A Report

on

Traffic Sign Recognition Using Python

Submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Technology (CSE)

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

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December, 2021

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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the thesis/project/dissertation, entitled **"Traffic Sign Recognition using Python"** in partial fulfillment of the requirements for the award of the B.Tech(CSE) submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of July 2021, to December 2021, under the supervision of Mr. Shubham Kr Singh , Assistant Professor, Department of Computer Science and Engineering/Computer Application and Information and Science, of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

Asmi Mishra(19SCSE1050010)
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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Mr. Shubham Kr. Singh
Assistant Professor

CERTIFICATE

The Final Project Report Viva-Voce examination of Asmi Mishra (19SCSE1050010) & Shishu Pandey(19SCSE1180063) has been held on 5/12/2021 and his/her work is recommended for the award of BTECH (CSE).

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date: November, 2013
Place: Greater Noida

Acknowledgement

I would like to express my gratitude toward staff of SCSE as well as the Dean of SCSE for providing me a great opportunity to complete a project on Traffic Sign Recognition Using Python

My sincere thanks go to Mr. Shubham Kumar Singh for his support and guidance for the completion of this project.

Abstract

As we all know that how much traffic signs mean to someone driving a vehicle and even walking on road. In today’s generation of autonomous vehicle the risk have increased as there will be vehicles running using AI. AI learns from datasets and result and it keeps learning.

There are several different types of traffic signs like speed limits, no entry, traffic signals, turn left or right, children crossing, no passing of heavy vehicles, etc. Traffic signs classification is the process of identifying which class a traffic sign belongs to.

In this Python project example, we will build a deep neural network model that can classify traffic signs present in the image into different categories. With this model, we are able to read and understand traffic signs which are a very important task for all autonomous vehicles.

In this Python project with source code, we have successfully classified the traffic signs classifier with 95% accuracy and also visualized how our accuracy and loss changes with time, which is pretty good from a simple CNN model. We will be using Computer Vision, Deep Learning and all.

The project is just for betterment of upcoming vehicle generation. As we all know that upcoming world is will be a world of automatic things. In future we will try to add some features like the engine will be directed automatically to do whatever needed when the AI will see any sign.

Contents

CHAPTER-1 Introduction

There are several different types of traffic signs like speed limits, no entry, traffic signals, turn left or right, children crossing, no passing of heavy vehicles, etc. Traffic signs classification is the process of identifying which class a traffic sign belongs to.
In this Python project example, we will build a deep neural network model that can classify traffic signs present in the image into different categories. With this model, we are able to read and understand traffic signs which are a very important task for all autonomous vehicles. For this project, we are using the public dataset available at Kaggle. The dataset contains more than 50,000 images of different traffic signs. It is further classified into 43 different classes. The dataset is quite varying, some of the classes have many images while some classes have few images. The size of the dataset is around 300 MB. The dataset has a train folder which contains images inside each class and a test folder which we will use for testing our model. You must have heard about the self-driving cars in which the passenger can fully depend on the car for traveling. But to achieve level 5 autonomous, it is necessary for vehicles to understand and follow all traffic rules.

In the world of Artificial Intelligence and advancement in technologies, many researchers and big companies like Tesla, Uber, Google, Mercedes-Benz, Toyota, Ford, Audi, etc are working on autonomous vehicles and self-driving cars. So, for achieving accuracy in this technology, the vehicles should be able to interpret traffic signs and make decisions accordingly.

CHAPTER-2 Literature Survey

Our project deals with classification of traffic signs which will help automatic vehicles to understand the situation. You must have heard about the self-driving cars in which the passenger can fully depend on the car for traveling. But to achieve level 5 autonomous, it is necessary for vehicles to understand and follow all traffic rules.

In the world of Artificial Intelligence and advancement in technologies, many researchers and big companies like Tesla, Uber, Google, Mercedes-Benz, Toyota, Ford, Audi, etc are working on autonomous vehicles and self-driving cars. So, for achieving accuracy in this technology, the vehicles should be able to interpret traffic signs and make decisions accordingly.

In this Python project example, we will build a deep neural network model that can classify traffic signs present in the image into different categories. With this model, we are able to read and understand traffic signs which are a very important task for all autonomous vehicles.

Our approach to building this traffic sign classification model is discussed in four steps:

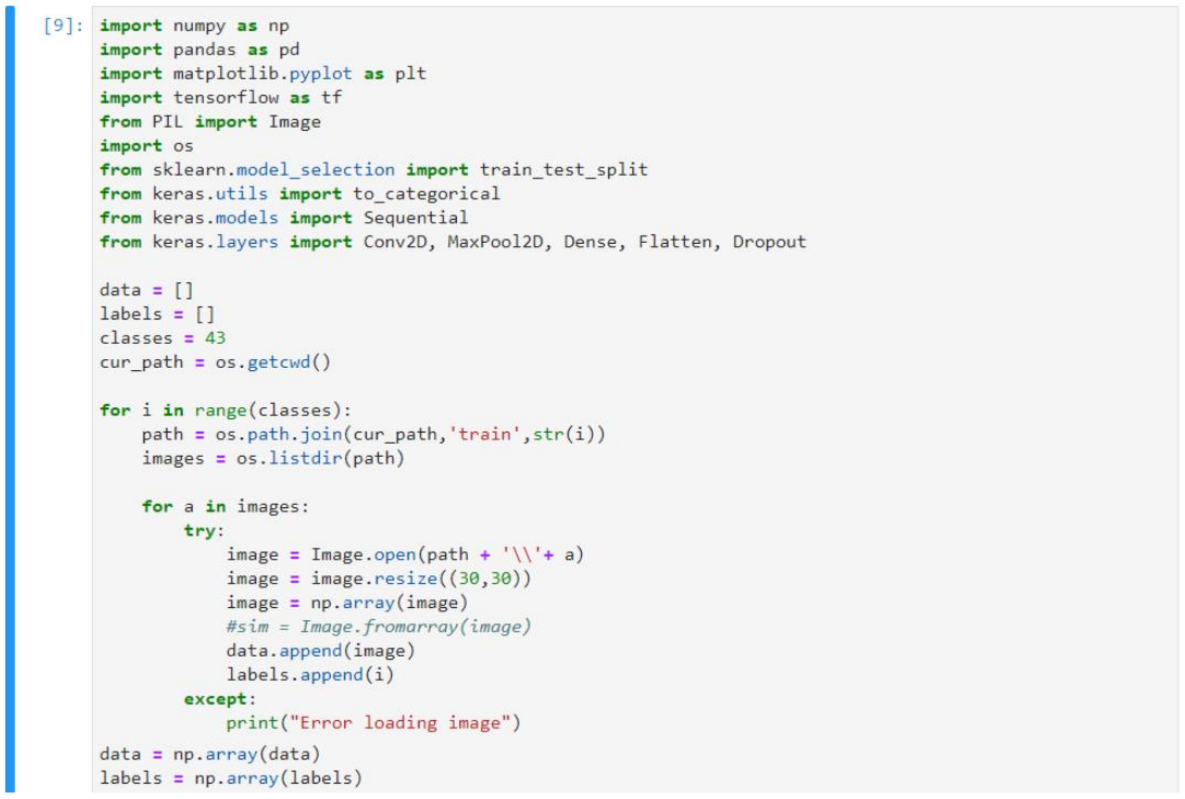
- Explore the dataset
- Build a CNN model
- Train and validate the model
- Test the model with test dataset

CHAPTER 3: Functionality/Working of Project

Step 1: Explore the dataset

Our ‘train’ folder contains 43 folders each representing a different class. The range of the folder is from 0 to 42. With the help of the OS module, we iterate over all the classes and append images and their respective labels in the data and labels list.

The PIL library is used to open image content into an array.



```
[9]: import numpy as np
     import pandas as pd
     import matplotlib.pyplot as plt
     import tensorflow as tf
     from PIL import Image
     import os
     from sklearn.model_selection import train_test_split
     from keras.utils import to_categorical
     from keras.models import Sequential
     from keras.layers import Conv2D, MaxPool2D, Dense, Flatten, Dropout

     data = []
     labels = []
     classes = 43
     cur_path = os.getcwd()

     for i in range(classes):
         path = os.path.join(cur_path,'train',str(i))
         images = os.listdir(path)

         for a in images:
             try:
                 image = Image.open(path + '\\'+ a)
                 image = image.resize((30,30))
                 image = np.array(image)
                 #sim = Image.fromarray(image)
                 data.append(image)
                 labels.append(i)
             except:
                 print("Error loading image")
     data = np.array(data)
     labels = np.array(labels)
```

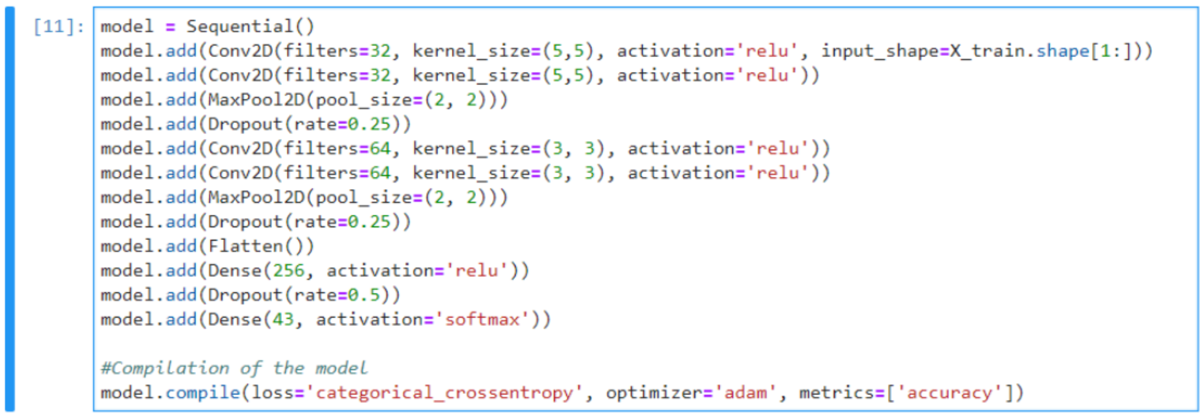
Step 2: Create a CNN Model

To classify the images into their respective categories, we will build a CNN. CNN is best for image classification purposes.
The architecture of our model is:

- 2 Conv2D layer (filter=32, kernel_size=(5,5), activation=”relu”)
- MaxPool2D layer (pool_size=(2,2))
- Dropout layer (rate=0.25)

- 2 Conv2D layer (filter=64, kernel_size=(3,3), activation=”relu”)
- MaxPool2D layer (pool_size=(2,2))
- Dropout layer (rate=0.25)
- Flatten layer to squeeze the layers into 1 dimension
- Dense Fully connected layer (256 nodes, activation=”relu”)
- Dropout layer (rate=0.5)
- Dense layer (43 nodes, activation=”softmax”)

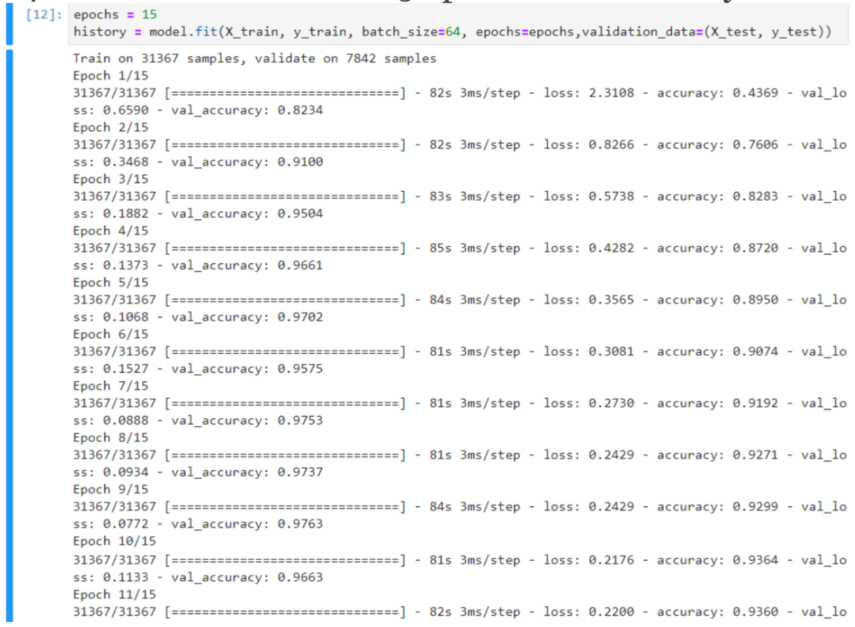
We compile the model with Adam optimizer which performs well and loss is “categorical_crossentropy” because we have multiple classes to categorise.



```
[11]: model = Sequential()
      model.add(Conv2D(filters=32, kernel_size=(5,5), activation='relu', input_shape=X_train.shape[1:]))
      model.add(Conv2D(filters=32, kernel_size=(5,5), activation='relu'))
      model.add(MaxPool2D(pool_size=(2, 2)))
      model.add(Dropout(rate=0.25))
      model.add(Conv2D(filters=64, kernel_size=(3, 3), activation='relu'))
      model.add(Conv2D(filters=64, kernel_size=(3, 3), activation='relu'))
      model.add(MaxPool2D(pool_size=(2, 2)))
      model.add(Dropout(rate=0.25))
      model.add(Flatten())
      model.add(Dense(256, activation='relu'))
      model.add(Dropout(rate=0.5))
      model.add(Dense(43, activation='softmax'))

      #Compilation of the model
      model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

Step 3: Training and validation of model

After building the model architecture, we then train the model using model.fit(). I tried with batch size 32 and 64. Our model performed better with 64 batch size. And after 15 epochs the accuracy was stable.



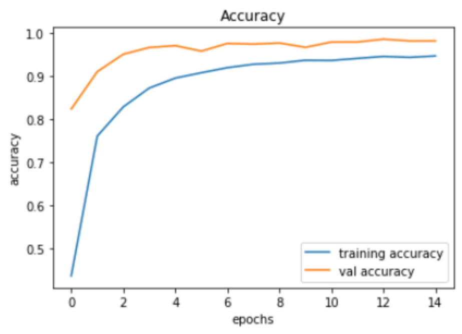
```
[12]: epochs = 15
      history = model.fit(X_train, y_train, batch_size=64, epochs=epochs,validation_data=(X_test, y_test))

      Train on 31367 samples, validate on 7842 samples
      Epoch 1/15
      31367/31367 [==============================] - 82s 3ms/step - loss: 2.3108 - accuracy: 0.4369 - val_lo
      ss: 0.6590 - val_accuracy: 0.8234
      Epoch 2/15
      31367/31367 [==============================] - 82s 3ms/step - loss: 0.8266 - accuracy: 0.7606 - val_lo
      ss: 0.3468 - val_accuracy: 0.9100
      Epoch 3/15
      31367/31367 [==============================] - 83s 3ms/step - loss: 0.5738 - accuracy: 0.8283 - val_lo
      ss: 0.1882 - val_accuracy: 0.9504
      Epoch 4/15
      31367/31367 [==============================] - 85s 3ms/step - loss: 0.4282 - accuracy: 0.8720 - val_lo
      ss: 0.1373 - val_accuracy: 0.9661
      Epoch 5/15
      31367/31367 [==============================] - 84s 3ms/step - loss: 0.3565 - accuracy: 0.8950 - val_lo
      ss: 0.1068 - val_accuracy: 0.9702
      Epoch 6/15
      31367/31367 [==============================] - 81s 3ms/step - loss: 0.3081 - accuracy: 0.9074 - val_lo
      ss: 0.1527 - val_accuracy: 0.9575
      Epoch 7/15
      31367/31367 [==============================] - 81s 3ms/step - loss: 0.2730 - accuracy: 0.9192 - val_lo
      ss: 0.0888 - val_accuracy: 0.9753
      Epoch 8/15
      31367/31367 [==============================] - 81s 3ms/step - loss: 0.2429 - accuracy: 0.9271 - val_lo
      ss: 0.0934 - val_accuracy: 0.9737
      Epoch 9/15
      31367/31367 [==============================] - 84s 3ms/step - loss: 0.2429 - accuracy: 0.9299 - val_lo
      ss: 0.0772 - val_accuracy: 0.9763
      Epoch 10/15
      31367/31367 [==============================] - 81s 3ms/step - loss: 0.2176 - accuracy: 0.9364 - val_lo
      ss: 0.1133 - val_accuracy: 0.9663
      Epoch 11/15
      31367/31367 [==============================] - 82s 3ms/step - loss: 0.2200 - accuracy: 0.9360 - val_lo
```

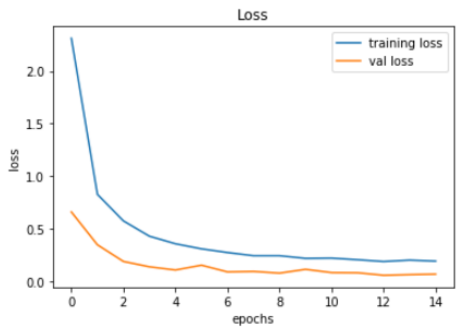
Our model got a 95% accuracy on the training dataset. With matplotlib, we plot the graph for accuracy and the loss.

```
[13]: plt.figure(0)
      plt.plot(history.history['accuracy'], label='training accuracy')
      plt.plot(history.history['val_accuracy'], label='val accuracy')
      plt.title('Accuracy')
      plt.xlabel('epochs')
      plt.ylabel('accuracy')
      plt.legend()

      plt.figure(1)
      plt.plot(history.history['loss'], label='training loss')
      plt.plot(history.history['val_loss'], label='val loss')
      plt.title('Loss')
      plt.xlabel('epochs')
      plt.ylabel('loss')
      plt.legend()
```

```
[13]: <matplotlib.legend.Legend at 0x24eece89e48>
```

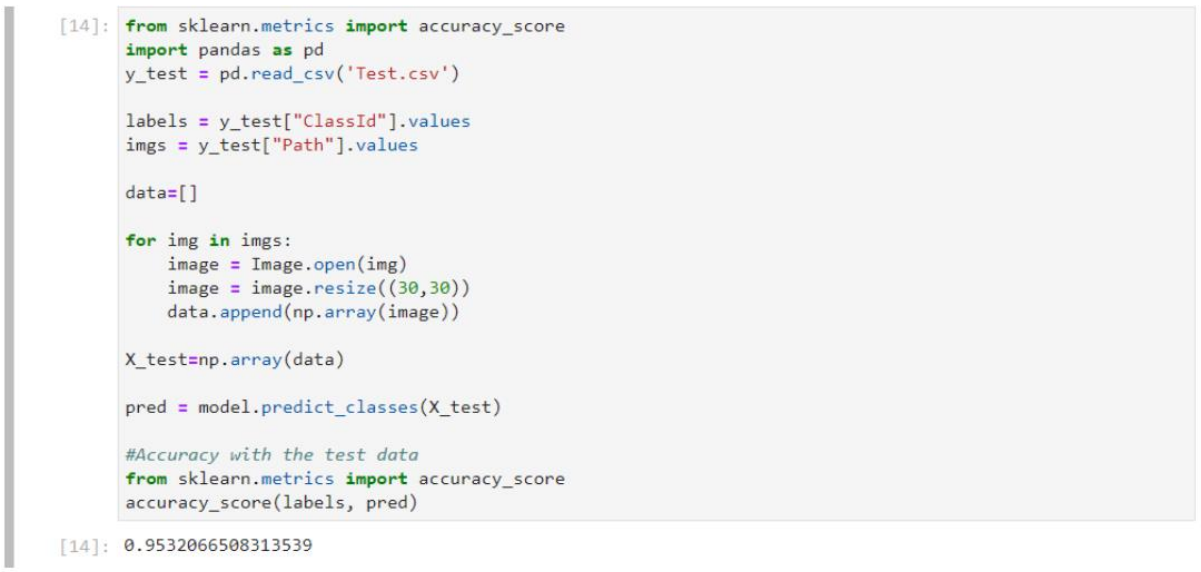
```
[13]: <matplotlib.legend.Legend at 0x24eece89e48>
```





Step 4: Test our model with test dataset

Our dataset contains a test folder and in a test.csv file, we have the details related to the image path and their respective class labels. We extract the image path and labels using pandas. Then to predict the model, we have to resize our images to 30×30 pixels and make a numpy array containing all image data. From the sklearn.metrics, we imported the accuracy_score and observed how our model predicted the actual labels. We achieved a 95% accuracy in this model.



```
[14]: from sklearn.metrics import accuracy_score
      import pandas as pd
      y_test = pd.read_csv('Test.csv')

      labels = y_test["ClassId"].values
      imgs = y_test["Path"].values

      data=[]

      for img in imgs:
          image = Image.open(img)
          image = image.resize((30,30))
          data.append(np.array(image))

      X_test=np.array(data)

      pred = model.predict_classes(X_test)

      #Accuracy with the test data
      from sklearn.metrics import accuracy_score
      accuracy_score(labels, pred)

[14]: 0.9532066508313539
```

In the end, we are going to save the model that we have trained using the Keras model.save() function.

```
model.save('traffic_classifier.h5')
```

Preparing the GUI for this project:

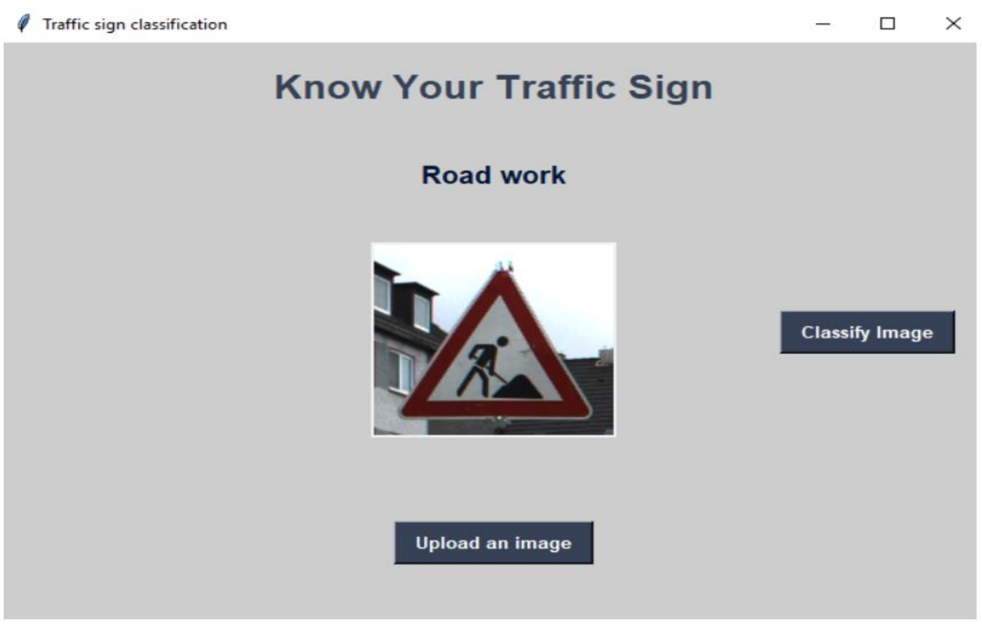
Now we are going to build a graphical user interface for our traffic signs classifier with Tkinter. Tkinter is a GUI toolkit in the standard python library. Make a new file in the project folder and copy the below code. Save it as gui.py and you can run the code by typing python gui.py in the command line.

In this file, we have first loaded the trained model 'traffic_classifier.h5' using Keras. And then we build the GUI for uploading the image and a button is used to classify which calls the classify() function. The classify() function is converting the image into the dimension of shape (1, 30, 30, 3). This is because to predict the traffic sign we have to provide the same dimension we have used when building the model. Then we predict the class, the model.predict_classes(image) returns us a number between (0-42) which represents the class it belongs to. We use the dictionary to get the information about the class. Here's the code for the gui.py file.

Code:

```
import tkinter as tk
from tkinter import filedialog
from tkinter import *
from PIL import ImageTk, Image

import numpy
#load the trained model to classify sign
from keras.models import load_model
model = load_model('traffic_classifier.h5')

#dictionary to label all traffic signs class.
classes = { 1:'Speed limit (20km/h)',
            2:'Speed limit (30km/h)',
            3:'Speed limit (50km/h)',
            4:'Speed limit (60km/h)',
            5:'Speed limit (70km/h)',
            6:'Speed limit (80km/h)',
            7:'End of speed limit (80km/h)',
            8:'Speed limit (100km/h)',
            9:'Speed limit (120km/h)',
            10:'No passing',
            11:'No passing veh over 3.5 tons',
            12:'Right-of-way at intersection',
            13:'Priority road',
            14:'Yield',
            15:'Stop',
            16:'No vehicles',
            17:'Veh > 3.5 tons prohibited',
            18:'No entry',
            19:'General caution',
            20:'Dangerous curve left',
            21:'Dangerous curve right',
            22:'Double curve',
            23:'Bumpy road',
            24:'Slippery road',
            25:'Road narrows on the right',
            26:'Road work',
            27:'Traffic signals',
            28:'Pedestrians',
            29:'Children crossing',
            30:'Bicycles crossing',
            31:'Beware of ice/snow',
            32:'Wild animals crossing',
            33:'End speed + passing limits',
            34:'Turn right ahead',
            35:'Turn left ahead',
            36:'Ahead only',
            37:'Go straight or right',
            38:'Go straight or left',
            39:'Keep right',
            40:'Keep left',
            41:'Roundabout mandatory',
            42:'End of no passing',
            43:'End no passing veh > 3.5 tons' }

#initialise GUI
top=tk.Tk()
top.geometry('800x600')
top.title('Traffic sign classification')
top.configure(background='#CDCDCD')

label=Label(top,background='#CDCDCD', font=('arial',15,'bold'))
sign_image = Label(top)

def classify(file_path):
    global label_packed
    image = Image.open(file_path)
    image = image.resize((30,30))
    image = numpy.expand_dims(image, axis=0)
    image = numpy.array(image)
    pred = model.predict_classes([image])[0]
    sign = classes[pred+1]
    print(sign)
    label.configure(foreground='#011638', text=sign)

def show_classify_button(file_path):
    classify_b=Button(top,text="Classify Image",command=lambda: classify(file_path),padx=10,pady=5)
    classify_b.configure(background='#364156', foreground='white',font=('arial',10,'bold'))
    classify_b.place(relx=0.79,rely=0.46)

def upload_image():
    try:
        file_path=filedialog.askopenfilename()
        uploaded=Image.open(file_path)
        uploaded.thumbnail(((top.winfo_width()/2.25),(top.winfo_height()/2.25)))
        im=ImageTk.PhotoImage(uploaded)

        sign_image.configure(image=im)
        sign_image.image=im
        label.configure(text='')
        show_classify_button(file_path)
    except:
        pass

upload=Button(top,text="Upload an image",command=upload_image,padx=10,pady=5)
upload.configure(background='#364156', foreground='white',font=('arial',10,'bold'))

upload.pack(side=BOTTOM,pady=50)
sign_image.pack(side=BOTTOM,expand=True)
label.pack(side=BOTTOM,expand=True)
heading = Label(top, text="Know Your Traffic Sign",pady=20, font=('arial',20,'bold'))
heading.configure(background='#CDCDCD',foreground='#364156')
heading.pack()
top.mainloop()
```

CHAPTER 4: Results and Discussion



In this Python project with source code, we have successfully classified the traffic signs classifier with 95% accuracy and also visualized how our accuracy and loss changes with time, which is pretty good from a simple CNN model.

And by doing this project we got more deep understanding of AI.

CHAPTER 5: Conclusion and Future Scope

This paper proposes a deep convolutional network with a fewer number of parameters and memory requirements in comparisons to existing methods. The presented network doesn't need data jittering and handcrafted data augmentations. Our main contribution includes the development of modified inception module and a deep network using spatial transformer layer for traffic sign classification.

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