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BIODIVERSITY CONSERVATION MONITORING SYSTEM IMAGE DETECTION USING TENSORFLOW

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ABSTRACT

As we know, there are a huge variety of animals in the nature. Some of these are rare animals that are protected under governmental legislation. Technology can help people discover the condition of animals that are protected by the government. With the forest characteristic, Deep learning is a multilayer neural network, a kind of machine learning based on pattern recognition from input data; it has a property of unsupervised features learning which mean it can learn a datasets that only contain very few labelled data along with unlabeled data which is important in image recognition method. There are some of deep learning methods such as CNN, DBNs and auto-encoders. In this paper we using TensorFlow an open source library for numerical computation, specializing in machine learning developed by Google Brain. TensorFlow is library that used in deep learning methods, similar to convolutional neural networks (CNN). The methods using inception a huge image classification model with millions of parameters that can differentiate a large number of kinds images[poets], to classified and training image data layer by layer. We are using TensorFlow as architecture to image detection system for detection and recognition an endangered animal. This image detection system could help researcher's detect and recognize one of endangered animal (Dicerorhinussumatrensis) such as sumatran rhino with population of approximately 100at the end of 2015. Our proposed model achieved 95% accuracy to recognize such images.

Keywords: deep learning, neural networks, image detection system, tensor flow, endangered animal.

INTRODUCTION

Nowadays, there are so many researches in development image processing technology in computer vision. technology of image processing development has already used in many segments for helping human daily activities to get information such as security system that could recognize pedestrian, to recognize a foreign word (google translate) or detection any object using camera. According to Agus Sukoco *et al.,* 2017, Monitoring and surveillance system in forest area is a system developed by implementing the achievement of technology and information to collect data and information in different ways.

In Sumatra, the government is committed to save the Sumatran rhino from extinction; they put cameras in the jungle and collect data in the wild life to help researchers. The current camera technology is enough to just capturing a picture continuously but because the absences of network infrastructure in the conservation area the keeper have to go into the jungle to collecting data and change the batteries every month.

By developing the camera device with trap area using infrared sensor, it increases the ability to capturing picture or recording video from an object that crosses on area. The data from camera will be transmitted to raspberry and process it to collecting a picture that contain an object. For data transmission it uses UAV with Delay Tolerant Network architecture. It may help solve researcher's problem to collecting data. DTN architecture use store-carry and forward concept, which mean when collecting the data and the connection not available, DTN will carry the message until the connection available and the data fully transmitted and sent to the computer center.

After collecting data and putting it into computer center, we can detect and recognize the image using TensorFlow library. TensorFlow has been trained with the rhino data to make the detection works, the rhino data was trained and classified with inception, to make the machine learning acknowledge if that data is rhino.

RELATED WORK

TensorFlow

According to Zhao *et al.,* 2016, TensorFlow in generally is deep learning library, deep learning is kind of machine learning method which can learn from datasets with few labeled data and many unlabeled data, which is important in image recognition method, deep learning features will extracting input that we gave and learn layer by layer, the output of one layer is the input of the next layer.

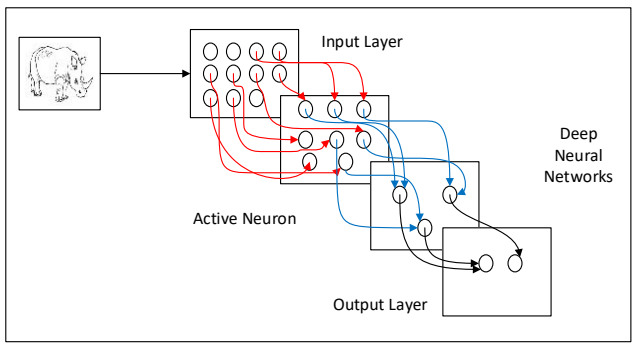

Figure-1. TensorFlowdeep neural networks layers.

TensorFlow is represented by nodes and edges, nodes represent mathematical operations and edges represent multidimensional data arrays (tensor) to be communicated between nodes (Martin Abadi *et al.,* 2015).

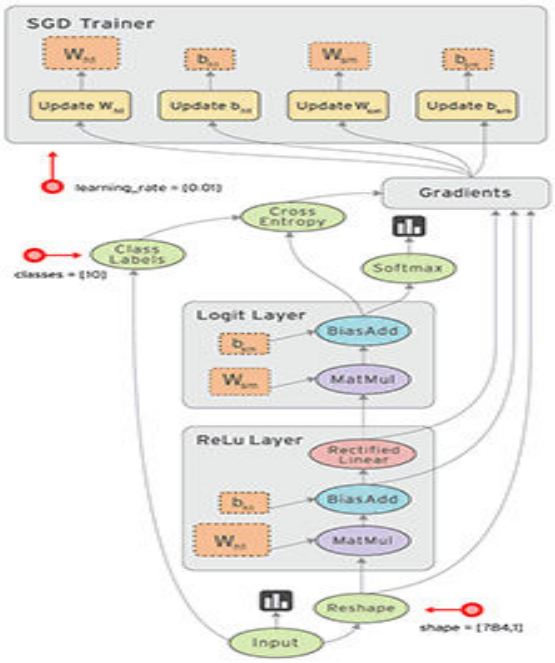

Figure-2. TensorFlow data flow diagram Martin Abadi *et al.,* 2015.

Convolutional neural networks

CNN architecture is kind of deep learning method for image classification tasks. Before image is used for classification, CNN apply a series to filters a raw pixel data of an image extract and learn higher-level features then we can use the data for classification. Simple model of CNN can you see in Figure-3.

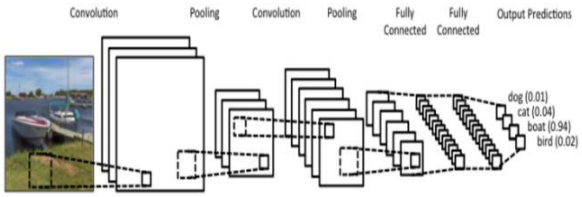

Figure-3. Simple model of CNN according to Wu, *et al.,* 2015.

CNN contains three components such as: Convolutional layers, which apply specified number of convolution filters to image.

a) Pooling layers, which down sample image data extracted then to reduce the dimensionality to decrease time
b) Dense layer, which perform classification.

Inception module

To train our data we use inception V3, the main idea of inception is how convolutional vision networks could be approximated and covered an optimal local sparse structure by readily available dense component (Szegedy *et al.,* 2015).

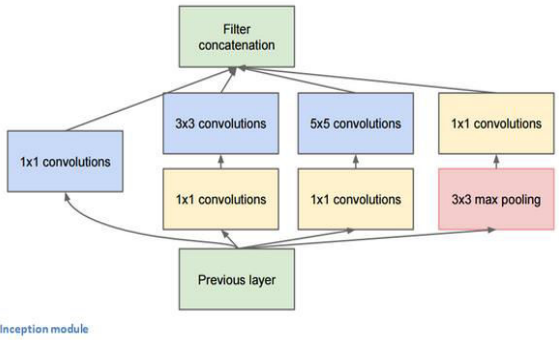

Figure-4. Full Inception Module by Szegedy*et al.,* 2015.

The first step is to analyze all the images on storage and calculates the bottleneck; inception is made by many layers. All of these layers are pre-trained and already benefitable at finding information to help classify the image.

The bottom box is an input and the top are output, and the rest of box basically is a layer of convolutional networks, which could choice of operation, pooling operation, convolutional operation or filter size. What an Inception module allows to do is to perform all of these operations in parallel (Szegedy *et al.,* 2015).

Transfer learning

In this paper we use transfer learning in TensorFlow. Without amount of data from google, we can't possibly create effective deep learning model. Transfer learning is the process of taking a pre-trained model, which means we utilizing a model that has been trained on another problem and retraining the data in similar problem, we just utilizing the final layer of the network and replace it with our classifier it make training the data done in short order according to Martin Abadi *et al.,* 2015.

Comparing image detection system

Our model is different in comparison to other image detection system such as deformable part model and YOLO as:

a) DPM is an image detection architecture which uses a sliding window approach to object detection, this model trained using discriminative procedure that require bounding boxes the object in set of images. Pedro F *et al.,* 2010 highlighted that to make accurate result and more efficient we could use the PASCAL VOC benchmarks and INRIA person data set. DPM was an innovation model from Dalal-Triggs that used HOG. In model pyramid it will separate the object into some part and classified them, which mean DPM

also can have high probability on detecting object but it complicated to train the data.

b) YOLO model is a Convolutional Networks (ConvNets) with unified detection, basically YOLO is also part of deep learning, which can detect multiple objects in an image simultaneously by dividing the image into aSxS grid and each grid will predict bounding boxes of object, confidence score and class probabilities. Joseph Redmon, 2016 and Nguyen *et al.,* 2016 infered that the confidence will reflect the score that box contain the images and think how accurate that box detect the image.

DESIGN

To develop image detection using TensorFlow we use python in Docker a virtual machine to run and compile TensorFlow.

Table-1. Experimental environment.

Software environment	Hardware environment
Operating System:	Computer: Asus N46V
Windows 10 64 bit.	CPU: Intel Core i5
Development tools:	Memory: 4GB
Docker virtual machine	Graphic:Nvidia GEFORCE
TensorFlow+Python	650

The whole system that we built could be seen in Figure-5; here it is a step by step data upload to server.

a) Sensor detection an object.
b) Trigger an Android to capture picture.
c) Raspberry Pi acts as a bundle receiver from Android.
d) Raspberry sent file to UAV.
e) Computer center get the data and detect an object.

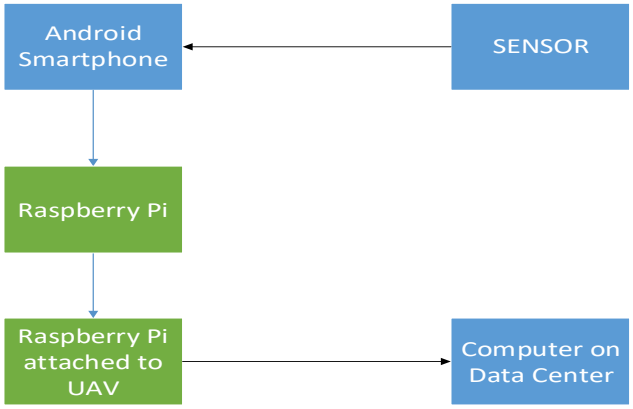

Figure-5. Block diagram of monitoring system.

That diagram shows us how the system works, when there are animal crosses the sensor are it will trigger the trap camera to capture a picture or record a video using Android smartphone. After that the android smartphone would send image and video using DTN to raspberry pi, and detecting an object or not.

For image files detection in raspberry, there are 2 image pre-processing methods that are used. Gaussian-Blur method and converting RGB to HSV color space. It will acknowledge the picture only and try to detect if the picture contains an animal or not, if the picture contains an animal it will separate into another folder and will collected by UAV.

Sending image file into UAV by using DTN, when connection is available; UAV will start collecting data, and if the connection is not available UAV will carry the file until the connection gets available and continue collecting data. When data moves to computer in data center it will use image detection system using TensorFlow to detect an image that contains only a rhino and separating it with another image.

RESULT AND DISCUSSIONS

TensorFlow that is used in this research works fine, as the result that we get TensorFlow can detect an object from approximately 20 images in short amount of time. The simulation was set to detect a rhino that contain in every image from any angle and position also mixed with some other image beside the rhino. The simulation successfully detected a rhino and spilt them into different location.

As the result TensorFlow detected accuracy approximately about 95%, but there is condition that image was detected contain other animal, it because the unique of the rhino such as the body, legs or another part has similarities with some animal or in that picture contain a rhino and other object but it's still detecting as a rhino.

Table-2. Accuracy result system with TensorFlow.

No	Filename	Percentage	Rhino detected	Rhino undetected
1	01.sumatran rhino.jpg	63%	Yes	
2	1.jpg	87%	Yes	
3	Clouded leopard.jpg	0.8%		No
4	Malayan sunbear.jpg	1%		No
5	3.jpg	94%	yes	
6	Sumatran tiger.jpg	2%		No
7	Malayan tapir.jpg	55%	Yes	
8	7.jpg	96%	Yes	
9	8.jpg	96%	Yes	
10	Sumatran elephant.jpg	2%		No
11	12.jpg	92%	Yes	
12	17.jpg	95%	Yes	
13	Rhino.jpg	86%	Yes	
14	Forest.jpg	8%		No
15	Lasndscape.jpg	9%		No
16	Human.jpg	50%	Yes	
17	People.jpg	0.5%		No
18	forest.jpg	8%		No
19	Muncak deer.jpg	1%		No
20	Sambar deer.jpg	43%		No

This table shows that most of images are accurately classified. Distribution of the Accuracy percentage is shows in Figure-6. Blue marking on the number 7 and 16 got 50 and 55 percentage, this image shows wrong classification.

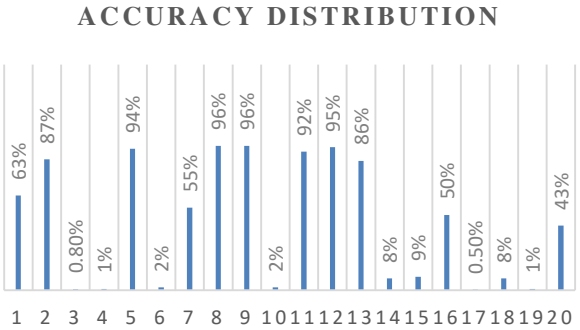

Figure-6. Accuracy distribution system test.

CONCLUSIONS

The purpose of this research was to apply the machine learning architecture to build image detection and recognition system to detect a rhino in the wild. The system can separate the picture that contains a rhino or not. Based on several tests even though the program could detect the object with approximately 95% accuracy, there is also a percentage of error to recognize the object accurately.

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