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Metro ticket automation project

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Abstract

This is an elementary project which explains how data science can be used in the process of metro rail ticket automation. Language used for this project is python. The concept of transfer learning is used for the purpose of currency detection and certain other python libraries are used in this project. Final aim of this project is to create a learned model which can be used in the process of ticket automation which includes few inputs from the user.

Project idea

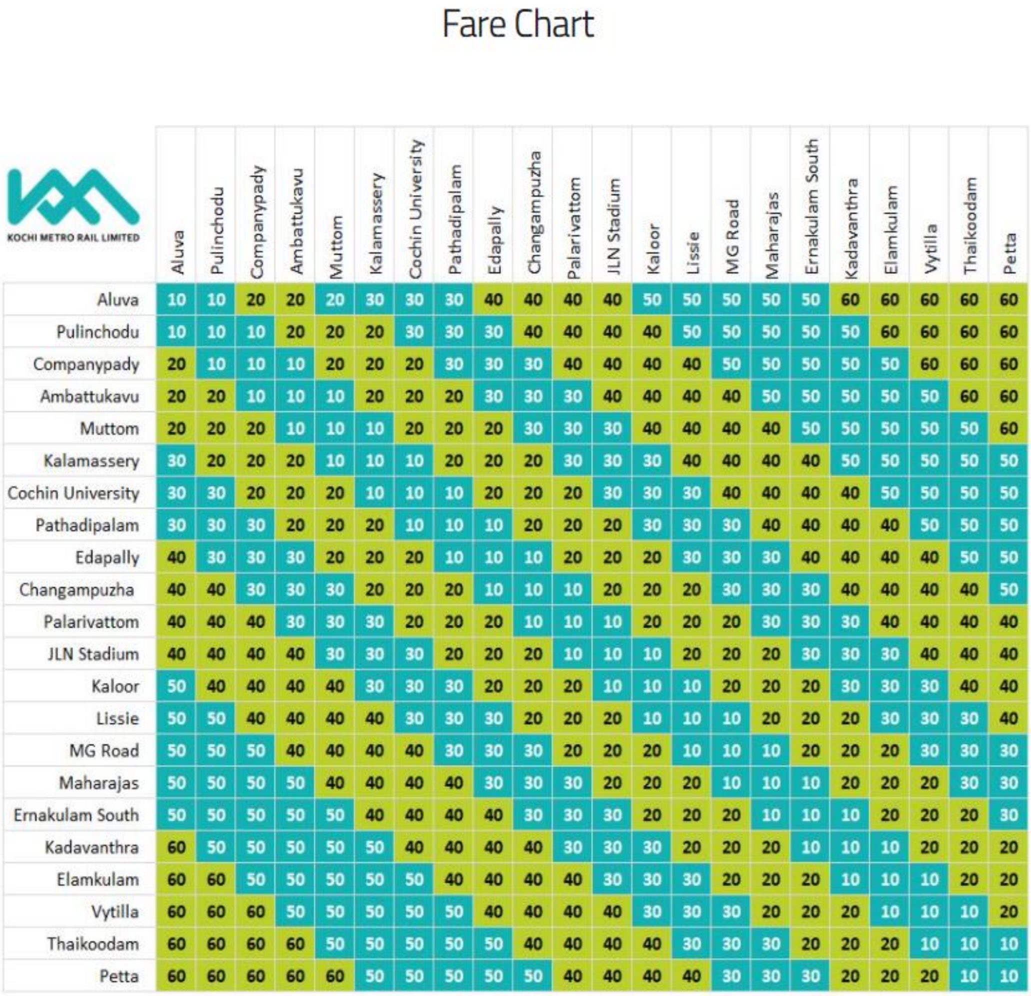
This project idea developed in my mind while I was travelling in Kochi metro. At present (As on 14th march 2021), there are 22 metro station. Each of them have 2 entry gates. On every entry gate there is a ticket counter which consist of around two staffs. Considering this each station will have 4 staffs at ticket counter and they work in shifts. At present they work on shift as the metro working time is from morning 6 to night 10. Considering shift there will be around 8 staffs per station and that sums to around 176 staffs in metro station. The purpose of this project is to reduce the human labour using basic AI. 8 staffs in each station can be cut down to a 4 staff just for customer support in case of automated ticket system failure. Hence the man force can be reduced using one time establishment of automated ticket counters.

Project explanation

This project only includes the back end of the whole project. The codes are written in python language and multiple libraries were used. This project was done as 3 parts:

Part-1

This project is done by taking Kochi metro rail as the subject. The first part includes collection of data regarding Kochi metro rail stations and fares. This was done with the help of data from https://kochimetro.org/fare-chart/ . From this stations and fares were assigned. The station opted for this project was "JLN Stadium". This was in order to select a station somewhere between the middle, but not exactly in the middle. So that there wont be any kind of bias in further program and also slight changes can be done on this program to implement the same thing on different stations.



Fare Chart

KOCHI METRO RAIL LIMITED	Aluva	Pulinchodu	Companypady	Ambattukavu	Muttom	Kalamassery	Cochin University	Pathadipalam	Edapally	Changampuzha	Palarivattom	JLN Stadium	Kaloor	Lissie	MG Road	Maharajas	Ernakulam South	Kadavanthra	Elamkulam	Vytilla	Thaikoodam	Petta
Aluva	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50	50	60	60	60	60	60
Pulinchodu	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50	50	60	60	60	60
Companypady	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50	50	60	60	60
Ambattukavu	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50	50	60	60
Muttom	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50	50	60
Kalamassery	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50	50
Cochin University	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50	50
Pathadipalam	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50	50
Edapally	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50	50
Changampuzha	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40	50
Palarivattom	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40	40
JLN Stadium	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40	40
Kaloor	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40	40
Lissie	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30	40
MG Road	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30	30
Maharajas	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30	30
Ernakulam South	50	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20	30
Kadavanthra	60	50	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20	20
Elamkulam	60	60	50	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20	20
Vytilla	60	60	60	50	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10	20
Thaikoodam	60	60	60	60	50	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10	10
Petta	60	60	60	60	60	50	50	50	50	50	40	40	40	40	30	30	30	20	20	20	10	10

Kochi metro Fare

The above chart shows the fares from stations to stations. And the 1st program takes an input from the user (a number which corresponds to different stations) and gives back the fare along with the platform.

Part - 2

This part involves the generation of a model that can be used to identify the currency input by the user. This was done with the concept of transfer learning. Data was acquired from Kaggle whose size was about 2.40 Gb. (https://www.kaggle.com/vishalmane109/indian-currency-note-images-dataset-2020) . This is a multi classification problem with 8 classes. These classes are as follows rupee 10,20,50,100,200,500,2000 notes are 7 categories and then there is another category called background in case no currency was identified as input. The data was trained on google co laboratory. The data from kaggle was imported to colab with the help of an article on medium. (https://medium.com/analytics-vidhya/how-to-fetch-kaggle-datasets-into-google-colab-ea682569851a). Then form keras application InceptionV3 was loaded which has pretrained weights from imagenet dataset. We use our last layer as softmax layer of 8 outputs and hence don't use the last layer of general inception model as it was particularly used to predict on 1000 classes for imagenet dataset.

In this process we have used loss function as categorical crossentropy and Adam optimizer in a batch size of 16. The trained model acquired an accuracy of about 84% and was saved in HDF format so that the trained model can be accessed later.

Part -3

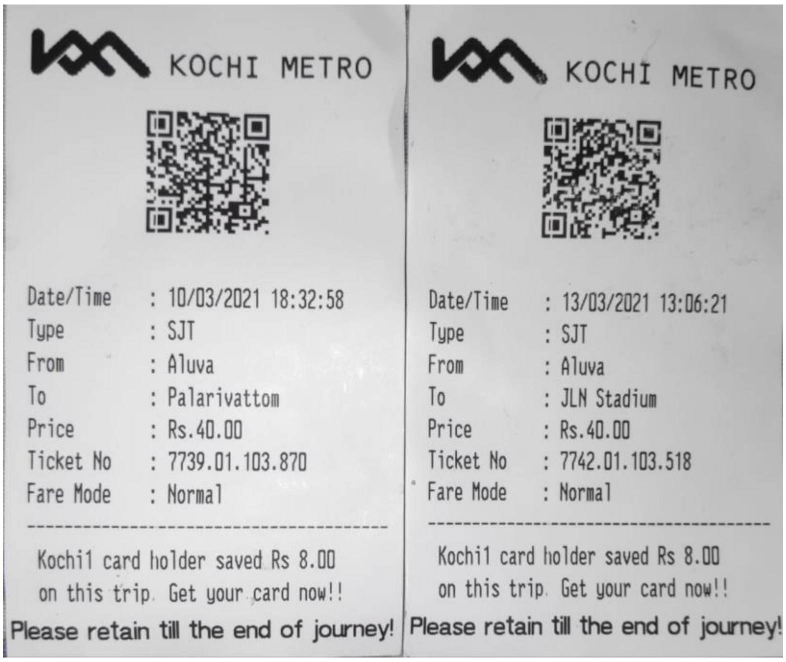
This is the part for next used input. In practical application the system will ask the used how many notes will the used provide and this currencies will move to a slot and the system recognizes which notes were inserted. But since this project only focuses on coding part the program will use ask the user the number of notes and after the input the camera will pop up and space key is used to capture the image of the notes. This was done with the help of basic opencv. Depending upon the number of inputs of currency note the system will iterate that many times and identifies all the input currency. In this case if the input is 2, then after showing the 1st note the space bar have to be pressed and then the 2nd note have to be shown and the space bar have to be pressed again to capture the image of 2nd currency note.

Working of the whole program

After importing the necessary modules and loading the pretrained model for currency detection when the program is run it will ask for the system initialization. This have to be done once while starting the program. In practical case it will be initialized by the system operator who knows the expected number of ticket takers for the day. This is done so that the whole program iterates that many number of times. Further the inputs are taken from the user or the customers who comes to take tickets.

Current station name will be displayed and used will be asked to select the station they want to travel by opting the provided number list. When the place is opted by the used the screen will display the amount and the platform and will ask to input the number of notes they are going to place. For the given number the camera iterates that many times and read all the currency from the user. Identifies the notes and if the amount is correct the ticket will be shown on the screen (in real case scenario it have to be sent to the print option) and then after 15 second screen will refresh for the next user.

If the amount provided is more than the fare, then the balance will be displayed in the screen and the ticket will be print. And in case if amount provided is less than the fare, then system outputs the message to input the correct amount. If no currency detected the system will show the message to the used as repeat the whole process.



```
KOCHI METRO

Date/Time    : 10/03/2021 18:32:58
Type         : SJT
From         : Aluva
To           : Palarivattom
Price        : Rs.40.00
Ticket No    : 7739.01.103.870
Fare Mode    : Normal
----------------------------------------
 Kochi1 card holder saved Rs 8.00
 on this trip. Get your card now!!
Please retain till the end of journey!
```

```
KOCHI METRO

Date/Time    : 13/03/2021 13:06:21
Type         : SJT
From         : Aluva
To           : JLN Stadium
Price        : Rs.40.00
Ticket No    : 7742.01.103.518
Fare Mode    : Normal
----------------------------------------
 Kochi1 card holder saved Rs 8.00
 on this trip. Get your card now!!
Please retain till the end of journey!
```

Kochi metro ticket

The above shown figure is the actual sample of Kochi metro ticket. In this program not all information are provided. Only selected information form this tickets are provided as this is just a testing program. Date, time, from and to along with the ticket date and time are provided in this program.

After reaching the whole iteration of the initial input from admin the program terminates and the screen will display the total amount collected for the day or the total amount for that full iterations.

The above explained is the whole working of this program:

Limitations of this program

- The training data is form Kaggle. It was a 2.4gb file with 8 different classes containing 3566 training images and 345 validation images form 8 different class. Which is certainly not enough data to create a high accuracy model.
- It was trained on google colab so that free access to better GPU's are available. But the amount of GPU usage is limited to a time of 12 hours.
- With the current batch size each epoch took around 5-6 minutes to complete. So that to perform a 50 epoch it took around 5 hours.
- Due to data limitation and time limitation the whole program was only able to achieve an accuracy of around 84% which not up to the mark.
- Due to system limitations and considering this program to be for the study purpose 84 is considered good enough accuracy.
- While capturing the currency image the whole note have to be visible to the camera and there should not be noise in the background.
- Even with all this precaution the system can still identify the currency wrong.

- When the camera pops for the first time the camera tab have to be selected to make it as the active window.

Future scope

Using this algorithm a mechanical system can be integrated along with the help of some micro controllers to make the system realistic. An in built QR generator with information can be added to this program in order to bypass validation gates at the station. Unique number for each ticket can be added to the program.

References

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- http://datahacker.rs/deep-learning-vgg-16-vs-vgg-19/
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- https://www.tensorflow.org/tutorials/keras/save_and_load