

Developments of Deep Learning for Animal Classification: A Review

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Abstract - Now a days Animal Classification with notifying system is an important for day-to-day activities like surveillance in wildlife, in household and, in farm to protect from wild animals also for professional photographers for study purpose. Deep Learning using CNN (Convolutional Neural Network) is increasing performance/accuracy of the system over traditional algorithms for real time animal classification. As deep learning uses deep neural network which are trained on large amount of data by which it will improve performance of the system. This review paper is for explanation of proper selection of architecture from all other deep learning architectures for real time implementation using embedded device (like Raspberry Pi) for animal classification

Key Words: Deep Learning, CNN, SSD, MobileNet, Raspberry Pi

1.INTRODUCTION

Animal Classification is important task now a days. Traditional Algorithms are not properly solving animal classification problem when dealing with real time application. For the last few years, there is rapidly growth of deep learning algorithms which are trained over large amount of data. Deep learning is a method which is used for neural network having more than one hidden layer also called as deep neural network. There are different deep learning algorithms and architectures [2]. From that CNN is mostly used in object classification, recognition [4] and computer vision. CNN (Convolutional Neural Network) comes under deep neural architecture. Animal Classification [5] and notifying system for remote areas are needed now a days, which can be done using development boards like Raspberry Pi [1], on which deep learning algorithms can be implemented. And then notifying about output makes the system useful in remote areas also [6]. These single board computers are having some restrictions while implementing it in real time so considering all these things, proper deep learning architecture should be selected. This Paper gives flow wise selection of deep learning architecture considering accuracy of the system.

Animal Classification using CNN can be done using two ways: -1) Direct CNN Classification (Without animal Localisation) 2) CNN classification (with animal localisation) also called as animal detection [3]

1.1 Framework

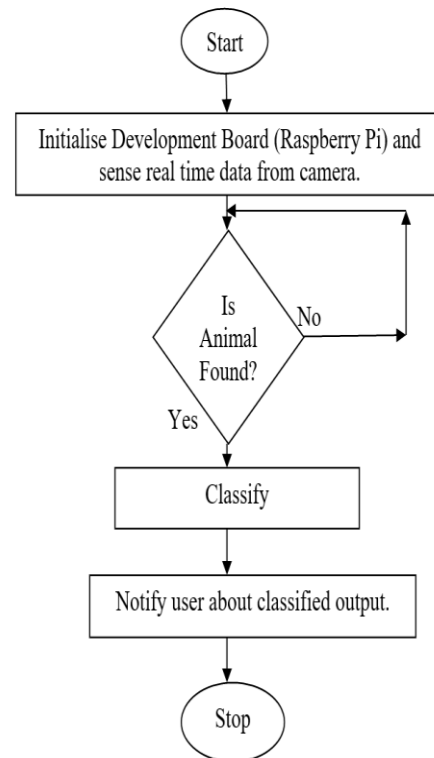


Fig. 1: Framework of animal classification system

So, general flow of the system is sensing the image from camera then use deep learning architecture for feature extraction, localisation and classification. If animal is found in the image, then classify image and notify the classified output to the user.

2. CNN CLASSIFICATION (WITHOUT ANIMAL LOCALISATION)

CNN (Convolutional Neural Network) is the feed forward (flow of information is in only one direction which does not contain any loopback) neural network. It is a class of deep neural network (more than one hidden layer) architecture [2]. CNN contains different layers like convolutional, pooling, fully connected [7].

There are two methods in CNN Classification [9]: -

a) CNN from scratch: -

In CNN from scratch, layers in the convolution can be changed according to the desired output. For that some initial configurations are needed to set first and then train the neural network. After training, testing and then comparing the results with previous trials and then again change the parameters that is adding some layers or changing values of neurons and repeating this again to find out final one having best results, takes more time. This CNN from scratch also gives less accuracy [9].so another method which is transfer learning is mostly used.

b) CNN using Transfer Learning: -

Transfer learning technique uses existing model whose weights are adjusted according to the data. These models have high accuracy in prediction of the image than CNN from scratch method. Some of transfer learning models are VGGNet, ResNet, MobileNet, Inception V3. These models need less training time as compared to the CNN from scratch method.

For animal classification, direct classification without localization gives less accuracy [1]. That is when animal classification has to be done on highly cluttered area, at that time before classification animal localization is needed to get more accurate results.

3. CNN CLASSIFICATION (WITH ANIMAL LOCALISATION)

Animal localisation and then classification also called as animal detection. Animal localisation means determining where animal is located in the given image/video and then classify the image. This makes increase in accuracy of the system. In generic object detection [8] first objects are located and then they are labelled with some rectangular shape boundary boxes which also shows the confidence of existence. Framework of object detection are categorized in two types [8]

A) Region proposal [8]-e.g, R-CNN, Fast R-CNN, Faster R-CNN etc.

b) Regression/classification based: - e.g. Multibox, YOLO, SSD, G-CNN etc.

3.1 Region proposal-based framework [8]

Contains stages like generating region proposal, CNN for feature extraction then bounding box regression which are trained separately. Latest faster R-CNN require to obtain shared convolution parameters so as a result time is spent while handling different parameters which will become bottleneck in the real time application.

So instead of RPN framework, regression/classification-based framework can be used which reduce time expenses for real time application.

3.2 Regression/classification-based framework [8]: -

There are two significant frameworks in regression/classification-based framework and they are: -

- i)YOLO [8] ii) SSD [8]

YOLO has difficulty for finding small objects in groups as YOLO contains fixed grids and SSD contains set of default anchor boxes. So, to overcome the problem SSD is used.

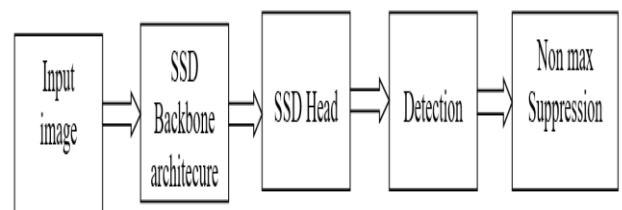


Fig.2: SSD simplified architecture

SSD [8] is used for real-time object detection. SSD has two components backbone architecture and SSD head. For Backbone different architectures can be used like VGG16, MobileNet. But when Application is for real time implementation on embedded device then at that time MobileNet which is light weighted can be used.

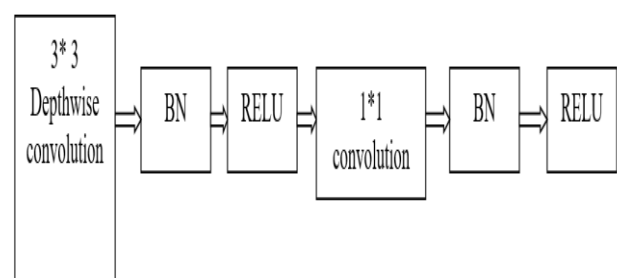


Fig. 3: MobileNet Architecture

MobileNet has small size, need low power which can be implemented on embedded device. In MobileNet both depth wise and pointwise convolution is done which makes it light weight neural network. So, SSD with MobileNet [3] architecture makes lightweight structure which can be deployed in embedded device for real time application.

4. CONCLUSION

Deep learning is making highly impact in all fields like medical, wildlife, Automation, as it has powerful ability of learning. This review paper provides selection of deep learning structure in a flow-wise manner from all other structures for animal classification in real time environment on embedded device by considering the factors like accuracy, embedded device capability. SSD with MobileNet architecture fulfills all requirement needed for real time implementation of system. This review is also helpful for other object detection applications in real time environment.

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