VNC viewer screen.

1)Image experiments by keeping images of cats and dogs in front of Picamera

. In this type Images of Cats and dogs were kept in front of Picamera and then image was classified. These images were randomly downloaded from Internet.

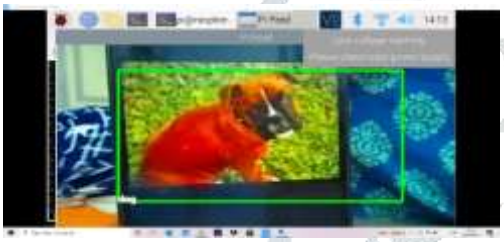

Fig.5. Correct Classification of Dog

Fig.6.Correct Classification of Cat

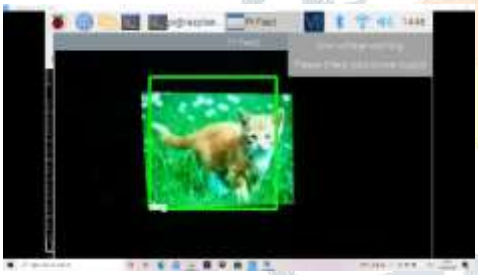

Fig.7.Missclassification of Cat as Dog

Fig.8.Correct Classification of Two animlas in one frame

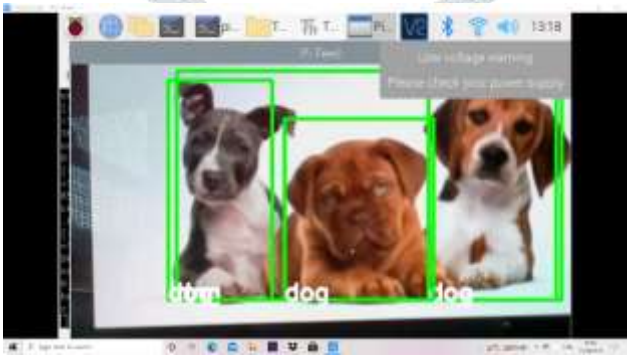

Fig.9 Classification of 3 dogs in one frame.

Sometimes results shows missclassification of animals because of some similarity between dogs and cats and also it is needed to take more number of images at the time of training to reduce this missclassification.Total 40 different Images of cats and dogs were taken to check system performance.and it is shown in following Table.

TABLE I

	Dogs	*Cats*
Total number of Images taken	*20*	*20*
Correct Classification	*19*	*17*
In percentage	*95%*	*85%*

2)Experimental Results when camera was hide so as to capture live animals

These results were taken by hiding camera and then capturing all this images from VNC Viewer so as to see system results on live animals.

Fig.10 Result for live Cat

Fig.11. Result 2 for live cat

Fig.12.Result for live Dog

IV.CONCLUSIONS AND FUTURE WORK

Successful demonstartion of animal classification was done using deep learning algorithm on RPi.Use of VNC Viewer made system to connect wirelessly RPi to laptop which was helpful to capture live animals from remote areas by hiding camera.Sometimes results shows misclassification of animlas and this is because system needs more number of images to train.This misclassification is also beacuase of light weight architecture selected for this system.

As this system is battery operated, but in future when any motion sensor is interfaced to the RPi so camera will only turn ON when there will be any motion by which it will save battery. Outdoor wi-fi with large distance connectivity can be used when data is needed to capture from large distance like in wildlife area.

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