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Modeling Deep into Learning: A framework-based approach towards image detection

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ABSTRACT

Purpose: Detecting Specie is a popular task performed in the field of biodiversity. With the innovation in technology, specie detection can be done using deep learning. As we all know that Deep Learning is a field of machine learning having huge set of layers of neural network that train the model very deeply. In Image classification, every layer in deep learning classifies image using one feature. The authors propose a framework to detect species using the deep learning techniques.

Design/Methodology/Approach: Literature is reviewed to understand the application of deep learning techniques. Then Android platform is used to detect species using the deep learning techniques.

Findings: The framework would scan the specie, identify it and give information about the identified specie. For identification purpose, inception model from Google is retrained using TensorFlow

Paper Type: Theme based purely and emphasize on the application of deep learning techniques

KEYWORDS Specie Detection | Deep Learning | Inception Model | Image Classification | TensorFlow

Introduction

Specie detection is a process to find different kind of species and identify them. This can be done by using many techniques. According to [1], specie can be identified using its DNA sample sequence. Another [2] proposed that specie can be detected through their electro-magnetic spectrum. [3][4][5][6][7][8] said that protein structure of specie can help to track them. A process of NIRS (Near Infrared Spectroscopy) is used for detecting species using absorption of light at selected wavelength of electromagnetic spectrum. Effective management of species requires their detection and identification. This can be low densities sometimes based on visual detection and count. Another way to detect species is Artificial Neural Network (ANN). Using them would help them resolve misclassification using texture features. However, the task of processing images and translating those into statistical distribution having low-level features is not easy. Since the images contain noise and are influenced by light, the task is very complicated.

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Deep Learning

Machine which perform intelligently use learning as one of their arguments. Understanding the subject deeply helps in taking decision more optimally and in more productive way. These types of machine act as an alternative to the bulky machines with additional programming. For different concepts, different algorithms are employed in machines. Technology of machine learning has changed many aspects of society. Machine learning algorithms are used from identifying objects to post products according to customer's interest to translating speech into text. All these uses a technique of machine learning known as Deep learning.

Initially through machine learning techniques we were able to process natural data and transfer them to raw data because of which required expertise in that area to construct a pattern recognition system with the help of machinelearning. There are already a number of methods to facilitate machine to input data and detect the relationship between them automatically. This is called representation learning. These methods are used in deep learning with multiple representation levels which gives a more abstract way to learn things. Having enough composition of such transformation a complex function can be learned. To classify an object, higher level layers of such composition would use amplified aspects of objects as input to suppress irrelevant variations. For example, an image can be transformed as an array of pixel values and presence/absence of an edge is controlled by first few layers of the composition. Another set of few layers would examine the arrangement of preset edges regardless of variations. Matching these arrangements with classified objects is done by next few layers. The main thing to be noticed here is that these layers are automated and learned by the machine rather than being man made and can be used in general-purpose procedures.

In other words, deep learning includes a huge set of layers that will help learn every feature very deeply. For a long time, Deep Learning is making many advanced in the field of artificial intelligence. Its discovery has revolutionized the science by being very good at processing high-dimensional data and is applicable in many areas' domains. It has already surpass many records including speech recognition [9][10] [11], image recognition [12][13][14][15], reconstruction of brain circuits [16], particle accelerating analysis [17][18], potential drug molecule detection [19] and encoding DNA expression [20][21]. It has also shown extremely impressive results in the field of topic classification, question answering [22], natural language understanding [23] and language translation [24][25][26][27]. Deep learning can make the standard of processing even higher in the future as it needs very less engineering efforts and more computation is done by machine itself.

Specie Detection using Specmac Framework

In today's world, when technology has become a vital part of everyone's daily life, there is a need to bridge the gap between technology and knowledge. To fill the gap between these two most important aspects, the proposed framework SPECMAC (Specie Machine) uses technology and provides basic knowledge and facts about the various species. The idea is to develop a framework which would allow everyone to get instant information about specie in front of their smart phone camera.

A framework is made for android users to provide information to the android users about the specie scanned from their smart phone. It is an inspiration from cartoon series Pokémon and is designed to provide some basic information and facts about the living specie using an android smart phone. In this, the android user has to scan the specie from his/her smart phone. The algorithm developed is capable of identifying all the features of the specie and match it with the training set to identify the specie. The program will then call out all the details about the identified specie.

Deep Learning, a process to make the machine learn and identify all the features of images is used to make the framework. Around 500 pictures per specie will be collected and used as the training set for training the algorithm. The framework is designed in Android Studio to make an app for android phones. For making an algorithm to identify the specie and do all the statistical work, Python is used.

The main objective of the model is to build an android application to be used in zoology area. The people in zoological research area can use the application while researching on wildlife to know their behavior, culture, etc. Some of the specific objectives are observed as below:

- Providing an interactive learning experience: The framework is designed in a way that it will provide interactive experience to all the users. The interface will be user-friendly and easy to operate.
- Bridge the gap between Technology and Knowledge: The framework use the smart phone to scan the specie and provide the knowledge about it. Thus, it fills the gap between two most important aspects of life, i.e., Technology and Knowledge.
- Transmission of knowledge with fun: Along with the knowledge, the framework will also be fun to operate. The user can challenge their knowledge about various species on the earth.
- E-learning in Schools: According to science, people can learn more from visuals and audios. The app can also be used in schools as a mode of e-learning. This will help students to learn more and in a better way.

The framework uses Images of Species to retrain the Inception Model made by Google. The retrained model is put inside an android application that helps in scanning the specie and gives the information about that specie as an output. The entire framework structure can be seen in Fig 1 and the work flow of the framework is represented in Fig 2.

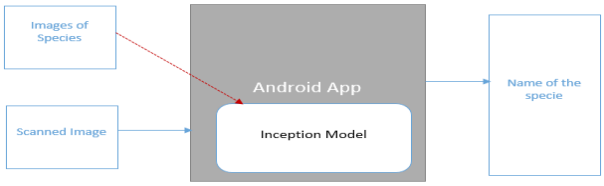

Fig 1: Framework Structure

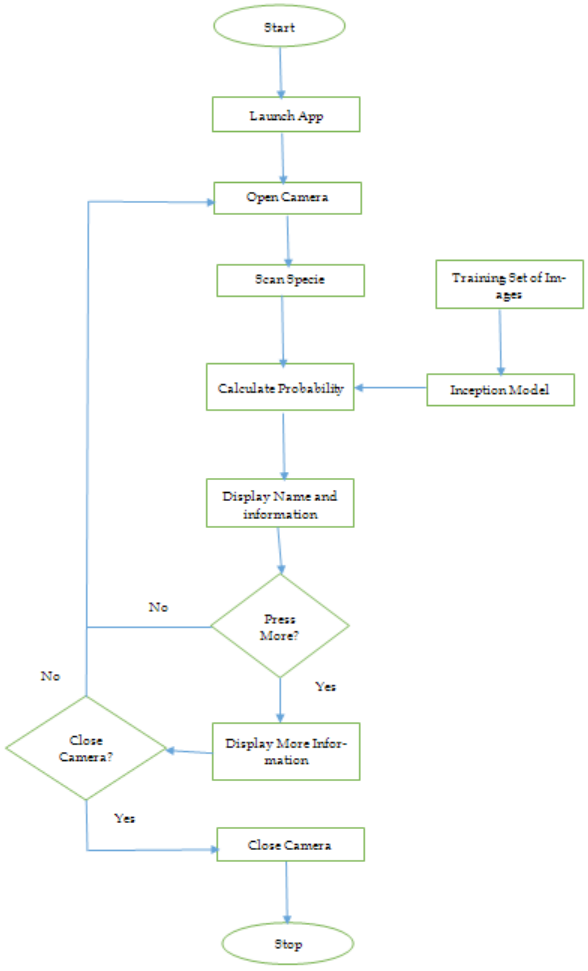

Fig 2: Framework Workflow

Experimental Procedure

Collecting Specie Images

The framework requires over 100 images for each specie to detect the scanned specie. For this purpose, around 500 images per specie have been collected. Table 1 displays the name of the specie and number of images collected.

Table 1: Image Collection Information about Species

S. No.	Name of the Specie	# of Images Collected
1	Ant	472
2	Buffalo	372
3	Butterfly	603
4	Cat	674
5	Cow	617
6	Crow	485
7	Dog	691
8	Honey Bee	617
9	Horse	793
10	House Fly	467
11	Human	1375
12	Mosquito	261
13	Parrot	501
14	Pig	401
15	Pigeon	496
16	Rabbit	654
17	Rat	413
18	Sparrow	616

The above collected images would serve as the training data for the model.

Retraining Inception Model

TensorFlow, a library working on Inception model made by Google is used for the tasks of image classification to detect species. This library is used with Python to make a model to classify between different images of species. Linux code is used to retrain the inception model. The code created 6500 bottlenecks. Every bottleneck represents a layer of neural network. The model can be used via python code.

To test the retrained model, a new image (Fig 3) is feed in it as input and output probabilities are noted as in Table 2.

Fig 3: A new image feed as input to model

Table 2: Output Probabilities by Retrained Model

Specie Name	Probability
Dog	0.54228
Human	0.05727
Pig	0.04678
Horse	0.04479
Cow	0.03896
Rat	0.02789
Buffalo	0.02702
Cat	0.02669
Honey Bee	0.02562
Rabbit	0.02294
House Fly	0.01970
Butterfly	0.01966
Ant	0.01941
Parrot	0.01832
Pigeon	0.01754
Crow	0.01717
Mosquito	0.01547
Sparrow	0.01245

The model gives the highest probability to Dog i.e. classify the specie as dog which was correct.

Building Android Application

After retraining the inception model, it is embedded in the android application made in Android Studio. Embedding of model will take less space than embedding of all the images which will require huge space on the device. Authors have developed the android code for launch screen of application to classify detected species. The results of Android application can be seen in Fig 4, 5, 6 and 7.

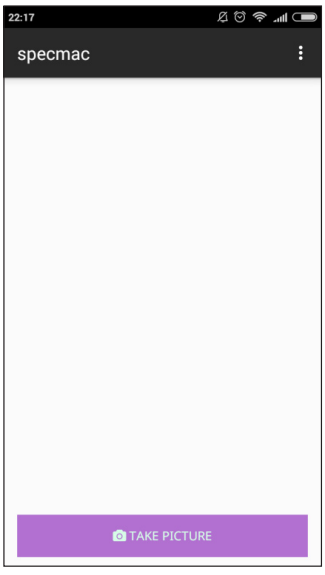

Fig 4: App Launch Screen

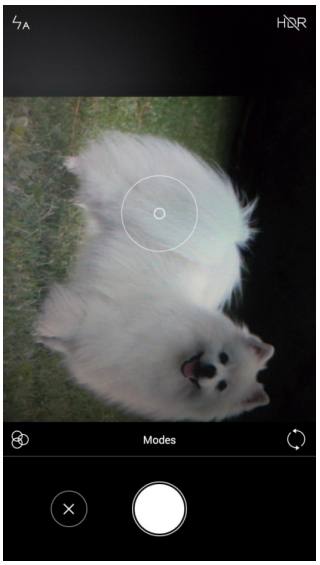

Fig 5: Scanning Specie Screen - I

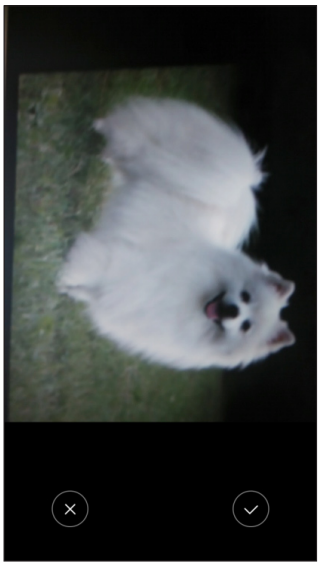

Fig 6: Scanning Specie Screen – II

Fig 7: Information screen

Future Scope

Since the framework is based on deep learning technology which is a subset of machine learning, it is not needed to update the algorithm as this will be done directly by machine self-learning. Apart from this, there are many possibilities as to how the project can be taken forward.

- The algorithm can further be developed for the iOS platform using swift.
- The data is collected as over 500 images for each species. More images can be collected for the better and effective accuracy of the model.
- The newly collected data can be stored in the form of table through SQLite which can be updated in the future after discovering them.
- We can use cloud storage for storing image of specie.

The framework can be further made as an expert system which can also give reply against the random questions asked by the user about the species.

Conclusion

For concluding, all the perspective of current system using in detection of the species are studied and then a plot is thought for a new system depending upon the latest technology. The proposed framework can be used in replacement of current system giving better results. It also helps in giving information about the species detecting through the device. For this purpose, the new approach of deep learning is used TensorFlow library and inception model. For making statistical work easy and effective, Python is chosen as workbenches. Data is collected as huge set of images, imported in inception model and this model is retrained using the images collected. The model is embedded within the android application build so it can be used by general public. The app would help new zoo-loggers to detect and learn about the specie on the Earth at any point through the portable smartphone.

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Annexure 1

Submission Date	Submission Id	Word Count	Character Count
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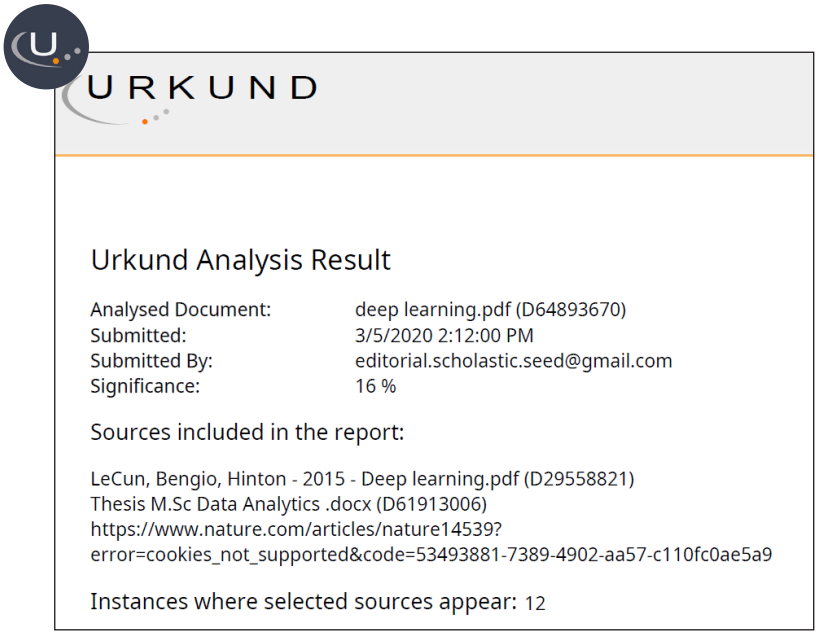
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Urkund Analysis Result

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Sources included in the report:

LeCun, Bengio, Hinton - 2015 - Deep learning.pdf (D29558821)
Thesis M.Sc Data Analytics .docx (D61913006)
https://www.nature.com/articles/nature14539?error=cookies_not_supported&code=53493881-7389-4902-aa57-c110fc0ae5a9

Instances where selected sources appear: 12

Reviewers Comment

Reviewer Comment1:
The overall level of paper is good. It is well structured and written in a simple and lucid manner. The proposed framework would help the zoologists to easily detect and have information about the species on the earth at any point and anywhere just with scanning the image of the species with the help of their smartphones.

Reviewer comment 2:
A deep learning framework is an interface, library or a tool which allows us to build deep learning models more easily and quickly, without getting into the details of underlying algorithms. They provide a clear and concise way of defining models using a collection of pre-built and optimized components.

Reviewer comment 3:
The paper aimed to propose a framework to detect species using the deep learning technique. Even though the paper is short and crisp, then also it covered all the important and required aspects and also it is well structured.

Reviewer Comment 4:
Work seems to be a good compilation. Submitted work relates to Specie detection and classification by inception model is done. Even though a lot of work has been done in this area in the last few years, then also the paper totally justifies the theme. The flow of paper is quite good across sections. Author has cited various references; latest paper referenced here is of 2015. The paper promises to provide a strong base for the further study in the area; for instance future studies can test the model with different images of dog and wolf and fox to check the proposed system or ML algorithm can be included.

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Conflict of Interest: Author of a Paper had no conflict neither financially nor academically.

Editorial Excerpt

At the time of submission, the paper had 16% of plagiarism which is an accepted percentage as per the norms and standards of the journal for the publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on timely basis to the authors (Shikha & Nihal) and accordingly all the corrections had been incorporated as and when directed and required to do so. The comments related to the manuscript are related to the theme **"Deep Learning as an Approach Towards Image Detection"** both subject-wise and research-wise. Deep learning is making advances in the field of artificial intelligence. It includes a huge set of layers which helps in to learn every feature very deeply and analytically. The author has proposed and deep leaning based framework "SPEMAC" for the android users, that will help zoologists to get the information anywhere and at any time about the any species just by scanning its image with their smartphones. The framework is proposed with over 500 images collected for each species. The paper is well written and some important considerations are highlighted. Overall, the paper promises to provide a strong base for the further study in the area with the scope to include more primary data in order to increase the reliability and acceptability of the framework proposed. After comprehensive reviews and editorials boards remarks the manuscript has been decided to categories and publish under the **"Theme Based Paper (TBP)"** category

Acknowledgement

The acknowledgment section is an essential part of all academic research papers. It provides appropriate recognition to all contributors for their hard work. The data presented and analyzed in this paper by (shikha & nikhil) were collected first handily and wherever it has been taken the proper acknowledgment and endorsement depicts. The author is highly indebted to their co-authors and others who had facilitated in accomplishing the research. Last but not least endorse all reviewers and editors of GJEIS in publishing in a present issue.

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