DIGITAL NATURALIST –AI ENABLED TOOL FOR BIODIVERSITY RESEARCHERS USING IBM WATSON

CONTENTS

1.ABSTRACT

A naturalist is someone who studies the patterns of nature, identifies a different kind of flora and fauna in nature. Being able to identify the flora and fauna around us often leads to an interest in protecting wild spaces, and collecting and sharing information about the species we see on our travels is very useful for conservation groups like NCC. When venturing into the woods, field naturalists usually rely on common approaches like always carrying a guidebook around everywhere or seeking help from experienced ornithologists. There should be a handy tool for them to capture, identify and share the beauty to the outside world. Field naturalists can only use this web app from anywhere to identify the birds, flowers, mammals and other species they see on their hikes, canoe trips and other excursions. In this project, we are creating a web application which uses a deep learning model, trained on different species of birds, flowers and mammals (Two sub classes in each for a quick understanding) and get the prediction of the bird when an image is been given.

2. INTRODUCTION

2.1 Overview: The ever-growing number of digital sensors in the environment has led to an increase in the amount of digital data being generated. This includes data from satellites, weather stations, data from “internet of things” devices, and data collected by members of the public via smartphone applications, to name but a few. These new sources of data have contributed to the era of “Big Data” characterized by large volumes of data, of numerous types and quality, being generated at an increasing speed. This presents challenges and opportunities across a number of domains, including water management, camera trapping and acoustic analysis. To process these data into useful information there are many tools available, including classical statistical analyses and classification by citizen scientists. However, at some point traditional approaches may become inefficient or even impossible given the volume, diversity, and heterogeneity of these data. Storage, exploration and revision of data may have to be re-thought to allow for their quick and efficient transformation, annotation, or analysis. This is particularly difficult for multimedia

data which are typically much more complex than other data types. For example, biodiversity and environmental records in the form of audio, video, or image files are typically larger and more complex than text or numeric data. Large-scale analysis of multimedia data has only been possible in recent years since the development of large computational facilities, both academic and commercial. Regardless, the analysis of multimedia data is often further complicated because of their non-standardized methods of acquisition, with highly diverse devices, sensors, formats, scales, environmental contexts, and taxonomic scope. Building efficient, scalable, and robust approaches to solve these problems is a difficult scientific challenge at the forefront of data science and machine learning specifically.

2.2 Purpose: Automated classification of species images using AI has further aided citizen science efforts. Automated identification has made considerable progress thanks to the development of deep learning and convolutional neural networks (CNNs) in particular. It was shown that CNNs were able to provide more accurate identifications than five out of nine specialists of the French flora who were asked to re-identify a set of plant specimens from images. Such automated identification technologies have been applied in citizen science projects to aid observers reach an identification but they also offer an opportunity to process large volumes of biodiversity imagery that would likely be impractical or time-inefficient for human experts to analyze.

3. LITERATURE SURVEY

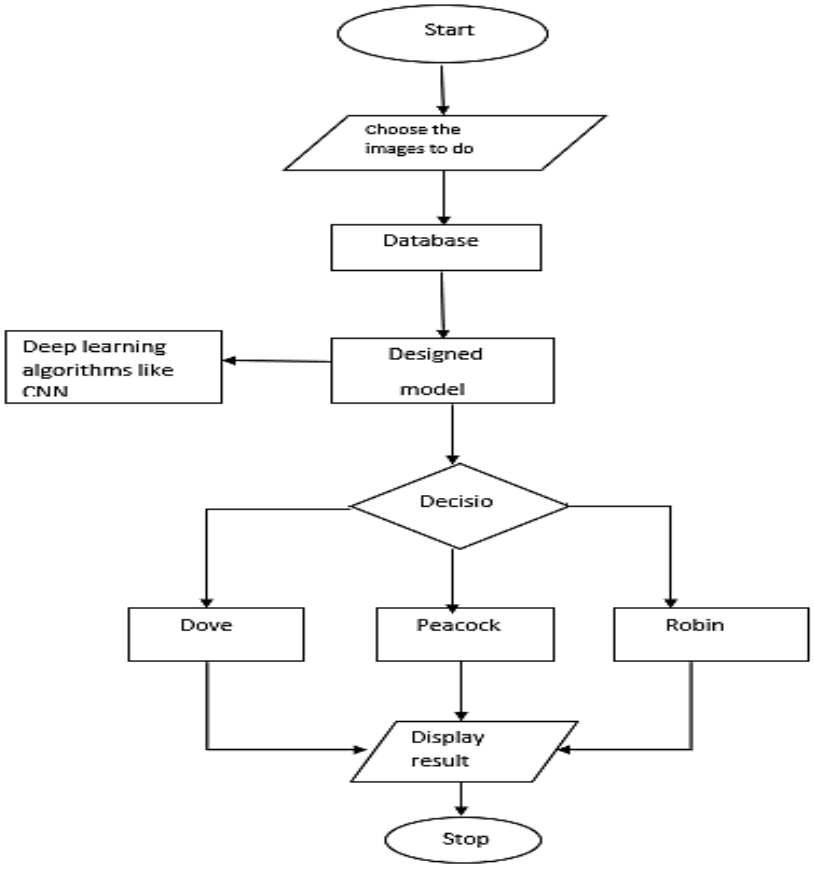
3.1 Existing problem: The key relationship in this work is between field biologists(of any level) and technologists(of any ability),thus many of our activities will involve hybrid artistic and scientific examinations of the wilderness surrounding us. For instance we may develop biological tools for studying nearby creatures, and then adapt these into artistic devices for continued exploration and sharing of this phenomena.

3.2 Proposed solution: We propose a web application to predict the given images from dataset

using CNN. The segmentation refers to the process of partitioning a digital image into multiple segments. So here we come up with the system, where system will detect (Robin, Dove, peacock) from given images. User has to select the image system which will process the image by applying image processing steps. We applied image processing algorithms to detect the classes from given image. Here we proposed image segmentation process for accuracy. In this firstly we train the model with some of the Birds images which predict that which bird is present. Based on the extracted features our model detects the type of bird.

4.THEORITICAL ANALYSIS

4.1 Block diagram:



4.2 Hardware / Software designing:

Software Requirements:

Python 3 - We have used Python which is a statistical mathematical programming language like R instead of MATLAB due to the following reasons:

1. Python code is more compact and readable than MATLAB
2. The python data structure is superior to MATLAB
3. It is an open source and also provides more graphic packages and data sets Keras (with TensorFlow backend 2.3.0 version) - Keras is a neural network API consisting of TensorFlow, CNTk, Theano etc. Python packages like Numpy, Matplotlib, Pandas for mathematical computation and plotting graphs, SimpleITK for reading the images which were in .mha format and Mahotas for feature extraction of GLCM Kaggle was used to obtain the online dataset. GitHub and Stackoverflow was used for reference in case of programming syntax errors. OpenCV (Open Source Computer Vision) is a library of programming functions aimed at real time computer vision i.e. used for image processing and any operations relating to image like reading and writing images, modifying image quality, removing noise by using Gaussian Blur, performing binary thresholding on images, converting the original image consisting of pixel values into an array, changing the image from RGB to grayscale etc. It is free to use, simple to learn and supports C++, Java, C, Python. Its popular application lies in CamScanner or Instagram, GitHub or a web-based control repository. Google Colaboratory (open-source Jupyter Notebook interface with high GPU facility) - Google Colab /Colaboratory is a free Jupyter notebook environment that requires no setup and runs entirely on cloud. With Colab, one can write and execute code, save and share analyses, access powerful computing resources, all for free from browser.[Jupyter Notebook is a powerful way to iterate and write on your Python code for data analysis. Rather than writing and rewriting an entire code, one can write lines of code and run them at a time. It is built off of iPython which ©RCCIIT, DEPT. OF EE Page 20 is an interactive way of running Python code. It allows Jupyter notebook to support multiple languages as well as storing the code and writing own markdown.]

Hardware Requirements:

Processor: Intel® Core™ i3-2350M CPU @ 2.30GHz

Installed memory (RAM):4.00GB

System Type: 64-bit Operating System

5. EXPERIMENTAL INVESTIGATIONS

while working on the solution we investigated on the what is AL and what is ML and how to build models using them and how to do image processing. And mainly we had studied about the CNN because our solution mainly need this so we worked on these aspects.

Artificial Intelligence:Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems enabling it to even mimic human behaviour. Its applications lie in fields of Computer Vision, Natural Language Processing, Robotics, Speech Recognition, etc.

Basic Operation of Neural Networks: Neural Networks (NN) form the base of deep learning, a subfield of machine learning where the algorithms are inspired by the structure of the human brain. NN take in data, train themselves to recognize the patterns in this data and then predict the outputs for a new set of similar data. NN are made up of layers of neurons. These neurons are the core processing units of the network.

Transfer Learning: A major assumption in many machine learning and data mining algorithms is that the training and future data must be in the same feature space and have the same distribution. However, in many real-world applications, this assumption may not hold. For example, we sometimes have a classification task in one domain of interest, but we only have sufficient training data in another domain of interest, where the latter data may be in a different feature space or follow a different data distribution. In such cases, knowledge transfer, if done successfully, would greatly improve the performance of learning by avoiding much expensive data labelling efforts. In recent years, transfer learning has emerged as a new learning framework to address this problem.

Convolutional Neural Network: Classifier models can be basically divided into two categories respectively which are generative models based on hand- crafted features and discriminative

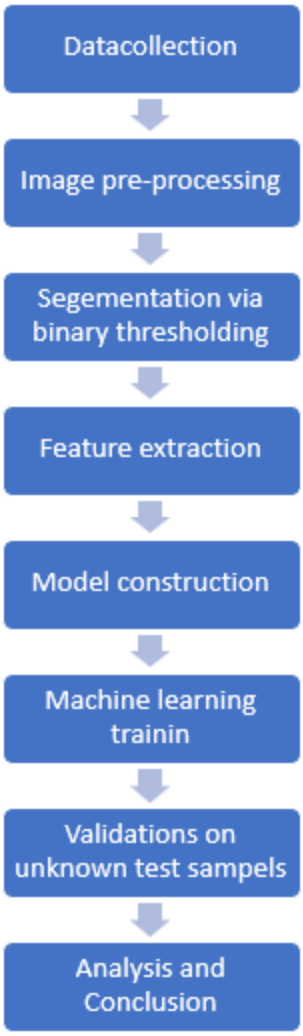
models based on traditional learning such as support vector machine (SVM), Random Forest (RF) and Convolutional Neural Network (CNN). One difficulty with methods based on hand-crafted features is that they often require the computation of a large number of features in order to be accurate when used with many traditional machine learning techniques.This can make them slow to compute and expensive memory-wise. More efficient techniques employ lower numbers of features, using dimensionality reduction like PCA (Principle Component Analysis) or feature selection methods, but the reduction in the number of features is often at the cost of reduced accuracy. Brain tumor segmentation employ discriminative models because unlike generative modelling approaches, these approaches exploit little prior knowledge on the brain‘s anatomy and instead rely mostly on the extraction of [a large number of] low level image features, directly modelling the relationship between these features and the label of a given voxel.

Activation Function: Sigmoid function ranges from 0 to 1 and is used to predict probability as an output in case of binary classification while Softmax function is used for multi-class classification. tanh function ranges from -1 to 1 and is considered better than sigmoid in binary classification using feed forward algorithm. ReLU (Rectified Linear Unit) ranges from 0 to infinity and Leaky ReLU (better version of ReLU) ranges- from -infinity to +infinity. ReLU stands for Rectified Linear Unit for a non-linear operation.

The output is $f(x) = \max(0,x)$.ReLU‘s purpose is to introduce non-linearity in our ConvNet. Since, the real world data would want our ConvNet to learn would be non-negative linear values. There are other nonlinear functions such as tanh or sigmoid that can also be used instead of ReLU. Most of the data scientists use ReLU since performance wise ReLU is better than the other two. Stride is the number of pixels that would move over the input matrix one at a time.

Sometimes filter does not fit perfectly fit the input image. We have two options: either pad the picture with zeros (zero-padding) so that it fits or drop the part of the image where the filter did not fit. This is called valid padding which keeps only valid part of the image.

6. FLOW CHART


Datacollection
Image pre-processing
Segementation via binary thresholding
Feature extraction
Model construction
Machine learning trainin
Validations on unknown test sampels
Analysis and Conclusion

7. RESULT

```
model.fit(x_train,steps_per_epoch =len(x_train) ,epochs = 50, validation_data = x_test,validation_steps =len(x_test) )
70/70 [==============================] - 15s 220ms/step - loss: 0.2970 - accuracy: 0.8910 - val_loss: 0.1445 - val_accuracy:
0.9688
Epoch 22/50
70/70 [==============================] - 20s 282ms/step - loss: 0.2675 - accuracy: 0.9037 - val_loss: 0.3047 - val_accuracy:
0.8646
Epoch 23/50
70/70 [==============================] - 15s 219ms/step - loss: 0.2523 - accuracy: 0.9064 - val_loss: 0.1595 - val_accuracy:
0.9479
Epoch 24/50
70/70 [==============================] - 16s 230ms/step - loss: 0.2455 - accuracy: 0.9149 - val_loss: 0.3590 - val_accuracy:
0.8750
Epoch 25/50
70/70 [==============================] - 17s 235ms/step - loss: 0.2196 - accuracy: 0.9207 - val_loss: 0.1114 - val_accuracy:
0.9583
Epoch 26/50
70/70 [==============================] - 16s 233ms/step - loss: 0.2139 - accuracy: 0.9261 - val_loss: 0.4553 - val_accuracy:
0.8646
Epoch 27/50
70/70 [==============================] - 16s 224ms/step - loss: 0.2320 - accuracy: 0.9198 - val_loss: 0.2415 - val_accuracy:
0.9167
```

8. ADVANTAGES & DISADVANTAGES

Advantages:

1. The IBM Watson platform employs the use of “cognitive commerce” and provides product recommendations to shoppers based on their online activity.
2. **Natural language integration.**

Disadvantages:

1. **Slow integration.**
2. **Can be viewed as a disruptive technology.**
3. **Site maintenance**.

9. APPLICATIONS

1. The main application of this model is to preprocess the images to a machine-readable format. It is well trained so that it will predict the correct data.

10. CONCLUSION

Field naturalist can only use this web app from anywhere to identify the birds, flowers, mammals and other species they see on their hikes, canoe trips and other executions.

In this project, we are creating a web application which uses a deep learning model, trined on different species of birds, flowers and mammals. There is great diversity among naturalists, but some common ground too. All naturalism begin with an admiring attitude towards science and its achievements. In many cases this admiring attitude is combined with a contempt or distrust for the way that philosophy has been or is conducted. This combination of views has a long history. Many of the advocates of first philosophy , Descartes, Kant and Carnap, shared the same admiration of science or nascent science and distrust of philosophy.

11.FUTURE SCOPE

Essentially, the proposed guidelines treat statistical comparison of ML based quality estimators as a multi-dimensional problem. Accordingly, we seek to access the predictors more historically in terms of their local performance on specific test conditions, their learning ability and the magnitude of treatment effect. In contrast, the current approach tends to reduce this task to binary and global statistical decision making and does not reveal systematic weakness of the predictors. In order to provide a tool for practice use, software implementing the proposed guidelines is made publicly available.

12.BIBILOGRAPHY

1. T.F. Crack, O. Ledoit, “Central limit theorems when data are dependent: Addressing the pedagogical gaps”, J. Financol. Educ., vol.36, no. 1, pp.38-60,2010.

2. K. Sainani, ‘Statistically speaking”, PM R, vol. 2, no. 9, pp. 858-861,2020.

3. K. J. Rothman, “No adjustments are needed for multiple comparisons”, Epidemiology, vol. 1, no. 1, pp. 43-46, 1990.

4. E. Krasula, K. Fliegel, P. L. Callet, M. Klima, “On the accuracy of objective image and video quality models: New methodology for performance evaluation”, Proc. 8th Int. Conf. Qual. Multimedia Exp. Pp. 1-6, Jun. 2016.

5. E. Kausya, “Mann-Whitney U test when variances are unequal”, Animal Behav., vol. 61, no. 6, pp. 1247-1249, Jun. 2001.

Appendix

CNN code:

```
from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Dense, Convolution2D,MaxPooling2D,Flatten

import pandas as pd

from tensorflow.keras.preprocessing .image import ImageDataGenerator

train_datagen = ImageDataGenerator(rescale = 1./255,shear_range = 0.2,zoom_range = 0.2,horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)

x_train=train_datagen.flow_from_directory(r"D:\nature\digital naturalist with IBM-updated\datasets\New\traindata",target_size = (64,64),batch_size = 32,class_mode = "categorical")

x_test=test_datagen.flow_from_directory(r"D:\nature\digital naturalist with IBM-updated\datasets\New\testdata",target_size = (64,64),batch_size = 32,class_mode = "categorical")

x_train.class_indices
```

```
model=Sequential()

model.add(Convolution2D(32,(3,3),input_shape = (64,64,3)))

model.add(MaxPooling2D((2,2)))

model.add(Flatten())

model.add(Dense(units = 128,activation = "relu"))

model.add(Dense(units = 9, activation = "softmax"))

model.compile(optimizer= "adam",loss = "categorical_crossentropy" , metrics =["accuracy"])

model.fit(x_train,steps_per_epoch =len(x_train) ,epochs = 50, validation_data =
x_test,validation_steps =len(x_test) )

model.save("natur1.h5")

from tensorflow.keras.models import load_model

from tensorflow.keras.preprocessing  import image

import numpy as np

model = load_model("./natur1.h5")

from IPython.display import Image

img=Image(filename=r"D:\nature\digital naturalist with IBM-
updated\datasets\New\traindata\gatto\cat.jpg")

img

from tensorflow.keras.preprocessing  import image

path2=r"D:\nature\digital naturalist with IBM-updated\datasets\New\traindata\gatto\cat.jpg"
```