ANIMAL BEHAVIOR DETECTION USING DEEP LEARNING

BY

MD. RAJIB AHAMED
ID: 162-15-7798

MD. KHORSHED ALAM
ID: 162-15-8087

AND

MD. SAIKAT AHSAN
ID: 162-15-8099

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Prof. Dr. Syed Akhter Hossain
Professor and Head
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY
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APPROVAL

This Project/internship titled **"Animal Behavior Detection Using Deep Learning"**, submitted by Md. Rajib Ahamed, ID No: 162-15-7798 and Md. Khorshed Alam, ID No: 162-15-8087 and Md. Saikat Ahsan, ID No: 162-15-8099 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 14th SEPTEMBER 2019.

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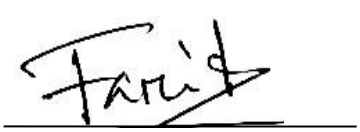

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Department of Computer Science and Engineering
United International University

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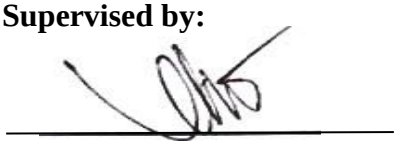
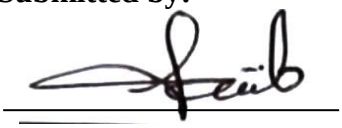
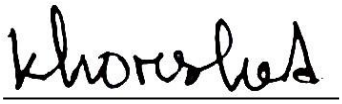


Prof. Dr. Syed Akhter Hossain
Professor and Head
Department of CSE
Daffodil International University

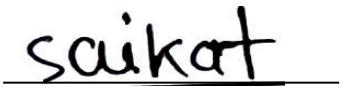
Submitted by:



Md. Rajib Ahamed
ID: 162-15-7798
Department of CSE
Daffodil International University



Md: Khorshed Alam
ID: 162-15-8087
Department of CSE
Daffodil International University



Md. Saikat Ahsan
ID: 162-15-8099
Department of CSE
Daffodil International University

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ABSTRACT

In this competitive modern era, machine learning has been retained the crucial contribution to detect and recognize the object from real-time image data and much more. So one of the most fabulous tasks is ABD, ABD (Animal Behavior Detection) will automate the analysis and recognitions the emotions of an animal such as cat behaviors as monitoring the unobstructed natural environmental image DataSet. In this experiment at firstly, we proposed all technics in the theoretical background. Secondly, we collected entire informatory data such as image data to detect the behavior of animal which illustrates the diverse types of emotions of the cat behavior. In this step, OpenCV could be processing and analysis the images. Thirdly, we used TensorFlow and attempted to fabricate a neural network with different images of cat emotions, and then we attempted to search the correct classification through plenty of test images. We used a deep learning CNN based model (Inception-ResNet-v2) that is used to train all the images from the ImageNet database and classification, also it used to recognize the emotions in static images. Finally, finishing all the required tasks of this application will work thoroughly and will give us nearly 84.5% accuracy.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Over the years, pet emanated as the essentially with a family of this world and peoples are very interested to foster pet with more enthusiasm. In addition to this as human population growing up likewise as well as pet populations also. The most phenomenal thing is so many animals are stable on this planet and among them pets are very infatuated animal who's laying and sharing the bed with their owner of the family members. According to the GFK (Growth From knowledge of Global study), more than 40-50 percent of peoples internationally are living with their pets. Moreover, Argentina (around 82 percent), Mexico (around 71 percent) and Brazil (around 76 percent) are the highest percentages of the owner of the pets where the USA (about 90 percent) and Russia (about 85 percent) are the top places here. On the other hand, Asians are bottom place own pets. According to the survey of Live Science in 2013, 88.3 million cats, 74.8 million dogs, 24.3 million small animals, 13.8 million horses and solely 16 million birds are most popular in this world.

So nowadays between the human and animal are becoming very close to each an others. Throughout the world, the animal has completed an integral range of various actions and the number and variety are consistently expanding [1]. Animal Behavior detection is a significant and outbound area because of a big amount of real-life applications. Various animal detection systems are developed to perceive that what type of animal it is, as it is wildlife or pet [2]. Then by the tracking of animals for monitoring or detect the behavior of animals. Researchers in implemented zoological systems for tracking an animal, identification by using radio-frequency identification (RFID) and GPS (Global Positioning System) [2]. A number of few years ago, by pre-trained deep CNN (convolutional neural networks), proved and shown to perform well in extracting image features in challenging databases such as ImageNet for detecting human emotion recognition.

In this paper chiefly we focused on detecting the behavior of pet animals such as cats and we attempted to get the behavior from the image processing.

1.2 Motivation

From the beginning of civilization, humans as pet's dogs, cats, cows, goats have been reared as pets with a variety of animals. At present, peoples are more likely to be related to pets. Currently, in this age of technology, animated movies or cartoons are becoming quite popular with animal behavior today. Some animals can be seen laughing, crying, or being angry [3].

There are animals like humans and feelings of emotions. They also angry, sad, sick, sleep, hunger, tired and we sometimes see very little amount of that situation or understand. But in reality, it is not very easily understood by an empty eye or an animal that wants to express its intention in that situation [3]. The topic of animal motivation deals with:

How and why animals assign in egregious activities.

What tackles inside the animal generates behavior.

How incentives from the external environment dominance these mechanisms.

How this behavior is salutary to the animal.

How animal interacts with people and how to understand the different types of emotion between animals.

So, we are working with an animal behavior detection project to detect the exact animal emotion and find the perfect characteristic at a particular time for a particular user [4].

1.3 Rationale of the Study

Animal behavior detection is a massive procedure and challenging to detect the behavior from the real-time image process of the animal. To make more interaction among humans and animals this method would be enormously effective, although it is not such an easy it is attractive also. In this research primarily have to collect image data, to classify

the object, to make the neural network and implement the application then get the best solution and accuracy of output. Despite it is a lengthy process but this is a highly easy way to detect the behavior of the animal along to make easy to communicate with them. So this procedure will help to comprehend the passionate people to interconnect with the animal. That's why we have been working as much as effortlessly on it to get better performance.

1.4 Research Questions

Q1. Is there any technique to detect animal behavior Identification?

Q2. How can detect animal behavior from real time image object?

Q3. Is it possible to get behavior as result from real-time images of animal faces?

1.5 Expected Output

In the machine learning area, there is plenty of work has done and predicted and perceive the improvable think so far. Here we have worked on animal behavior detection by the machine learning. We have implemented the application to detect the behavior of animals either it is feeling angry, sick, sad, sleepy by classifying the object. Although it is not possible that work on the entire animal. We have worked on pet cat animals that indeed identify the emotions and demonstrate the behavior. By following this procedure any researchers will work on it to make various types of their application. In the future, we will be retain continuing to detect different types of animal behavior.

1.6 Report Layout

In chapter 1: We discussed the primary concepts of "Animal Behavior Detection" and additionally practice with motivation, the rationale of the study, research questions, expected output, report layout of our research-based project.

In chapter 2: We describe the related works, research summary, the scope of the problem and challenges.

In chapter 3: Focus on research methodology and also discuss research subject and

Instrumentation, data collection procedure, statistical analysis, implementation requirements.

In chapter 4: We describe the details of experimental results and discussion which, includes the following parts such as, experimental results, descriptive analysis, and summary.

In chapter 5: We have concluded our evaluation outcome and also about some other features that can be included in future works for the betterment of my research work.

CHAPTER 2

BACKGROUND

2.1 Introduction

In this chapter, we will reveal associated work where it has been picked up that whether until now any work has achieved which is related to our lookup work. And then here we analyzed the research summary where mainly allusion about our work. Also, discuss the scope of the problem of our application and after that, we have explicit about the challenges of our work.

2.2 Related Works

Animal behaviour detection is particularly complex. It spans a remarkably achievement extensive range of phenotypes for instances, fighting, food search and so on [5]. Now in this part, have been done so far as animal behavior research monitoring the behavior of livestock animal welfare and health tracking by using track lab not the way of the machine learning also had not implemented [6]. Just several years ago has been developed analyzing animal behavior in wildlife videos using face detection and tracking. Here to detect the ALB (Animal Locomotive Behaviour) by combining detection and tracking of animal faces in wildlife videos has given. For instance, the algorithm is used for lion faces. And then to detect the algorithm is dependent on face detection of the human process utilized hears like features and Adaboost Classifiers [7]. To acquire the classify the ALB (animal locomotive behavior), a particular process that primarily put in and therefore traces the animal faces in a given video sequence data has developed. At the beginning point to monitoring the image support for the appearance of the animal face, we have applied an algorithm for identifying and recognized human equitable faces, which induced by Viola and Jones. To detect the image territories through the human faces by using this algorithm [7]. Adrian Rosebrock has developed animals detect as detecting cats in images with OpenCV by using deep learning algorithms. Also to learn about rate schedules and erosion by using keras [8].

In the same way, we will implement the application that detects the animal and recognize

the behavior of the animal (such as cat behavior detection). To detect the object we used OpenCV in computer vision and we used the deep learning algorithm. And then the most significant thing is that we used CNN (Convolutional Neural Network) to classifying or retrain the network with TensorFlow image classifier the data such as whether the cat behavior is angry, sick, sad, sleepy and neutral. After that will be showing the text on the OpenCV window to getting the accurate result.

2.3 Behaviour Categories

Regarding the research of human emotion recognition have been traced around in 1970. For the first time researchist Paul Ek-man and his associates they invented six expressions of human faces such as (Happy, angry, sad, disgust, fear, surprise). Those expressions may be perceived that people have come from a different culture. The difference is between the background impressions face disclosure [9]. Based on those expressions we tried to detect the animal (such as a cat) and recognized the expressions of this animal (angry, sad, sick and sleepy). And such as the cat have not been having something for the last 2 or 3 hours. After that what will it be feeling, this expression will be detected by this process. By the same way would be to detect the other's expression of cat. Here, we have shown the different types of behavior categories as below,

Figure 2.3.1: Different types of behavior.

2.4 Research Summary

Since before there has been implemented plenty of emotion recognition of humans based on Deep CNN (Convolutional Neuron Network) of machine learning of that was

admirable also the great achievement for humanity. Subsequently, many researchers have done a plethora of work by following this way into their own way. We have implemented our application (animal behavior detection) by following the same way of human emotion recognition. The summary of our research has given bellow-

First step

- Collect data and processed them
- Categorized input data and diminish unnecessary data

Second step

- Load the XML file
- Detect cat animal (as object) and faces of them

Third step

- Feed those data into deep CNN
- Use cross-validation for divided data into train and test set

Fourth step

- Training the Deep Convolutional Neuron Network(CNN) classifier

Fifth step

- Detect behaviour from new cat photos
- Get expected output result

Sixth and final step

- Get the accuracy of each detection result.

2.5 Scope of the Problem

Animal behavior detection is a process that help to perceived the sentiment of the animal. Categorized the datasets of images of cats that have done by using the various deep learning algorithm of machine learning trained and tested image datasets by using those deep algorithm [10]. By this system, we have tried to inspected the datasets and find out act of animal. After analyzing the image datasets we will get the result (which is animal behavior such cat behavior). Despite the animal detection (pet or wild animal) has done in abroad but has not done animal behavior detection from its expression yet also in Bangladesh .Through this procedure we have tried to find out the animal and recognized different act from its various expressions.

Therefore, this method can make sure by its expression that what is doing feel and make an obtainable way to make communication between human and cat animal

2.6 Challenges

When people go to do something innovative or changing, there are various types of obstacles. Likewise, we have faced many setbacks or challenges in doing this research based project. And we have made every effort to tackle the problem. Since we are new to this research-based project platform, so we first needed to know how Deep CNN works to work on this thesis project. The identification of animal behavior is a major challenge due to the imagery of different types of animals. And this challenge can be solved simply by using deep CNN. On the other hand, our main purpose was to provide real results through artificial intelligence technology when an animal is staying in Angry, Sad, Hungry, Sick, Sleepy state, and what they mean by using the image capture of the animal at that time.

A significant problem is the data collected photos of hundreds of different species. Which we've collected efficiently and carefully, and with them we were able to replace the ImageNet database by creating a neural network. And the above tasks were challenging For us.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

A research strategy is a prepared format for regulating research. It composes the theoretical evaluation of the discern of strategies and concepts associated with a zone of expertise.

In this chapter varied steps are considered, Firstly we have collected image datasets and shown them as well and pre-processing the data, then we used instrumentation to get the result and then feed Deep CNN and training it after that detect the behavior of the animal (such cat behavior). In the first phase, feature reductions are reduced extra and unnecessary data from data using OpenCV. In the second phase train our Deep CNN with shuffled data and get validate the result.

3.2 Research Subject and Instrumentation

Animal behavior detection is my research subject what have done by deep learning algorithm.in case of research field it is rigor and challenging task. Especially people are becoming always looking forward to get innovative thinking in this world. Though in our country, One-third of people are very interested to used to with pet animal but in abroad majority of people are eager to used to with pet animal. Hence we thought before that we will implement a system that will create easy way and interaction between human and their luscious pet at home and abroad. we have used python for this project and most exoteric Machine learning (ML) library TensorFlow also deep CNN for getting best accuracy model also we have used OpenCV for pre-trained object [11].

3.3 Data Collection Procedure

We have shown and described the procedure of data collection within two experiments with details.

Experiment 1:

For this project data collection, the procedure is like an extreme task. We have collected the image datasets for various behavior from different sources such as real-time image datasets we had to go to few places and we collected the majority of the datasets from different websites. To follow the procedure we have stored the images dataset into the database which has shown below.

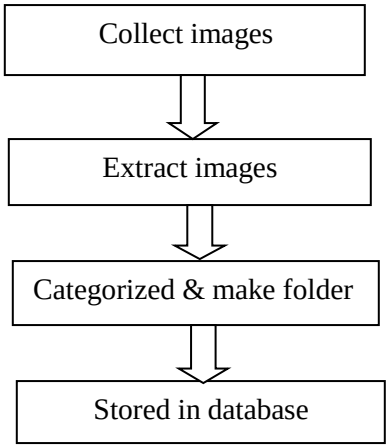

Figure 3.3.1: Data collection procedure.

Experiment 2:

Table 3.3.1: Statistics of image collection with detailed.

Features of images	Total no. of images for each behavior	Image format	Size of the images
Angry	700	JPG File (.jpg)	Various
Sad	700	JPG File (.jpg)	Various
Sick	700	JPG File (.jpg)	Various
Sleep	700	JPG File (.jpg)	Various
Neutral	0	Null	Null

From table 3.3.1 Here are various image datasets that we are getting see and there are four varied image datasets such as angry, sad, sick and sleep where neutral is 0. In total we accrued more than 2800 image data for 4 different behaviour for this procedure. Then we depot entire image datasets in the database. And trained the image datasets within the

deep Convolutional Neural Network (CNN) model alongside exert the deep learning algorithm we will get the performance for this method.

Here contains distinguish stages of the data collection procedure of experiments. We have trained image datasets and tested datasets discretionary conventionally (80% and 20%) data to realized the sentiment of cat animal.

Table 3.3.2: Separated the entire dataset for training and testing set [11]

Features of images	Total no. of images for each behaviour	Train image datasets (80%)	Test image datasets (20%)
Angry	700	80	20
Sad	700	80	20
Sick	700	80	20
Sleep	700	80	20

3.4 Statistical Analysis

Which data gathered should be proper to the procedure for the neural network. Primarily the data have made ascertained that value stays proper to an intimate extent. And those data should be unique that will show the best performance with the accuracy. So in this case, Statistical analysis embroils gathering and anatomize each data form in a set of rank from where form could be drawn.

3.4.1 Pre-processing

Here we will sent data into preliminary processing (pre-processing) system, remove adventitious, reduce feature and will image data shape.

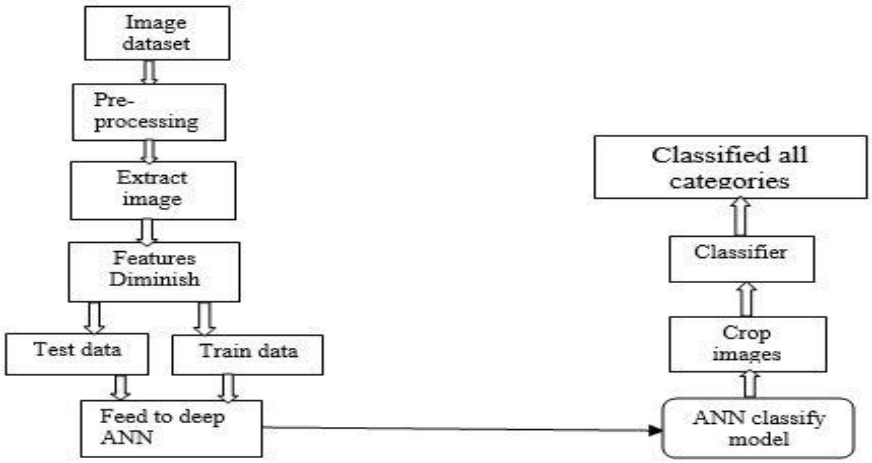

Figure 3.4.1: Preliminary processing architecture.

Here, we filtered the image and extract junk from images which is shown in bellow,

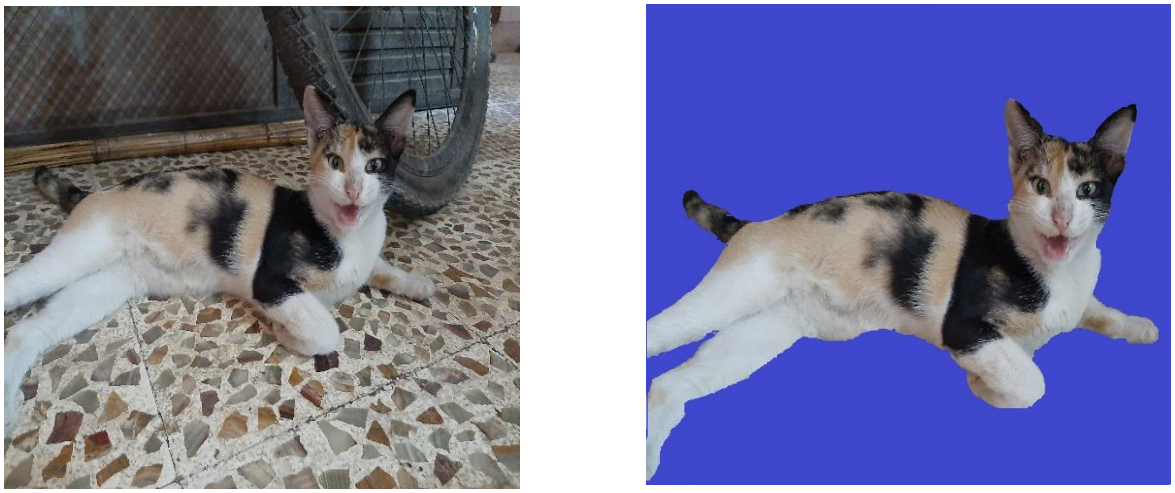

Figure 3.4.2: Removed outsider garbage.

3.4.2: Image Data Richness

The assessment of image data richness that can be multicolor different images. And then we arranged 4 types of image data such these are angry, sad, sick and sleep. These image data are a help to the classifier to perceive the face and eyes of the cat. And the neutral is to remain null that our classifier can make different and detect the behavior.

3.4.3 Feature Reduction

Before train and test data have to reduce the some inessential image of features which do most significant. Cause, in the image there could be few others view that can be perish the aspects of view. So the wane of the characteristic is essentiality for making the proper aspect of the image data sets.

Reshape Image

We collected several formats including various shape images. Such as some of the data can be a large size and some can be a small size that dimensions respectively (2016x1512) where width 2016 and height 1512 pixels which is the big computational problem. So we have to reduce this size and convert into a matrix format (64x64) that respectively 64 pixels for row and 64 pixels for a column to make a standard image size.

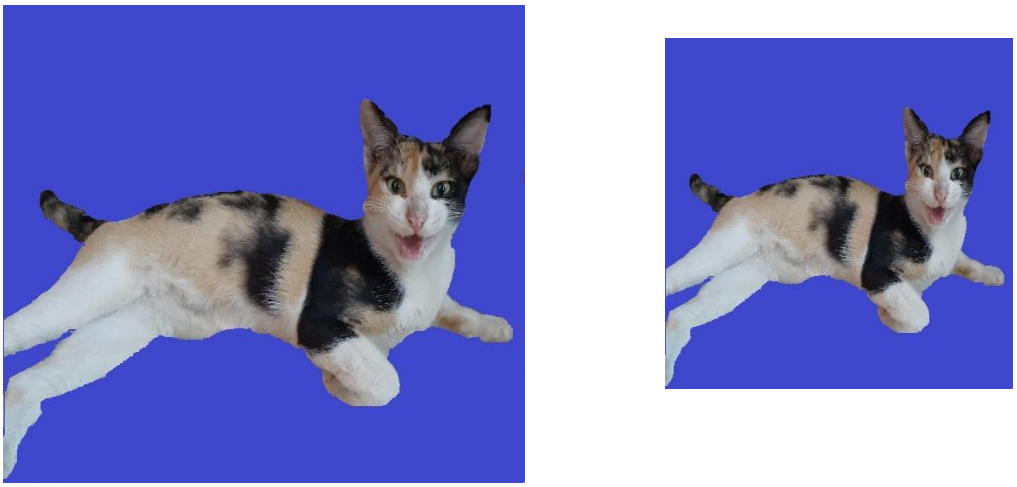

Figure 3.4.3: Resize images.

Background Elimination

During classification, classify process sometimes gets confused due to the unnecessary background data when we feed data to the CNN and the classification process considers them to classify content or area. So we will try to reduce this issue completely and wipe background data from images.

Figure 3.4.4: Background elimination.

Noise Reduction

Noise reduction is an imperative trouble for making object sharp and clear identification. So we utilized the Non-Local Means algorithm to curtail a group of pixels surrounding a goal noise pixel to clean the image.

$$u(p) = \frac{1}{C(p)} \int_{\Omega} v(q) f(p,q) dq.$$

Where,

u(p) = Filtered value of the image.

v(q) = Unfiltered value of the image.

f(p,q) = Weighting function.

C(p) = Normalizing factor.

Where, **C(p)** is indicated by:

$$C(p) = \int_{\Omega} f(p,q) dq.$$

Figure 3.4.5: Noise Reduction.

Crop faces from image data

Since we working on animal behaviour detection from face expression that's why we need only faces from all the images of all emotions directory. Then we require to crop the face of images to detect the behaviour of cat animal.

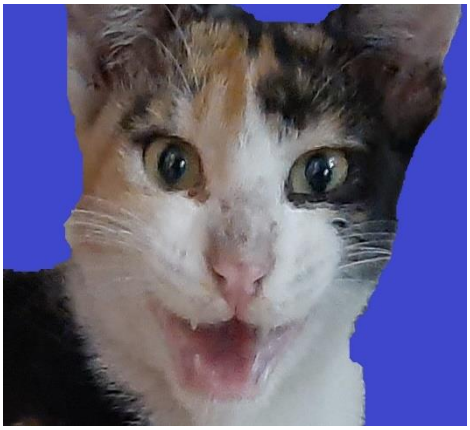

Figure 3.4.6: Crop faces from image cat.

Proposed processing model

In this design procedure, here are a diverse type of steps and each step has the diverse task of this procedure [11]. Every step linked with the nearest steps. Therefore during develop, firstly we have to take an image as input and then follow this procedure which has shown below.

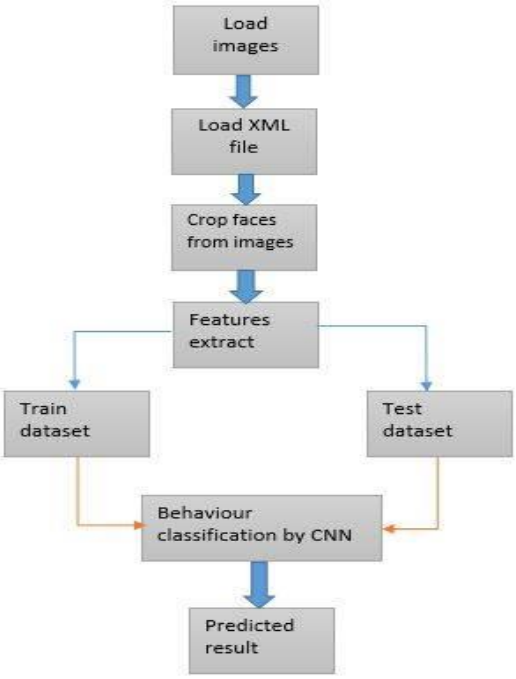

Figure 3.4.7: Proposed processing model architecture.

3.4.4 Deep CNN

CNN is an excellent algorithm for supervising and unsupervised learning method. Which is a neural network that makes Interrelation with classify problem where solve any problem like a flowchart. At the beginning point, we created a model, model parameters, biases, and a hidden layer. In the animal behaviour detection method, we will solve the identification problem by Deep CNN (inception v2) (GoogleNet). It gives us more authentic result.

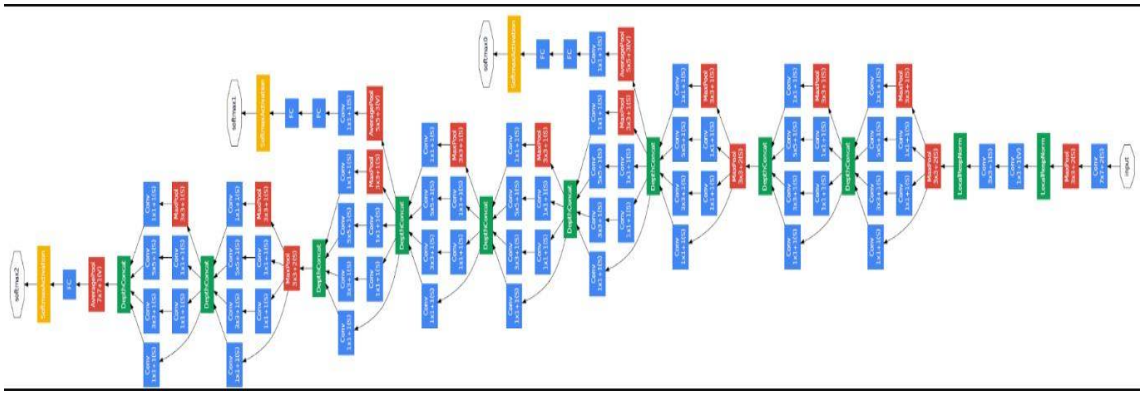

Figure 3.4.8: Inception v2 architect

3.4.5 Feed to Deep CNN

We have done all the prerequisite of our process model so now we could began our work. Basically we are going to feed our deep CNN inception v2 model and before doing this we had to ripe our data to feed CNN model. We have shown below the model graph which is almost like this.

Figure 3.4.9: Deep CNN model graph [11].

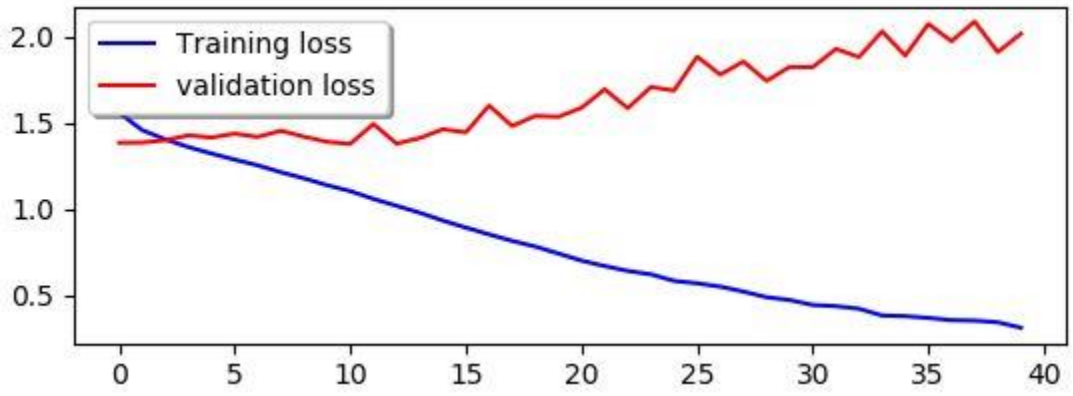

Figure 3.4.10: Training and validation loss.

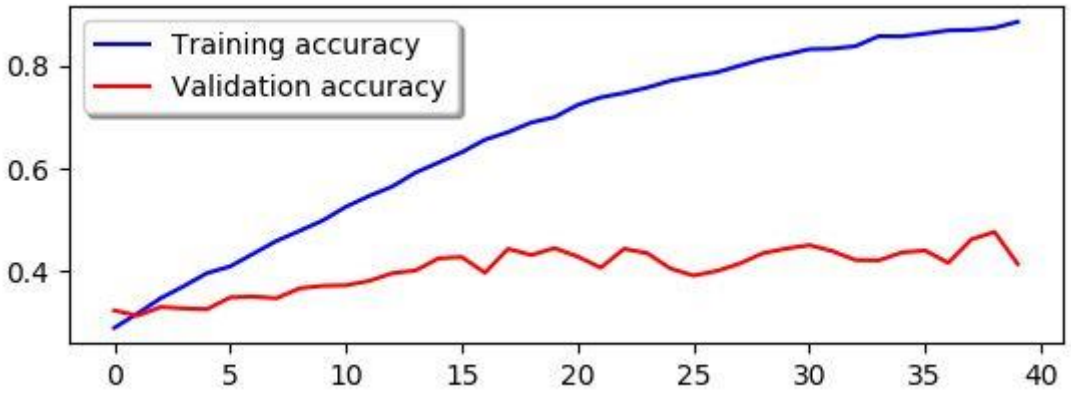

Figure 3.4.11: Training and validation accuracy.

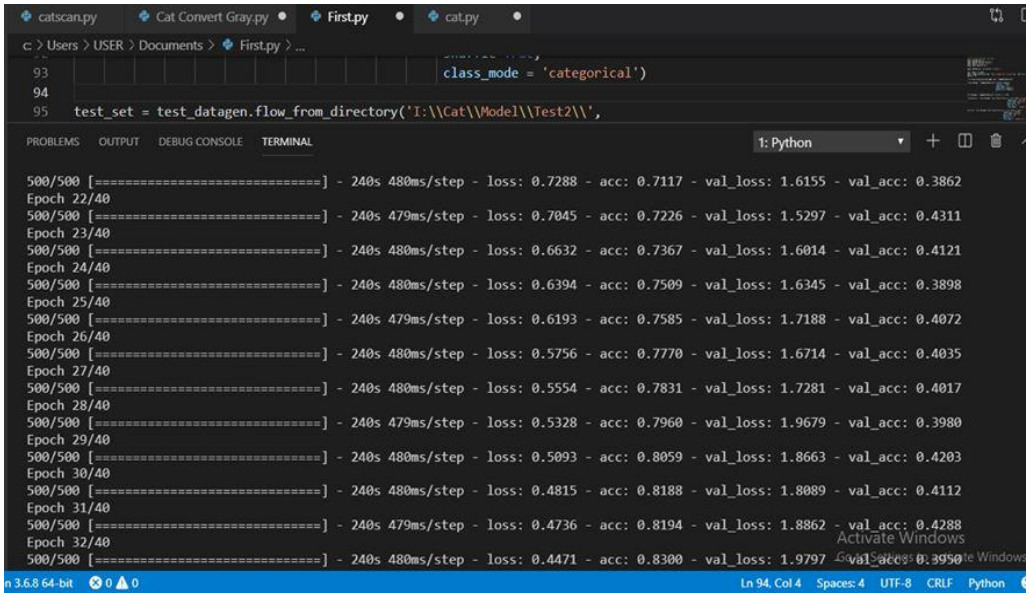

Figure 3.4.12: Test accuracy.

3.5 Implementation Requirements

❖ Hardware Requirements (Desktop version):

- Minimum Dual-Core processor and hardware.
- **RAM:** Minimum 2GB or above.
- **Processor speed:** 2.0GHz or above.
- **Hard Disk:** Minimum 80GB or above.

❖ Software Requirements:

1. **System software:**
    - **Operating system:** 64-bit Operating System.
2. **Application Software**:
    - **Python:** Jupyter or Visual Studio Code with any version.

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

The accuracy of animal behavior detection is immensely precise. As the foremost task of the CNN model that classify all the images dataset of animals (cats) whither the accuracy level of the classification of the image is around 84.5%. And the more precious point is our data that is more utile for each categorized for that we got the worth of a result of this method. Besides, the second task in our system which to classified the extremely inflexible image. Cause, we had to make the CNN and sum up with this layer to the images dataset what was taking much time to computation. But the accuracy level was contented.

4.2 Experimental Results

As we are working on animal behavior detection from faces and eyes of the cat, few of the time it is horrifically in dilemma and it cannot detect faces and eyes. For that reason, the classifier couldn't categorize data duly. There was innovated so many methods to curtail this type of inconvenience from where to get the appropriate result. So this kind of issue can reduce by using the Deep ANN algorithm. In our Deep CNN has trained the model to classify these into 4 features. Such as angry, sad, sick and sleep. And the deep Convolutional Neural Network (CNN) that essence the images dataset in many various ways to get the best performance with the best accuracy. During the time of tuning, fine-tuning will run begin. And the classifier will detect the behavior alongside find the more accurate result with aggregately 84.5% accuracy by training the classify model. By a table we have shown in bellow about the accuracy level of the training data sets.

Table 4.2.1: Accuracy of the result with percentage in various behavior.

Features	Accuracy of the result (%)
Angry	0.89
Sad	0.75
Sick	0.82
Sleep	0.92

Details histogram about training accuracy fulfillment is proven:

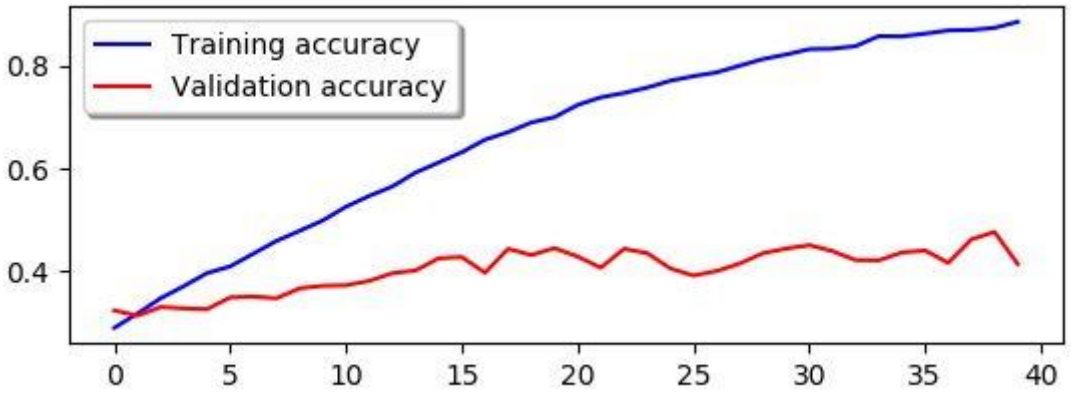

Figure 4.2.1: Accuracy of training and validation.

4.3 Descriptive Analysis

As our research has been achieved primarily based on the check data. So the first stage of the scan there we used 80% records for the coaching set and 20% statistics are used for the check set. Already you have regarded our deep CNN classifier, it can now classify 4 instructions almost accurately.

In desk 4.1 there you can see the share of the correct classification accuracy results. Now we already understand about how our model labeled animal conduct detection. But why this is not getting stability? Two the reply is very simple, as we already recognize the

working method of deep CNN and its layers. In the validation process, our model parameter determination works that's why the price is frequently altering over iteration.

4.4 Summary

In our experiment, we are an attempt to dispose of the animal behavior detection problem more strictly using a deep convolutional neural network (Inception-ResNet-v2) [14]. After that fine-tuning and dispose of the learning we acquire in the region of 70% - 96% accuracy of more than 4 classes. Their angry detection accuracy is near about 89%, sad detection accuracy 75%, sick detection accuracy 82%, sleep detection accuracy 92%.

CHAPTER 5

SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE RESEARCH

5.1 Summary of the Study

At the end of the literature review work we are attempt to illustrate a deep learning approach in an animal (emotion detection) to detect animal behaviour problem using Convolutional Neural Network (CNN) model [15]. The following is our whole research summary is given below —

I. First step

- Data gathering and processed them.
- Categorized input data and diminish unnecessary data.

II. Second step

- Metastasis learning.
- Detect cat animal (as object) and faces and eyes.

III. Third step

- Classify the animal (cat) behavior problem using deep CNN.

IV. Fourth step

- Training the Deep Convolutional Neuron Network (CNN) classifier [15].

V. Fifth step

- Detect behavior from new animal (cat) photos.

VI. Last and final step

- Find precision and entropy to get better results.

Find and contact to our team to get better accuracy and accomplishment.

5.2 Conclusions

In this test, the detection of emotion with the behavior of animals have been examined in our model, but we are trained our model with four classes. So our model can recognize four sorts of levels there are anger, sad, sick, sleep and neutral etc. The classification that is applied in our experiments is Deep Learning which consists of a Convolutional Neural Networks (CNN). It has several secret levels. Each hidden layer collects different data from the image data, thereby improving the classification of Convolutional Neural Networks (CNN) more precisely.

At the end of the session, we can say that it can easily detect any type of animal emotion base photo with higher accuracy. For other things, it can also detect easily it’s not an animal (cat).

5.3 Recommendations

We apply image classification algorithms in CNN/deep learning to detect an animal's peculiarity entirely [16]. This study used more than 2800 samples. To acquire more accurate results we need to consider more samples. Moreover, here considered the real animal emotion photo from the environment, but next to be tried to detect any animals from the finicking picture and show 100% accurate results from the animal image.

And it's even more animal behavior to detection in as like any similar or scouring type of image environment. The researchers searched the current expansion strategies. In the future, we will be offering a new prolongation strategy which works more effectively.

5.4 Implication for Further Study

In this experiment, we exhibition animal behavior detection from an animal. We have used a midsize image Dataset and metastasis learning to our CNN classifier model (Inception-ResNet-v2). For the time being, we were selected four classes to classify, but in the future, we will our model with varied animals to detect their behaviour’s, and then we constitute a larger neural network database. So that it can categorize exceedingly behavior at a similar time

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APPENDICES

Appendix A: Research Reflection

When we started this research, we have done face-to-face many problems and retardation from time to time. Then when we have solved the problems of programming and artificial intelligence then we learned about the several types of techniques and technologies. In these cases, we had to learn new machine learning, deep learning techniques and Convolution Neural Networks (CNN). Then we had to learn the mode of training or re-training. When we ware completing the research, then we learned both theoretically and practically deep knowledge of how to neural network works in hidden layers. We hope this knowledge will do greatly avail of our future career in the long run.

Appendix B: Related Issues

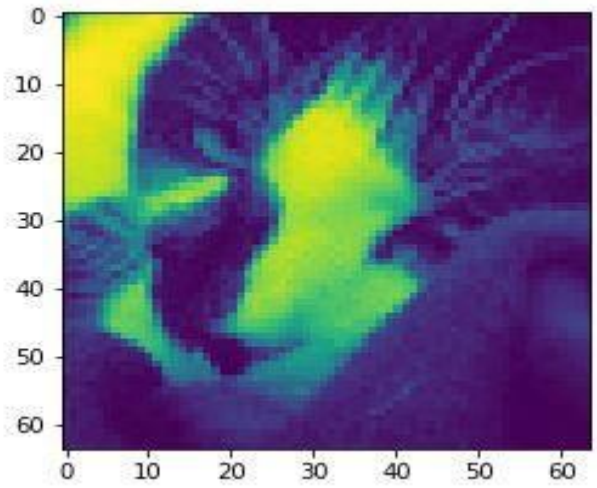
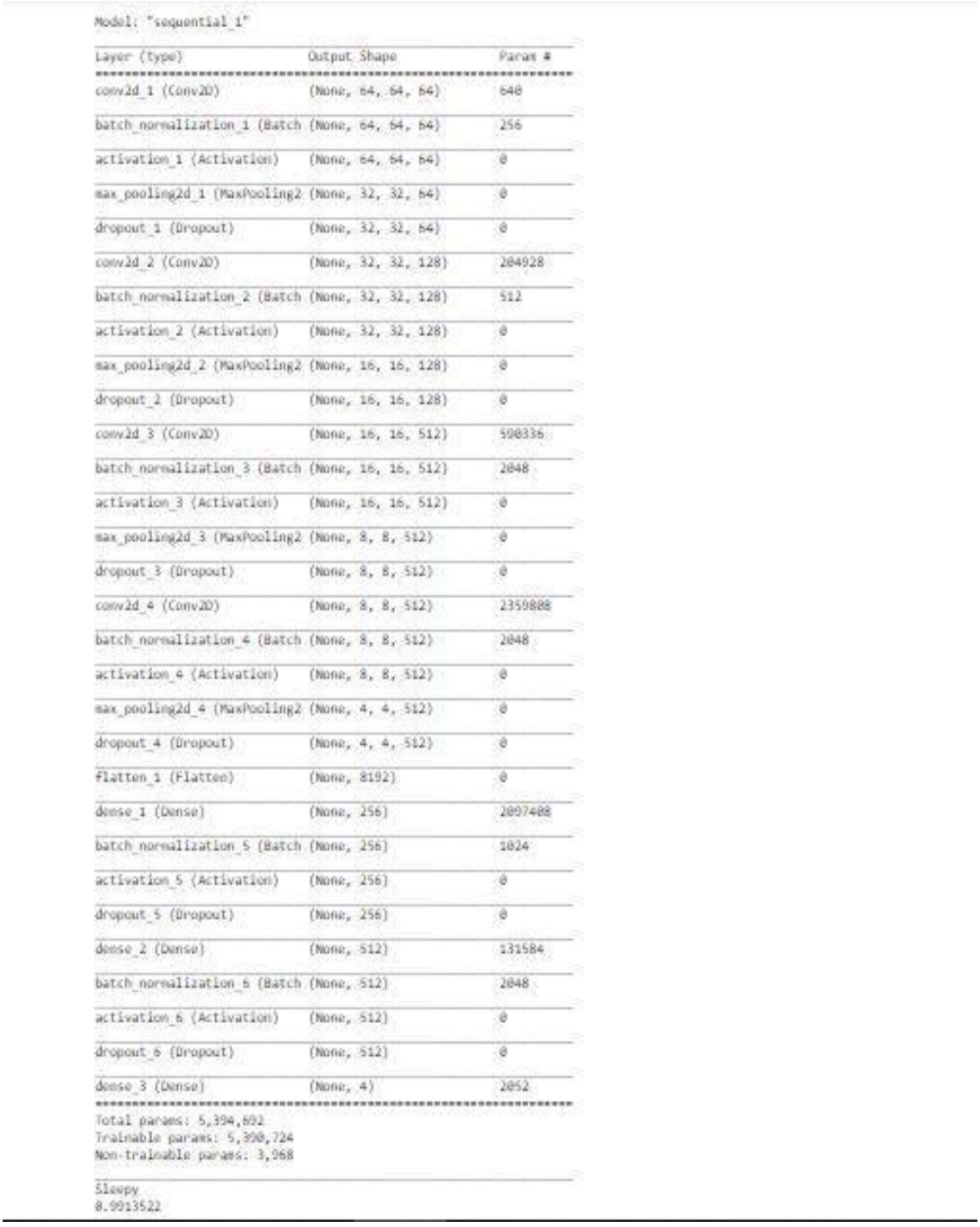


Figure: Face detection test

In figure (Face detection test) shows the firstly detected face and then will give output with accuracy. So before that, we have run this program by load the images from trained dataset that time classifier detects the face and will give the output with expected result 99% accuracy which sentiment is sleepy of the cat. In figure (Face detection test) shows the firstly detected face and then will give output with accuracy in figure (Face detection

accuracy). So before that, we have run this program and load the image after that classifier detects the face and will give the output with expected result 84.5% accuracy.



Model: "sequential_1"

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 64, 64, 64)	640
batch_normalization_1 (Batch	(None, 64, 64, 64)	256
activation_1 (Activation)	(None, 64, 64, 64)	0
max_pooling2d_1 (MaxPooling2	(None, 32, 32, 64)	0
dropout_1 (Dropout)	(None, 32, 32, 64)	0
conv2d_2 (Conv2D)	(None, 32, 32, 128)	204928
batch_normalization_2 (Batch	(None, 32, 32, 128)	512
activation_2 (Activation)	(None, 32, 32, 128)	0
max_pooling2d_2 (MaxPooling2	(None, 16, 16, 128)	0
dropout_2 (Dropout)	(None, 16, 16, 128)	0
conv2d_3 (Conv2D)	(None, 16, 16, 512)	590336
batch_normalization_3 (Batch	(None, 16, 16, 512)	2048
activation_3 (Activation)	(None, 16, 16, 512)	0
max_pooling2d_3 (MaxPooling2	(None, 8, 8, 512)	0
dropout_3 (Dropout)	(None, 8, 8, 512)	0
conv2d_4 (Conv2D)	(None, 8, 8, 512)	2359808
batch_normalization_4 (Batch	(None, 8, 8, 512)	2048
activation_4 (Activation)	(None, 8, 8, 512)	0
max_pooling2d_4 (MaxPooling2	(None, 4, 4, 512)	0
dropout_4 (Dropout)	(None, 4, 4, 512)	0
flatten_1 (Flatten)	(None, 8192)	0
dense_1 (Dense)	(None, 256)	2097408
batch_normalization_5 (Batch	(None, 256)	1024
activation_5 (Activation)	(None, 256)	0
dropout_5 (Dropout)	(None, 256)	0
dense_2 (Dense)	(None, 512)	131584
batch_normalization_6 (Batch	(None, 512)	2048
activation_6 (Activation)	(None, 512)	0
dropout_6 (Dropout)	(None, 512)	0
dense_3 (Dense)	(None, 4)	2052

Total params: 5,394,692
Trainable params: 5,390,724
Non-trainable params: 3,968

Sleepy
0.9913522

Figure: Face detection accuracy.

Animal Behavior Detection

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