"Pay As You Park" Smart Parking Solution

2021-198

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Student Information

Student ID	Student Name	Presentation Slides
IT18012552	M.D.S.M. Antany	Validate the parking yards standard and suggest the solution for parking yards
IT18154672	Priyankara A.D.D	Introduction and Find the availability of free spaces inside parking yard
IT18013092	Aadil M.R.M	Suggest and direct to most suitable parking yard for user
IT18013924	Ferreira L.V	Internal navigation in parking yards

Introduction

WHAT IS SMART PARKING ?

DOES CURRENT SOCIETY NEED A SMART PARKING SOLUTION?

Research Problem

- Existing payment process in parking systems

- Hardness to find a parking yard to park
- Difficulty of navigation inside parking yards

- Difficulty of measuring parking yards

  standard without human interaction

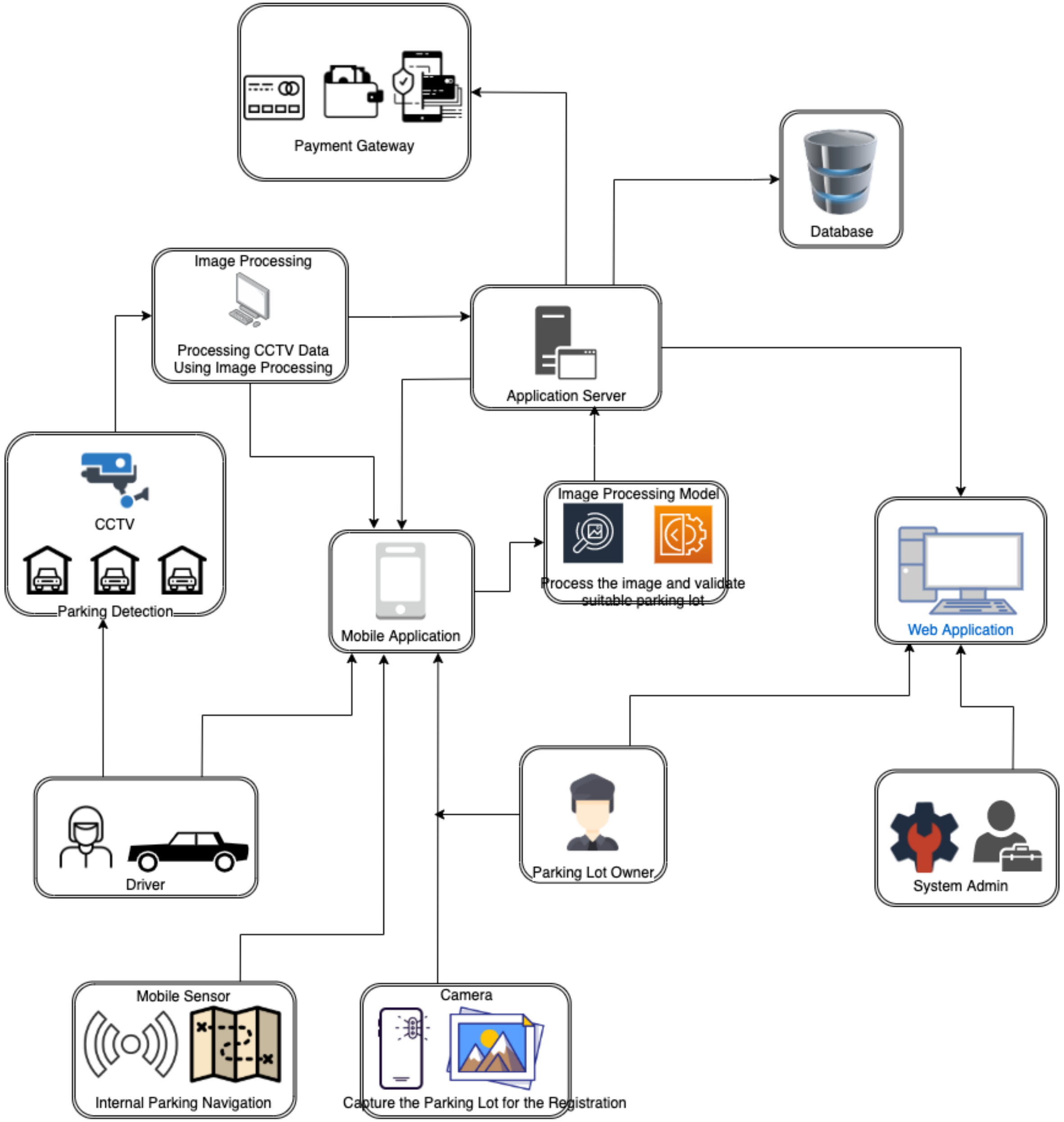
Objectives

- Introduce "pay as you park" concept to the parking system.
- Support users to find the most suitable parking yard
- Provide the best experience in parking using smart technology

Research Components

- Find the availability of free spaces inside parking yard
- Suggest and direct to most suitable parking yard for user
- Internal navigation in parking yards
- Measuring parking yards standard and validate suitability before the yard registration

System Diagram



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IT18154672 | PRIYANKARA A. D. D.

Software Engineering

INTRODUCTION

- Research Problem
- Research Gap
- Objectives

RESEARCH QUESTION

- What is the cost-friendly and accurate alternative to identify car parking spaces in a parking slot?

OBJECTIVES

- Identifying vacant parking slots in a parking lot.

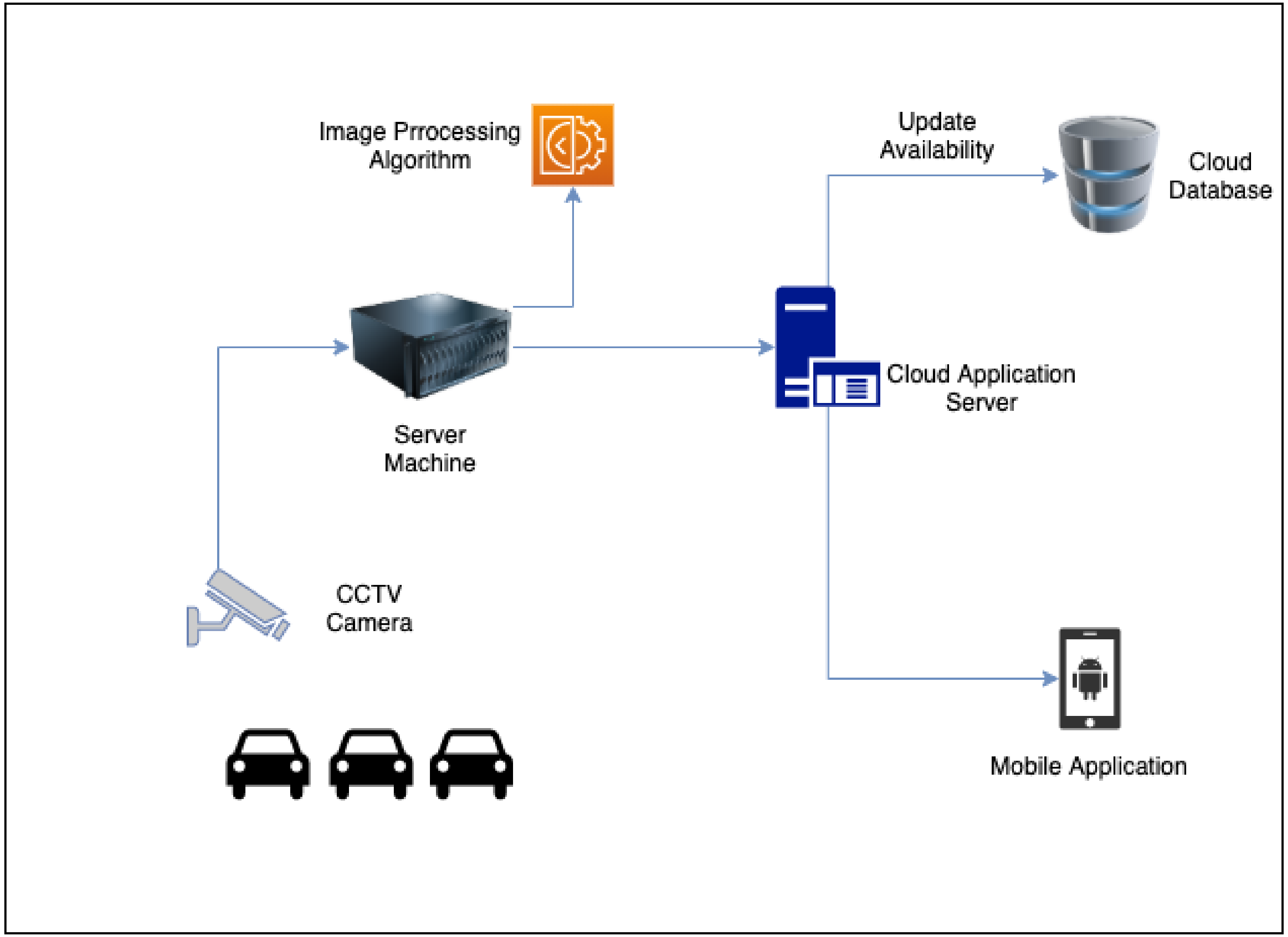
SUB OBJECTIVES

- Save time of the user by pre-identifying vacant spaces.
- Send the processed data for the further process.

RESEARCH METHODOLOGY

- System Diagram
- Technologies to be used

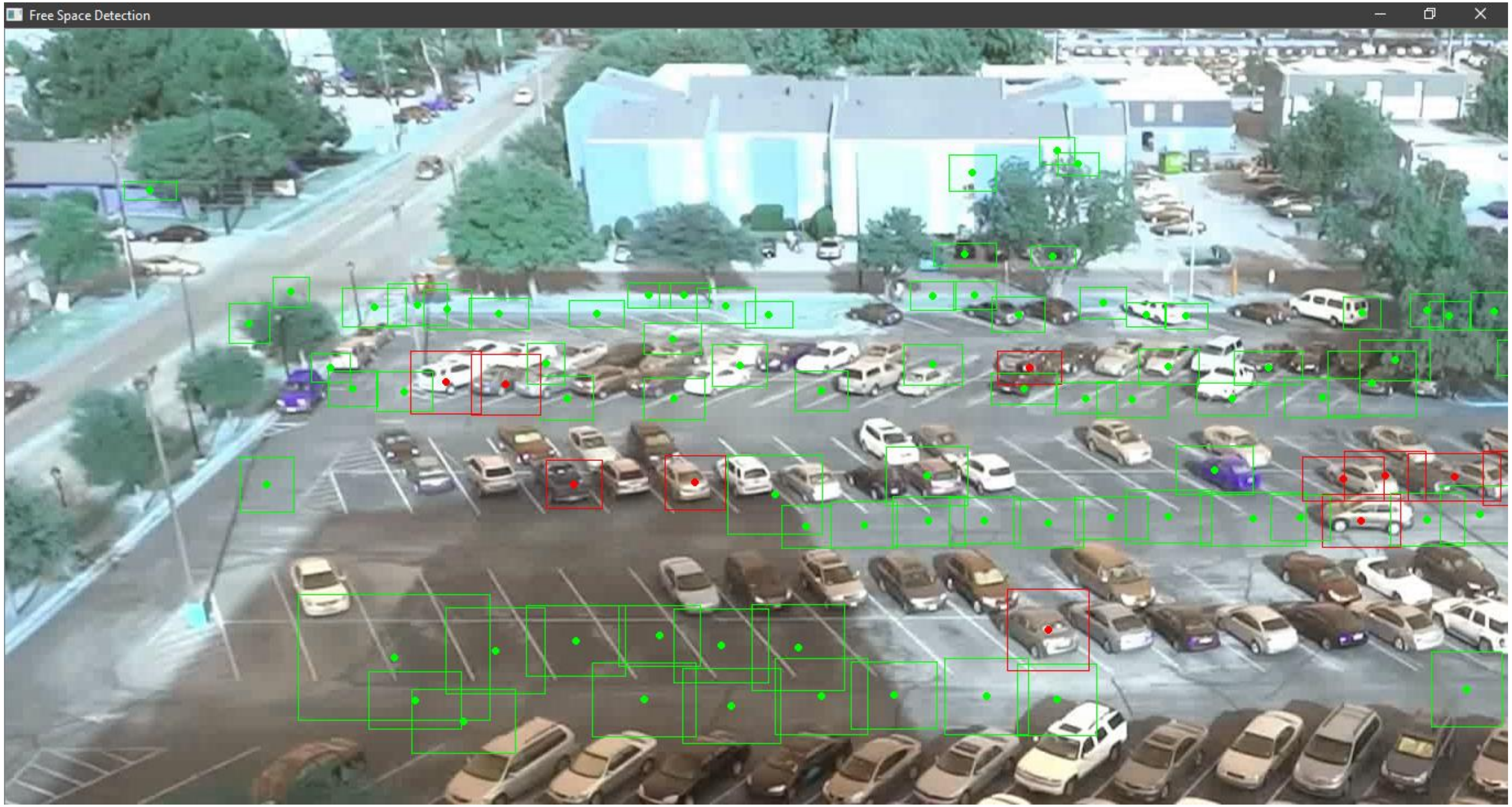
SYSTEM DIAGRAM



TECHNOLOGIES TO BE USED

- Identifying vacant/available parking spaces
- Number of vehicles detection
  - Mask RCNN (Region Based Convolutional Neural Networks)
- REST APIs
  - Express JS with MongoDB

EVIDENCE OF COMPLETION



REFERENCES

[1] Sukumar, M. B., Sireesha, G., Ashok, A., Mounish, G., & Prathap, D. Real Time Image Processing Based Vacant Car Parking Occupancy Information System.

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[3] Paidi, V., Fleyeh, H., Håkansson, J., & Nyberg, R. G. (2018). Smart parking sensors, technologies and applications for open parking lots: a review. *IET Intelligent Transport Systems*, *12*(8), 735-741.

[4] PcMag, (2021), Definition of smart parking | PCMag [Online] Available: https://www.pcmag.com/encyclopedia/term/smart-parking#:~:text=A%20vehicle%20parking%20system%20that,incoming%20drivers%20to%20available%20locations.&text=With%20the%20Smart%20Park%20system,car%2C%20smart%20home%20and%20smart [Accessed 20 Feb 2021]

[5] Gunasekara, G. G. Y. U., Gunasekara, A. D. A. I., & Kathriarachchi, R. P. S. (2015). A Smart Vehicle Parking Management Solution.

[6] Karunarathne, M. S., & Nanayakkara, L. D. J. F. (2014). A Prototype to Identify Availability of a Car in a Smart Car Park with Aid of Programmable Chip and Infrared Sensors. *Journal of Emerging Trends in Computing and Information Sciences*, *5*(2).

[7] Nandyal, S., Sultana, S., & Anjum, S. (2017). Smart car parking system using arduino uno. *International Journal of Computer Applications*, *975*(169), 1.

[8] Bachani, M., Qureshi, U. M., & Shaikh, F. K. (2016). Performance analysis of proximity and light sensors for smart parking. Procedia Computer Science, 83, 385-392.

[9] Britannica, (2021), Image processing | computer science | Britannica [Online]
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[10] True, N. (2007). Vacant parking space detection in static images. University of California, San Diego, 17, 659-662.

[11] Ichihashi, H., Notsu, A., Honda, K., Katada, T., & Fujiyoshi, M. (2009, August). Vacant parking space detector for outdoor parking lot by using surveillance camera and FCM classifier. In 2009 IEEE International Conference on Fuzzy Systems (pp. 127-134). IEEE.

IT18013092 | AADIL M.R.M

Software Engineering

INTRODUCTION

- Research Question
- Specific and Sub Objectives

RESEARCH PROBLEM

- Problems faced by the drivers when finding a parking yard.
- How does it affect the society ?
- How does it affect the environment ?

Objectives

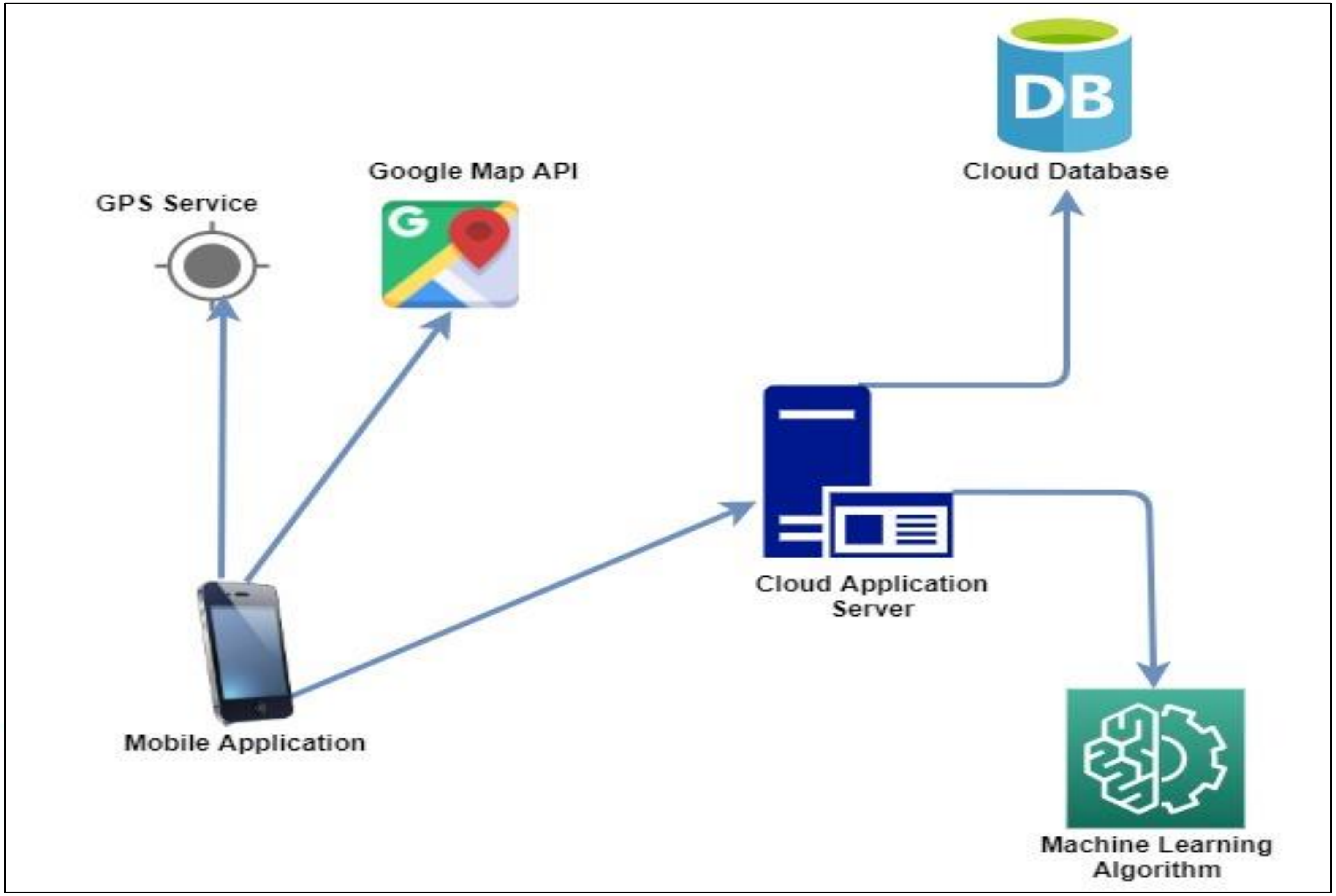
- Identify the nearest parking yard around user/user destination.
- Suggest optimal parking yard to park the vehicle based on key factors.
- Provide a cross platform mobile app to perform the task

RESEARCH METHODOLOGY

SYSTEM DAIGARM

TECHNOLOGY AND TECHNIQUES TO BE USED

SYSTEM DIAGRAM

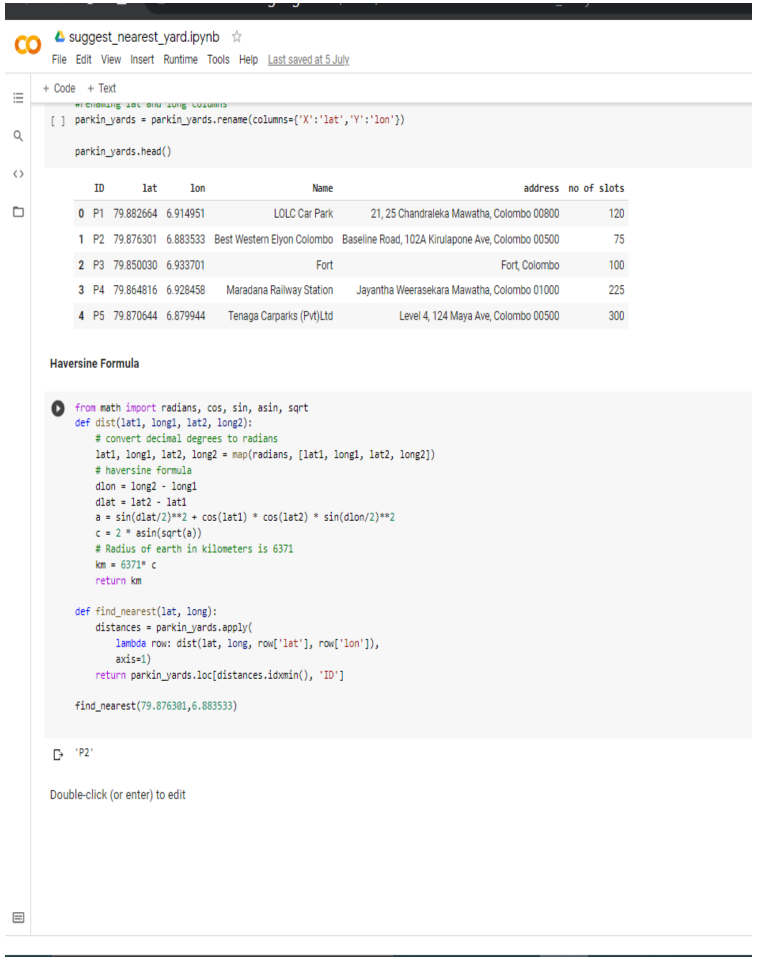


TECHNOLOGY AND TECHNIQUES TO BE USED

- Retrieving the current location of user
  - ➢ GPS related technology
  - ➢ Google Map API – visualize the location
- Suggest optimal parking yard to park the vehicle based on key factors
  - ➢ Machine learning algorithms : SARIMA
  - ➢ Haversine Algorithm
  - ➢ Google Map API – visualize the locations and directions

EVIDENCE FOR THE COMPLETION

Haversine Imp


suggest_nearest_yard.ipynb
File Edit View Insert Runtime Tools Help Last saved at 5 July
+ Code + Text

```
#renaming lat and long columns
parkin_yards = parkin_yards.rename(columns={'X':'lat','Y':'lon'})

parkin_yards.head()
```

	ID	lat	lon	Name	address	no of slots
0	P1	79.882664	6.914951	LOLC Car Park	21, 25 Chandraleka Mawatha, Colombo 00800	120
1	P2	79.876301	6.883533	Best Western Elyon Colombo	Baseline Road, 102A Kirulapone Ave, Colombo 00500	75
2	P3	79.850030	6.933701	Fort	Fort, Colombo	100
3	P4	79.864816	6.928458	Maradana Railway Station	Jayantha Weerasekara Mawatha, Colombo 01000	225
4	P5	79.870644	6.879944	Tenaga Carparks (Pvt)Ltd	Level 4, 124 Maya Ave, Colombo 00500	300

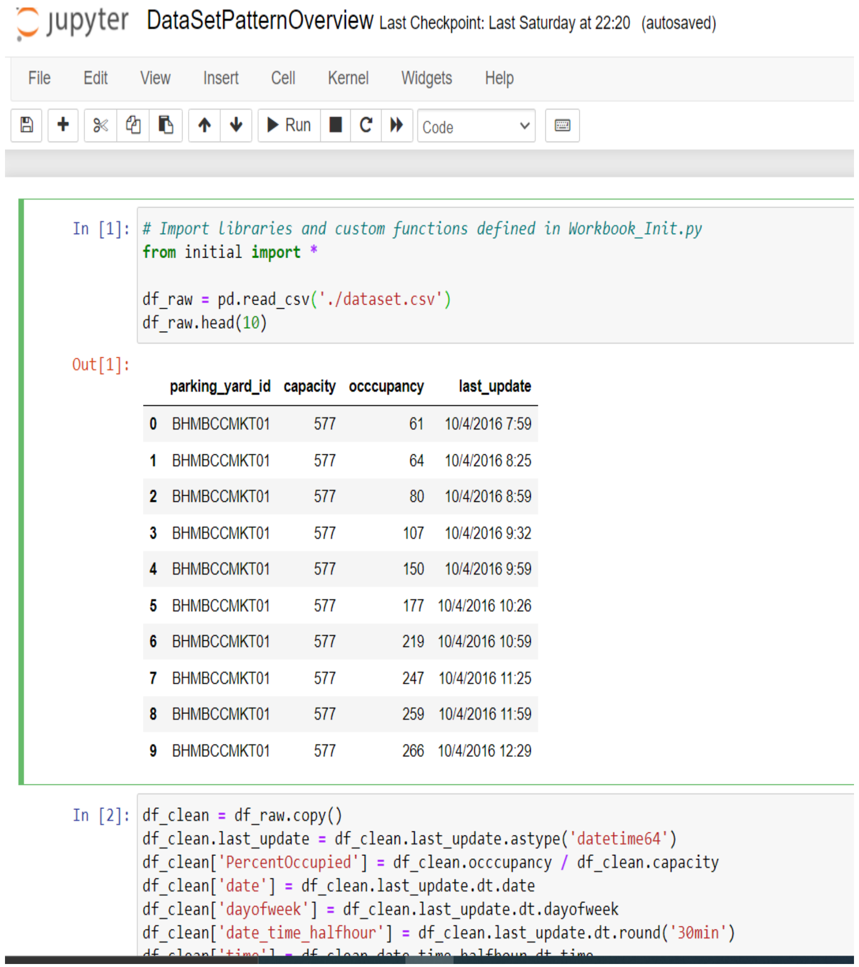
Haversine Formula

```
from math import radians, cos, sin, asin, sqrt
def dist(lat1, long1, lat2, long2):
    # convert decimal degrees to radians
    lat1, long1, lat2, long2 = map(radians, [lat1, long1, lat2, long2])
    # haversine formula
    dlon = long2 - long1
    dlat = lat2 - lat1
    a = sin(dlat/2)**2 + cos(lat1) * cos(lat2) * sin(dlon/2)**2
    c = 2 * asin(sqrt(a))
    # Radius of earth in kilometers is 6371
    km = 6371* c
    return km

def find_nearest(lat, long):
    distances = parkin_yards.apply(
        lambda row: dist(lat, long, row['lat'], row['lon']),
        axis=1)
    return parkin_yards.loc[distances.idxmin(), 'ID']

find_nearest(79.876301,6.883533)
```

```
'P2'
```

Double-click (or enter) to edit

Dataset Pattern Overview


jupyter DataSetPatternOverview Last Checkpoint: Last Saturday at 22:20 (autosaved)
File Edit View Insert Cell Kernel Widgets Help
Run
Code

```
In [1]: # Import libraries and custom functions defined in Workbook_Init.py
        from initial import *

        df_raw = pd.read_csv('./dataset.csv')
        df_raw.head(10)
```

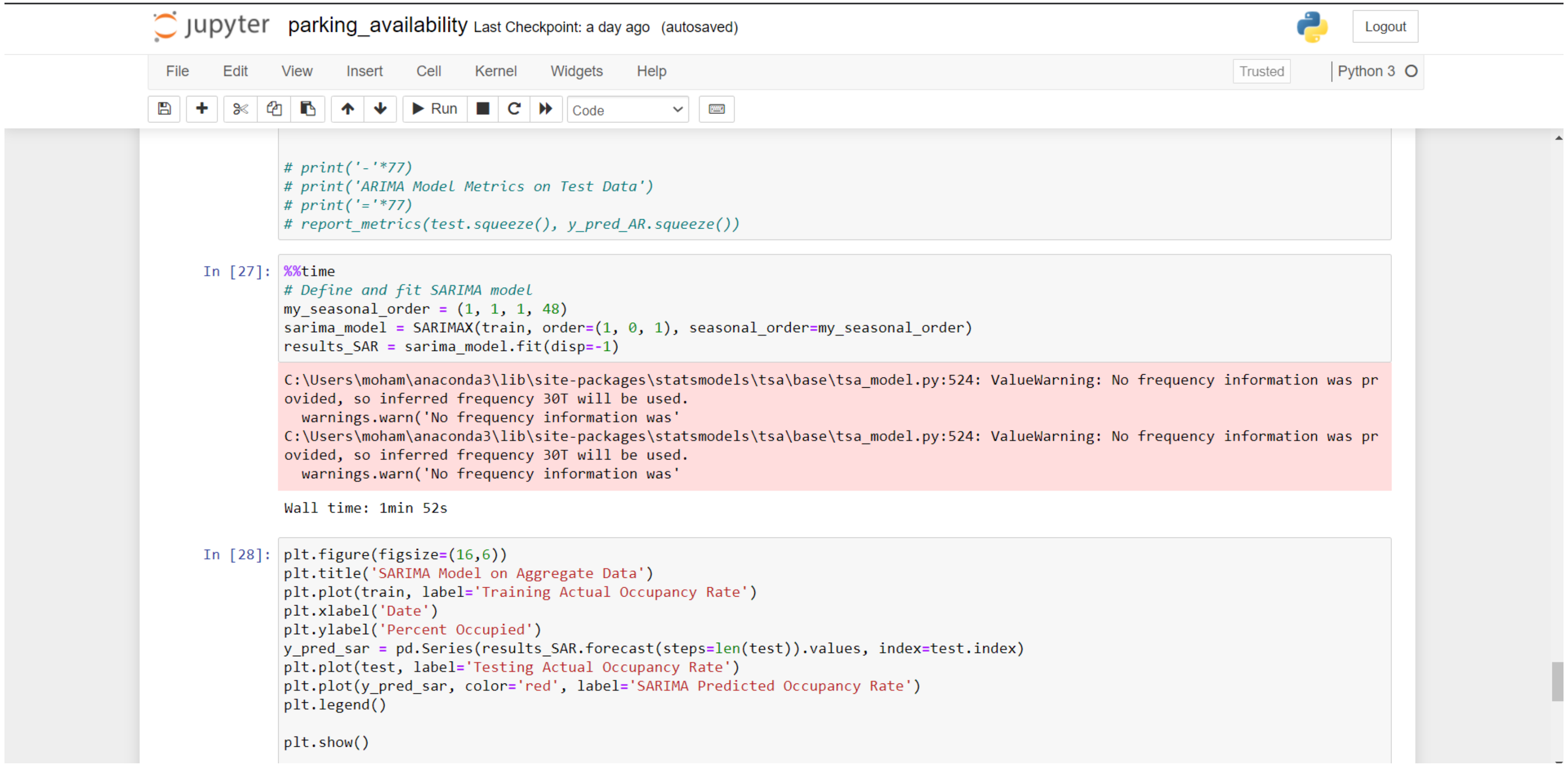
Out[1]:

	parking_yard_id	capacity	occcupancy	last_update
0	BHMBCCMKT01	577	61	10/4/2016 7:59
1	BHMBCCMKT01	577	64	10/4/2016 8:25
2	BHMBCCMKT01	577	80	10/4/2016 8:59
3	BHMBCCMKT01	577	107	10/4/2016 9:32
4	BHMBCCMKT01	577	150	10/4/2016 9:59
5	BHMBCCMKT01	577	177	10/4/2016 10:26
6	BHMBCCMKT01	577	219	10/4/2016 10:59
7	BHMBCCMKT01	577	247	10/4/2016 11:25
8	BHMBCCMKT01	577	259	10/4/2016 11:59
9	BHMBCCMKT01	577	266	10/4/2016 12:29

```
In [2]: df_clean = df_raw.copy()
        df_clean.last_update = df_clean.last_update.astype('datetime64')
        df_clean['PercentOccupied'] = df_clean.occcupancy / df_clean.capacity
        df_clean['date'] = df_clean.last_update.dt.date
        df_clean['dayofweek'] = df_clean.last_update.dt.dayofweek
        df_clean['date_time_halfhour'] = df_clean.last_update.dt.round('30min')
        df_clean['time'] = df_clean.date_time_halfhour.dt.time
```

EVIDENCE FOR THE COMPLETION

SARIMA Model



```
# print('-'*77)
# print('ARIMA Model Metrics on Test Data')
# print('='*77)
# report_metrics(test.squeeze(), y_pred_AR.squeeze())
```

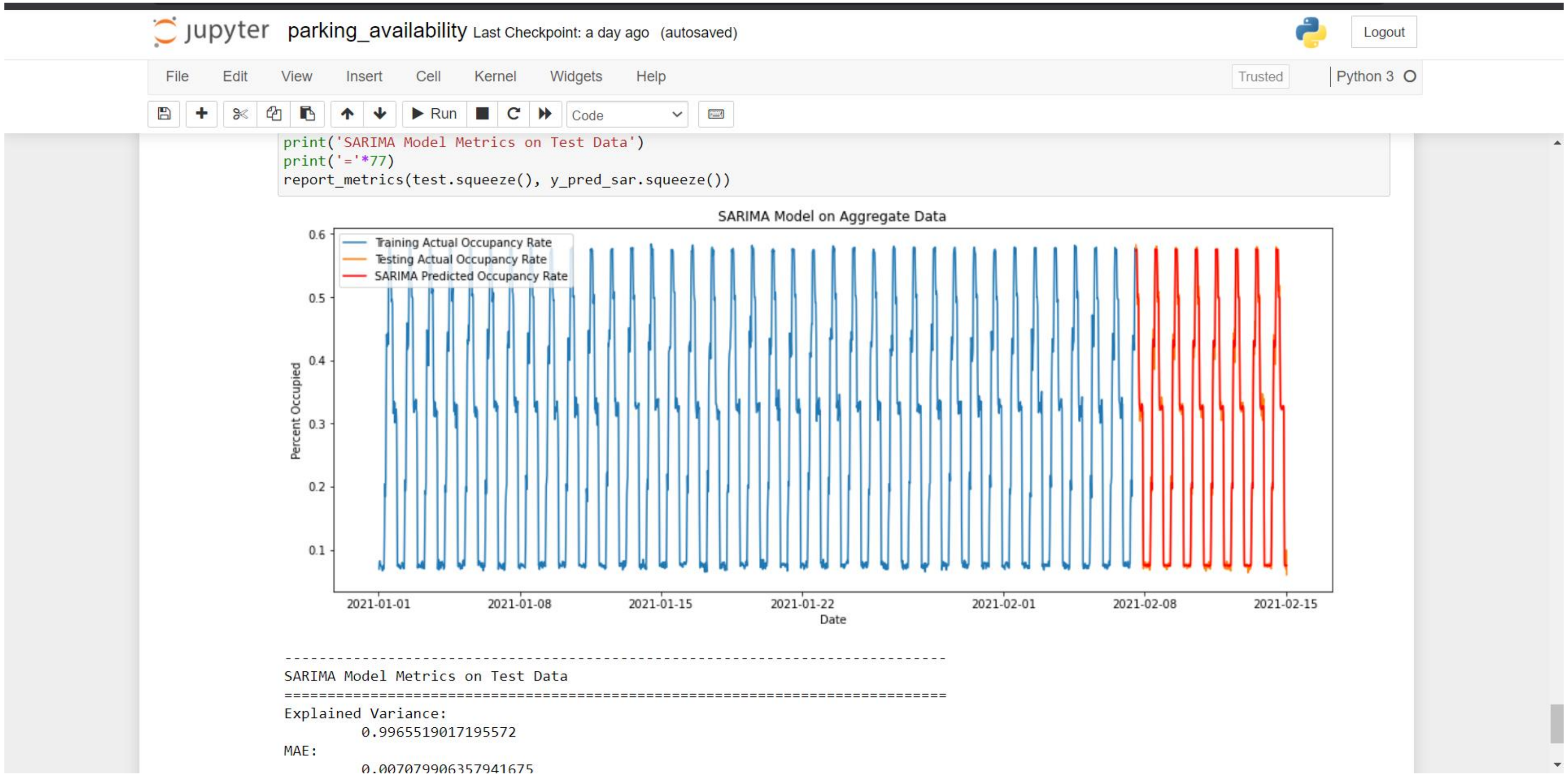
In [27]:
```
%%time
# Define and fit SARIMA model
my_seasonal_order = (1, 1, 1, 48)
sarima_model = SARIMAX(train, order=(1, 0, 1), seasonal_order=my_seasonal_order)
results_SAR = sarima_model.fit(disp=-1)
```

```
C:\Users\moham\anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:524: ValueWarning: No frequency information was pr
ovided, so inferred frequency 30T will be used.
  warnings.warn('No frequency information was'
C:\Users\moham\anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:524: ValueWarning: No frequency information was pr
ovided, so inferred frequency 30T will be used.
  warnings.warn('No frequency information was'

Wall time: 1min 52s
```

In [28]:
```
plt.figure(figsize=(16,6))
plt.title('SARIMA Model on Aggregate Data')
plt.plot(train, label='Training Actual Occupancy Rate')
plt.xlabel('Date')
plt.ylabel('Percent Occupied')
y_pred_sar = pd.Series(results_SAR.forecast(steps=len(test)).values, index=test.index)
plt.plot(test, label='Testing Actual Occupancy Rate')
plt.plot(y_pred_sar, color='red', label='SARIMA Predicted Occupancy Rate')
plt.legend()

plt.show()
```

EVIDENCE FOR THE COMPLETION

SARIMA Forecasting



```
print('SARIMA Model Metrics on Test Data')
print('='*77)
report_metrics(test.squeeze(), y_pred_sar.squeeze())
```

```
-----------------------------------------------------------------------------
SARIMA Model Metrics on Test Data
=============================================================================
Explained Variance:
            0.9965519017195572
MAE:
            0.007079906357941675
```

IT18013924 | FERREIRA L.V.

Software Engineering

INTERNAL PARKING NAVIGATION INSIDE A PARKING AREA

INTRODUCTION

- What is a parking and an Internal Navigation inside a parking area?
- Indoor/outdoor parking areas.
- Why use Beacon technology and its advantages.

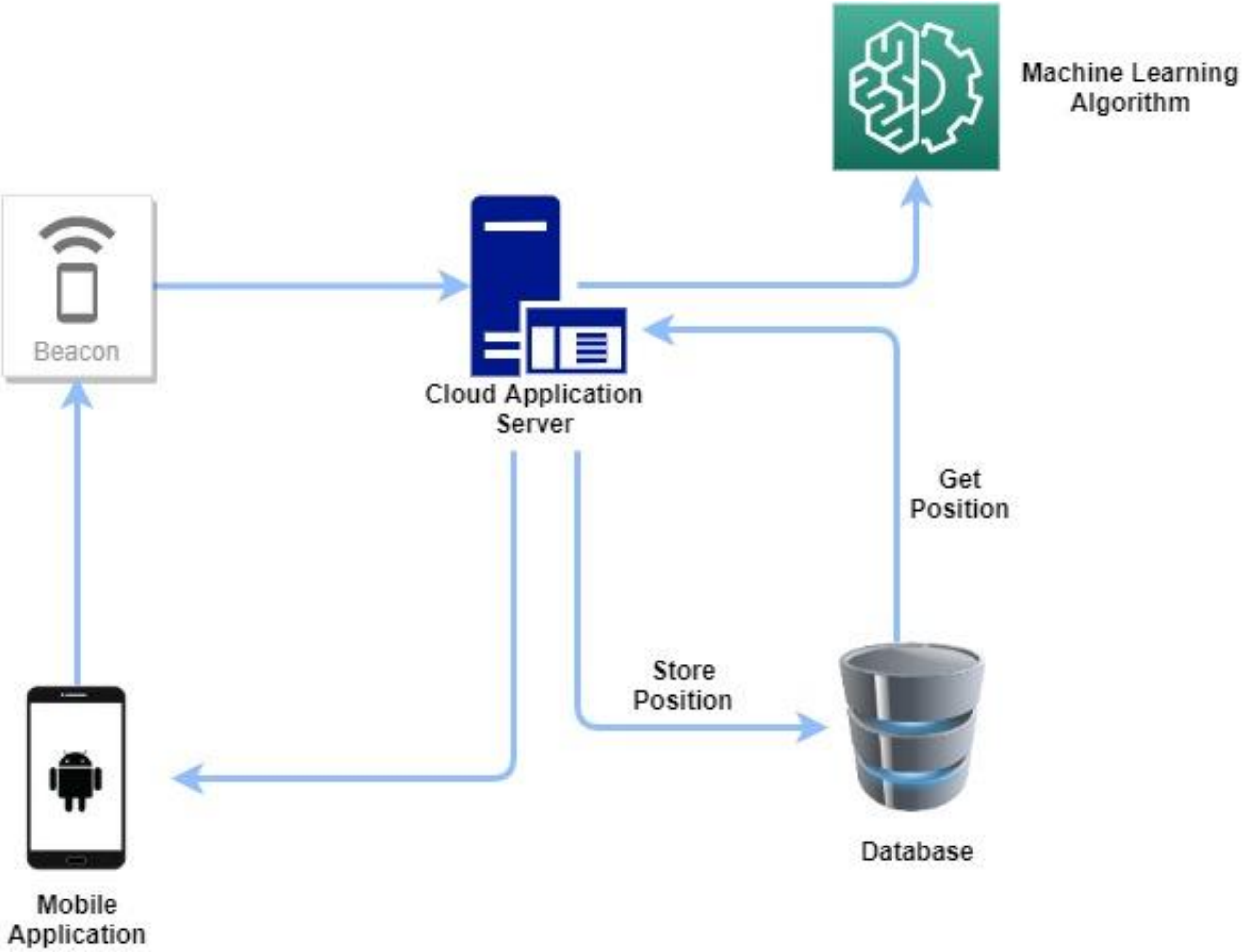
OBJECTIVES

- Identify the user's position
- View user's position in a map
- Show users path to free parking slots

METHODOLOGY

- Models Created
- Accuracy of these Models
- How to show predicted location in a map

SYSTEM DIAGRAM



TECHNOLOGY AND TECHNIQUES TO BE USED

- Identify the User's Position
  - Beacons
  - Calculate Distance of the Beacons(by getting RSSI values)
  - Machine learning algorithms : Nural Network(Sequential)
  - Pass image of the map and show user's position
  - Show path to the destination(free slot)

COMPLETION OF THE COMPONENT

- Trained the Model
- Dummy Map which can show User Position
- Implemented a method to get position of a user when give three beacon distances to user as input parameters

TO-DO...

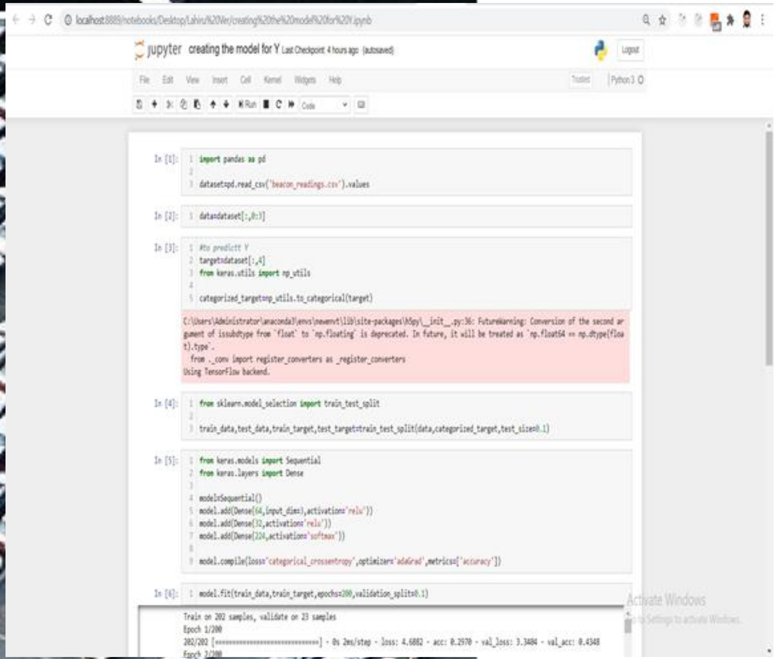
- Implement a Code to calculate the distance by using Beacon Bluetooth Signal Values

- Design All the UIs and Databases

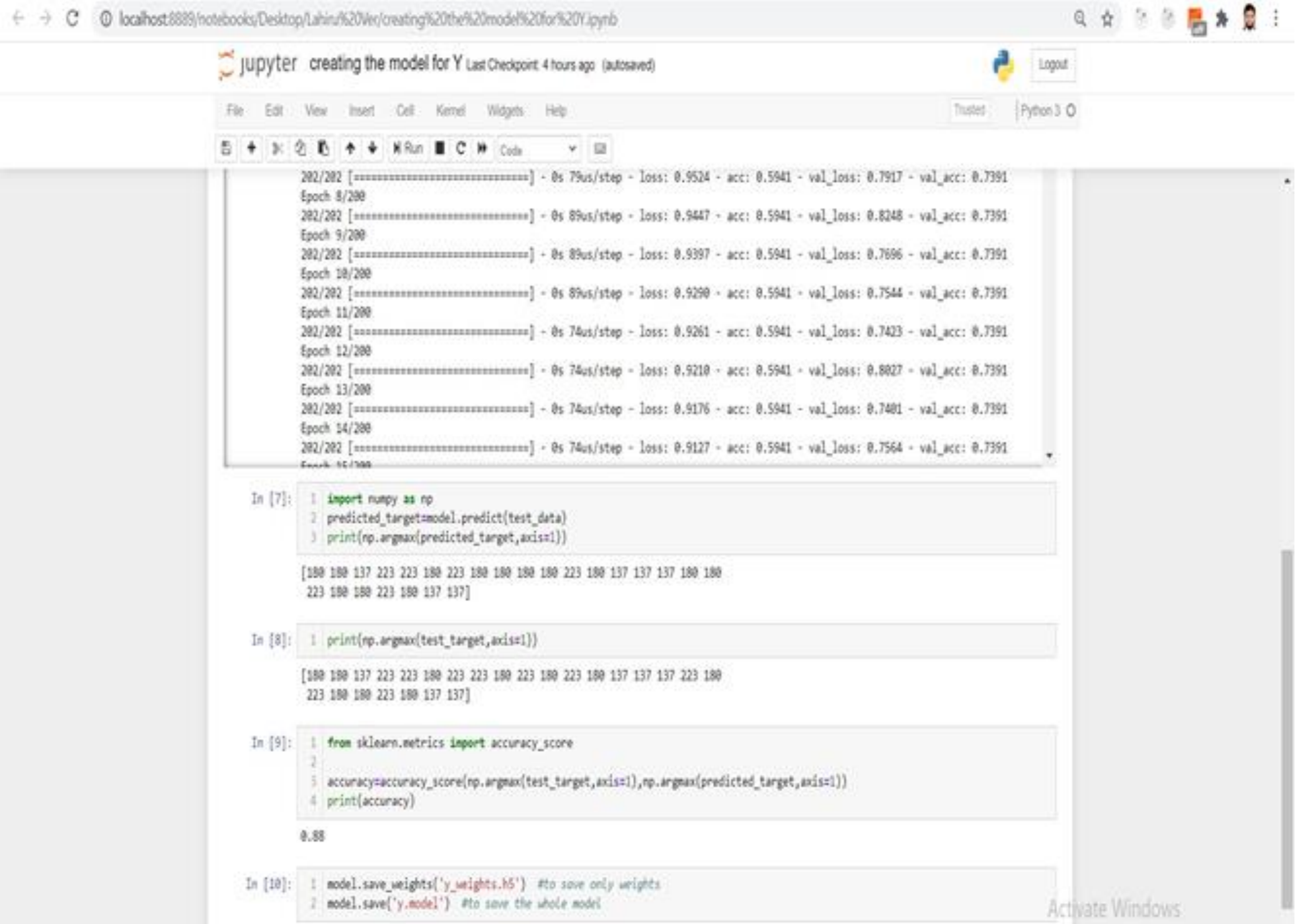
- Implement a way to show the path from user to the destination

EVIDENCE FOR THE COMPLETION

Model Predicts Position Y



```
In [1]: import pandas as pd

        dataset=pd.read_csv('beacon_readings.csv').values

In [2]: data=dataset[:,0:3]

In [3]: #to predictt Y
        target=dataset[:,4]
        from keras.utils import np_utils

        categorized_target=np_utils.to_categorical(target)

C:\Users\Administrator\anaconda3\envs\newenvt\lib\site-packages\h5py\__init__.py:36: FutureWarning: Conversion of the second ar
gument of issubdtype from `float` to `np.floating` is deprecated. In future, it will be treated as `np.float64 == np.dtype(floa
t).type`.
  from ._conv import register_converters as _register_converters
Using TensorFlow backend.

In [4]: from sklearn.model_selection import train_test_split

        train_data,test_data,train_target,test_target=train_test_split(data,categorized_target,test_size=0.1)

In [5]: from keras.models import Sequential
        from keras.layers import Dense

        model=Sequential()
        model.add(Dense(64,input_dim=3,activation='relu'))
        model.add(Dense(32,activation='relu'))
        model.add(Dense(224,activation='softmax'))

        model.compile(loss='categorical_crossentropy',optimizer='adaGrad',metrics=['accuracy'])

In [6]: model.fit(train_data,train_target,epochs=200,validation_split=0.1)

Train on 202 samples, validate on 23 samples
Epoch 1/200
202/202 [==============================] - 0s 2ms/step - loss: 4.6882 - acc: 0.2970 - val_loss: 3.3484 - val_acc: 0.4348
Epoch 2/200
```



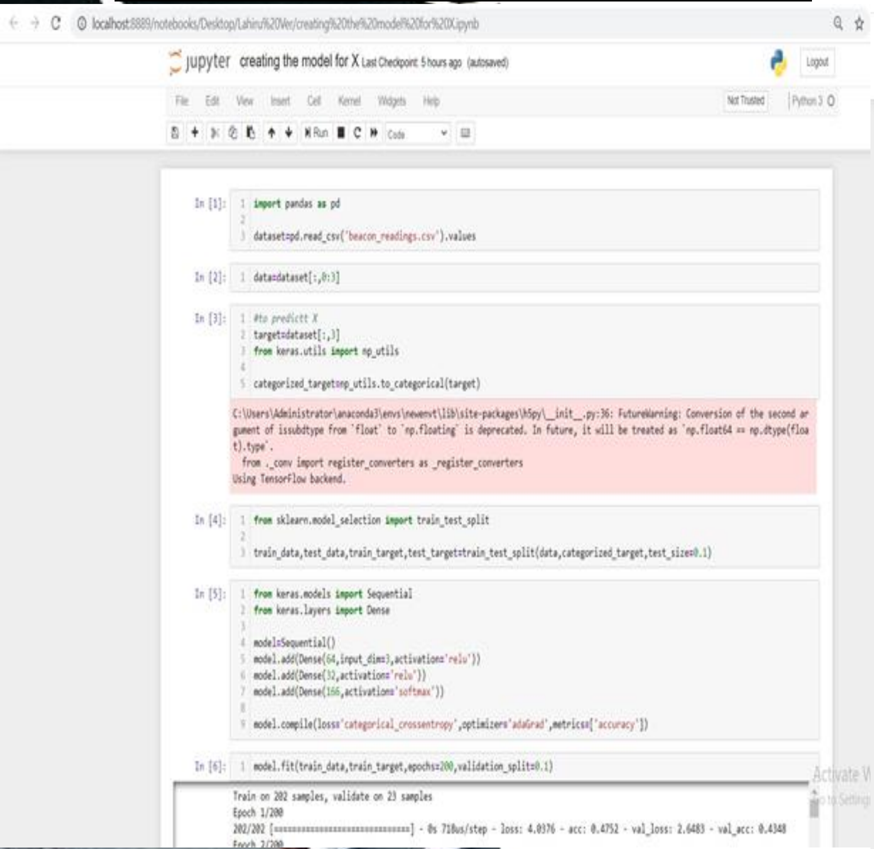
localhost:8889/notebooks/Desktop/Lahiru%20Ver/creating%20the%20model%20for%20Y.ipynb

jupyter creating the model for Y Last Checkpoint: 4 hours ago (autosaved)

```
202/202 [==============================] - 0s 79us/step - loss: 0.9524 - acc: 0.5941 - val_loss: 0.7917 - val_acc: 0.7391
Epoch 8/200
202/202 [==============================] - 0s 89us/step - loss: 0.9447 - acc: 0.5941 - val_loss: 0.8248 - val_acc: 0.7391
Epoch 9/200
202/202 [==============================] - 0s 89us/step - loss: 0.9397 - acc: 0.5941 - val_loss: 0.7696 - val_acc: 0.7391
Epoch 10/200
202/202 [==============================] - 0s 89us/step - loss: 0.9290 - acc: 0.5941 - val_loss: 0.7544 - val_acc: 0.7391
Epoch 11/200
202/202 [==============================] - 0s 74us/step - loss: 0.9261 - acc: 0.5941 - val_loss: 0.7423 - val_acc: 0.7391
Epoch 12/200
202/202 [==============================] - 0s 74us/step - loss: 0.9210 - acc: 0.5941 - val_loss: 0.8027 - val_acc: 0.7391
Epoch 13/200
202/202 [==============================] - 0s 74us/step - loss: 0.9176 - acc: 0.5941 - val_loss: 0.7481 - val_acc: 0.7391
Epoch 14/200
202/202 [==============================] - 0s 74us/step - loss: 0.9127 - acc: 0.5941 - val_loss: 0.7564 - val_acc: 0.7391

In [7]: import numpy as np
        predicted_target=model.predict(test_data)
        print(np.argmax(predicted_target,axis=1))

[180 180 137 223 223 180 223 180 180 180 180 223 180 137 137 137 180 180
 223 180 180 223 180 137 137]

In [8]: print(np.argmax(test_target,axis=1))

[180 180 137 223 223 180 223 223 180 223 180 223 180 137 137 137 223 180
 223 180 180 223 180 137 137]

In [9]: from sklearn.metrics import accuracy_score

        accuracy=accuracy_score(np.argmax(test_target,axis=1),np.argmax(predicted_target,axis=1))
        print(accuracy)

0.88

In [10]: model.save_weights('y_weights.h5')  #to save only weights
         model.save('y.model')  #to save the whole model
```

EVIDENCE FOR THE COMPLETION

Model Predicts Position X



localhost:8889/notebooks/Desktop/Lahiru%20Ver/creating%20the%20model%20for%20X.ipynb
jupyter creating the model for X Last Checkpoint: 5 hours ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Not Trusted
Python 3
Run
Code

```
In [1]: import pandas as pd

        dataset=pd.read_csv('beacon_readings.csv').values

In [2]: data=dataset[:,0:3]

In [3]: #to predictt X
        target=dataset[:,3]
        from keras.utils import np_utils

        categorized_target=np_utils.to_categorical(target)

C:\Users\Administrator\anaconda3\envs\newenvt\lib\site-packages\h5py\__init__.py:36: FutureWarning: Conversion of the second ar
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  from ._conv import register_converters as _register_converters
Using TensorFlow backend.

In [4]: from sklearn.model_selection import train_test_split

        train_data,test_data,train_target,test_target=train_test_split(data,categorized_target,test_size=0.1)

In [5]: from keras.models import Sequential
        from keras.layers import Dense

        model=Sequential()
        model.add(Dense(64,input_dim=3,activation='relu'))
        model.add(Dense(32,activation='relu'))
        model.add(Dense(166,activation='softmax'))

        model.compile(loss='categorical_crossentropy',optimizer='adaGrad',metrics=['accuracy'])

In [6]: model.fit(train_data,train_target,epochs=200,validation_split=0.1)

Train on 202 samples, validate on 23 samples
Epoch 1/200
202/202 [==============================] - 0s 718us/step - loss: 4.0376 - acc: 0.4752 - val_loss: 2.6483 - val_acc: 0.4348
Epoch 2/200
```
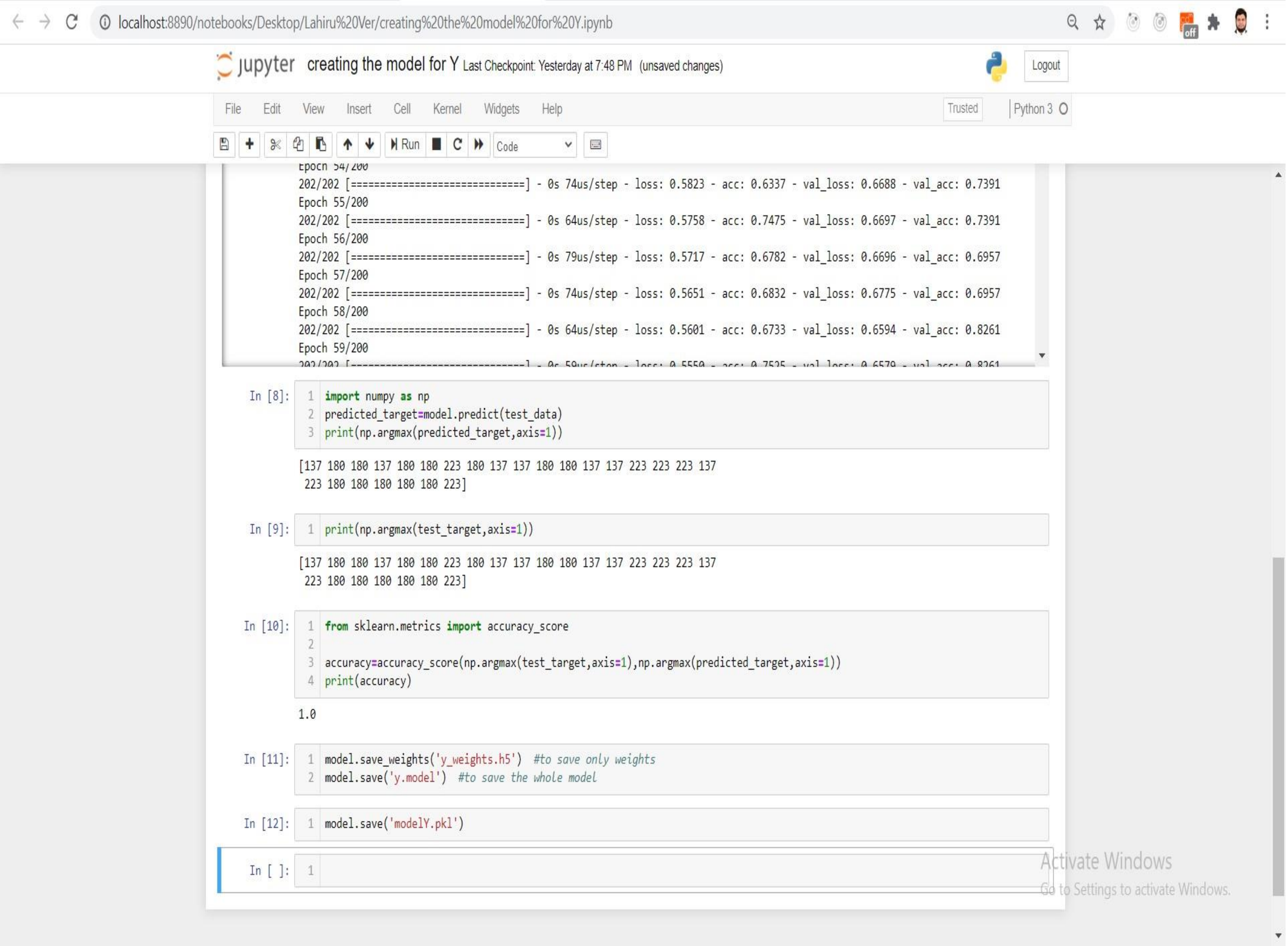
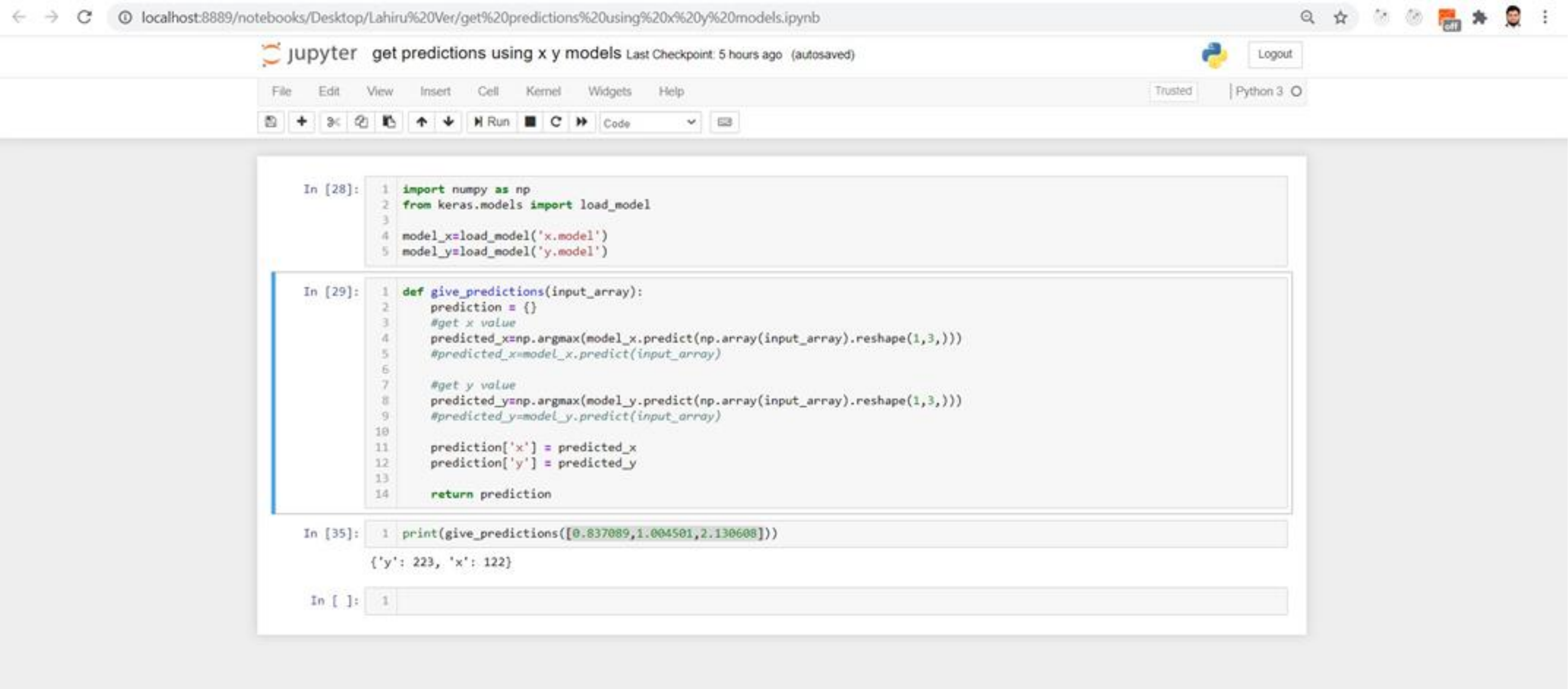



localhost:8890/notebooks/Desktop/Lahiru%20Ver/creating%20the%20model%20for%20Y.ipynb
jupyter creating the model for Y Last Checkpoint: Yesterday at 7:48 PM (unsaved changes)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code
Activate Windows
Go to Settings to activate Windows.

```
Epoch 54/200
202/202 [==============================] - 0s 74us/step - loss: 0.5823 - acc: 0.6337 - val_loss: 0.6688 - val_acc: 0.7391
Epoch 55/200
202/202 [==============================] - 0s 64us/step - loss: 0.5758 - acc: 0.7475 - val_loss: 0.6697 - val_acc: 0.7391
Epoch 56/200
202/202 [==============================] - 0s 79us/step - loss: 0.5717 - acc: 0.6782 - val_loss: 0.6696 - val_acc: 0.6957
Epoch 57/200
202/202 [==============================] - 0s 74us/step - loss: 0.5651 - acc: 0.6832 - val_loss: 0.6775 - val_acc: 0.6957
Epoch 58/200
202/202 [==============================] - 0s 64us/step - loss: 0.5601 - acc: 0.6733 - val_loss: 0.6594 - val_acc: 0.8261
Epoch 59/200
202/202 [==============================] - 0s 59us/step - loss: 0.5559 - acc: 0.7525 - val_loss: 0.6579 - val_acc: 0.8261

In [8]: import numpy as np
        predicted_target=model.predict(test_data)
        print(np.argmax(predicted_target,axis=1))

[137 180 180 137 180 180 223 180 137 137 180 180 137 137 223 223 223 137
 223 180 180 180 180 180 223]

In [9]: print(np.argmax(test_target,axis=1))

[137 180 180 137 180 180 223 180 137 137 180 180 137 137 223 223 223 137
 223 180 180 180 180 180 223]

In [10]: from sklearn.metrics import accuracy_score

         accuracy=accuracy_score(np.argmax(test_target,axis=1),np.argmax(predicted_target,axis=1))
         print(accuracy)

1.0

In [11]: model.save_weights('y_weights.h5')  #to save only weights
         model.save('y.model')  #to save the whole model

In [12]: model.save('modelY.pkl')

In [ ]:
```

EVIDENCE FOR THE COMPLETION

Implemented method to get position



localhost:8889/notebooks/Desktop/Lahiru%20Ver/get%20predictions%20using%20x%20y%20models.ipynb
jupyter get predictions using x y models Last Checkpoint: 5 hours ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code

In [28]:

```
import numpy as np
from keras.models import load_model

model_x=load_model('x.model')
model_y=load_model('y.model')
```

In [29]:

```
def give_predictions(input_array):
    prediction = {}
    #get x value
    predicted_x=np.argmax(model_x.predict(np.array(input_array).reshape(1,3,)))
    #predicted_x=model_x.predict(input_array)

    #get y value
    predicted_y=np.argmax(model_y.predict(np.array(input_array).reshape(1,3,)))
    #predicted_y=model_y.predict(input_array)

    prediction['x'] = predicted_x
    prediction['y'] = predicted_y

    return prediction
```

In [35]:

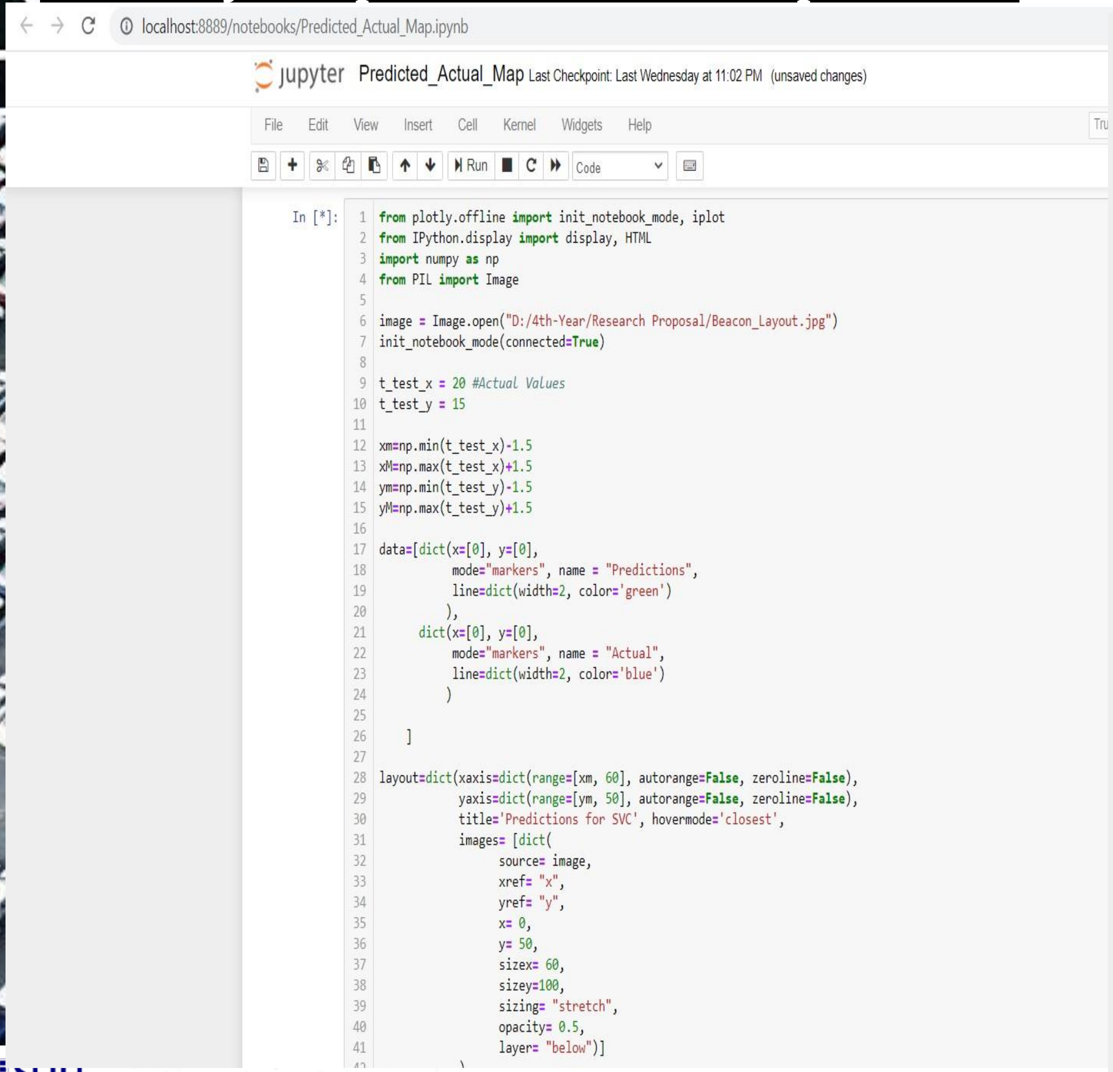
```
print(give_predictions([0.837089,1.004501,2.130608]))
```

```
{'y': 223, 'x': 122}
```

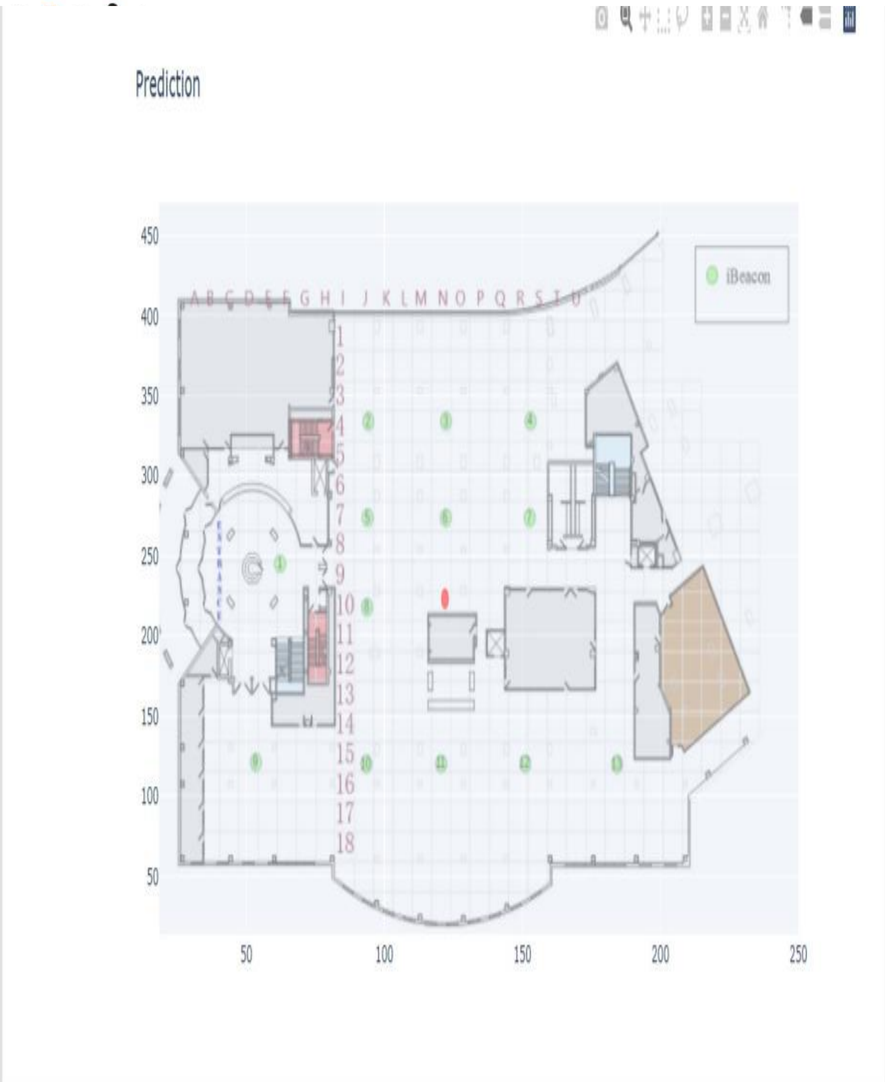
In [ ]:

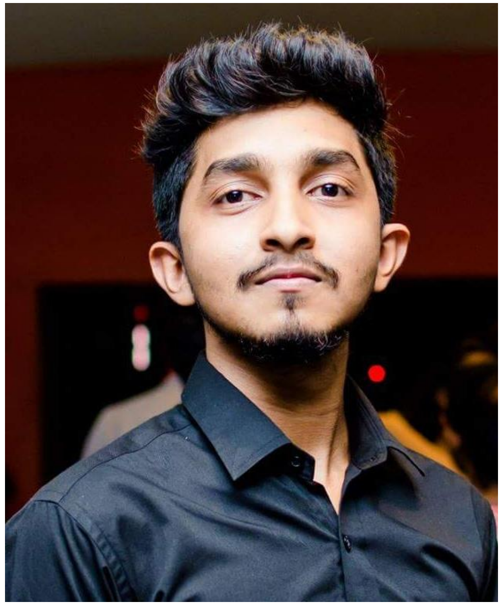
EVIDENCE FOR THE COMPLETION

Dummy Map to view user's position


localhost:8889/notebooks/Predicted_Actual_Map.ipynb
jupyter Predicted_Actual_Map Last Checkpoint: Last Wednesday at 11:02 PM (unsaved changes)
File Edit View Insert Cell Kernel Widgets Help
Run
Code
In [*]:

```
from plotly.offline import init_notebook_mode, iplot
from IPython.display import display, HTML
import numpy as np
from PIL import Image

image = Image.open("D:/4th-Year/Research Proposal/Beacon_Layout.jpg")
init_notebook_mode(connected=True)

t_test_x = 20 #Actual Values
t_test_y = 15

xm=np.min(t_test_x)-1.5
xM=np.max(t_test_x)+1.5
ym=np.min(t_test_y)-1.5
yM=np.max(t_test_y)+1.5

data=[dict(x=[0], y=[0],
          mode="markers", name = "Predictions",
          line=dict(width=2, color='green')
         ),
     dict(x=[0], y=[0],
          mode="markers", name = "Actual",
          line=dict(width=2, color='blue')
         )

    ]

layout=dict(xaxis=dict(range=[xm, 60], autorange=False, zeroline=False),
           yaxis=dict(range=[ym, 50], autorange=False, zeroline=False),
           title='Predictions for SVC', hovermode='closest',
           images= [dict(
                 source= image,
                 xref= "x",
                 yref= "y",
                 x= 0,
                 y= 50,
                 sizex= 60,
                 sizey=100,
                 sizing= "stretch",
                 opacity= 0.5,
                 layer= "below")]
          )
```





IT18012552 | M.D.S.M. ANTANY

Software Engineering

MEASURING PARKING YARDS STANDARD AND VALIDATE SUITAB BEFORE THE YARD REGISTRATION

RESEARCH QUESTION

How to identify a standard parking yard without time wasting and a without human interaction before registration?

- Reviewing thousands of parking registration forms by a human is time consuming
- Registration process is too complicated
- Inability to audit the parking yard condition without man power (monthly or annually)

MAIN OBJECTIVE

Identify the parking yard surface type and Quality of the surface before registering to the system as a valid parking yard

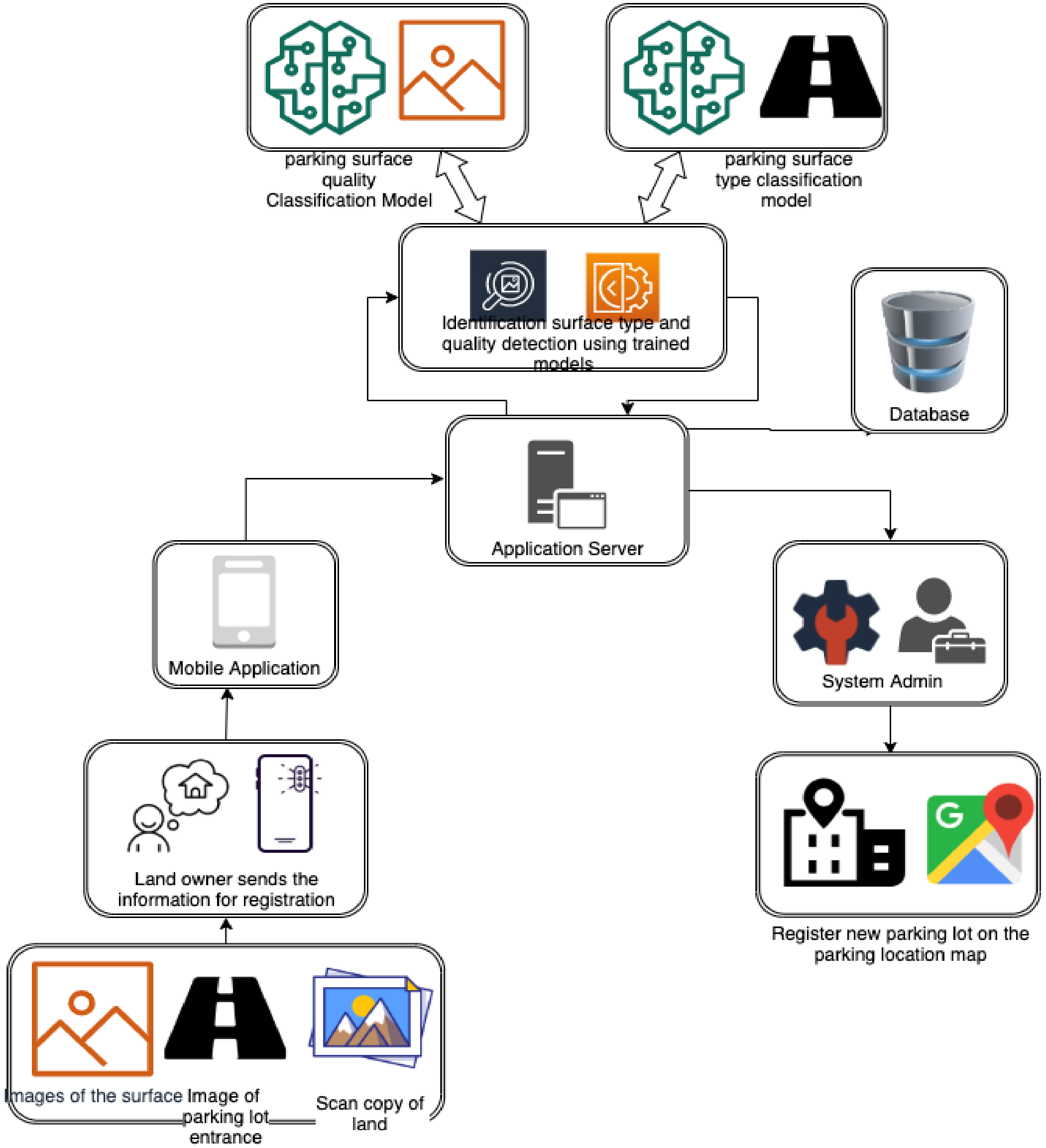
SUB OBJECTIVES

- Identify the parking yard surface type
- Identify the quality of the parking yard surface under the surface type

Research Methodology

- SYSTEM DAIGARM
- TECHNOLOGY AND TECHNIQUES USED

SYSTEM OVERVIEW DIAGRAM



parking surface quality Classification Model

parking surface type classification model

Identification surface type and quality detection using trained models

Database

Application Server

Mobile Application

System Admin

Land owner sends the information for registration

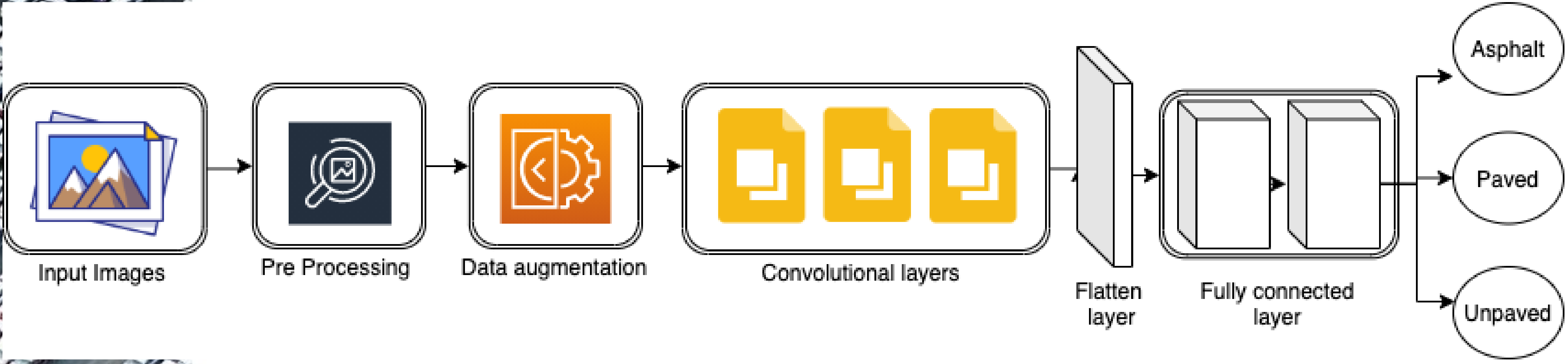
Register new parking lot on the parking location map

Images of the surface

Image of parking lot entrance

Scan copy of land

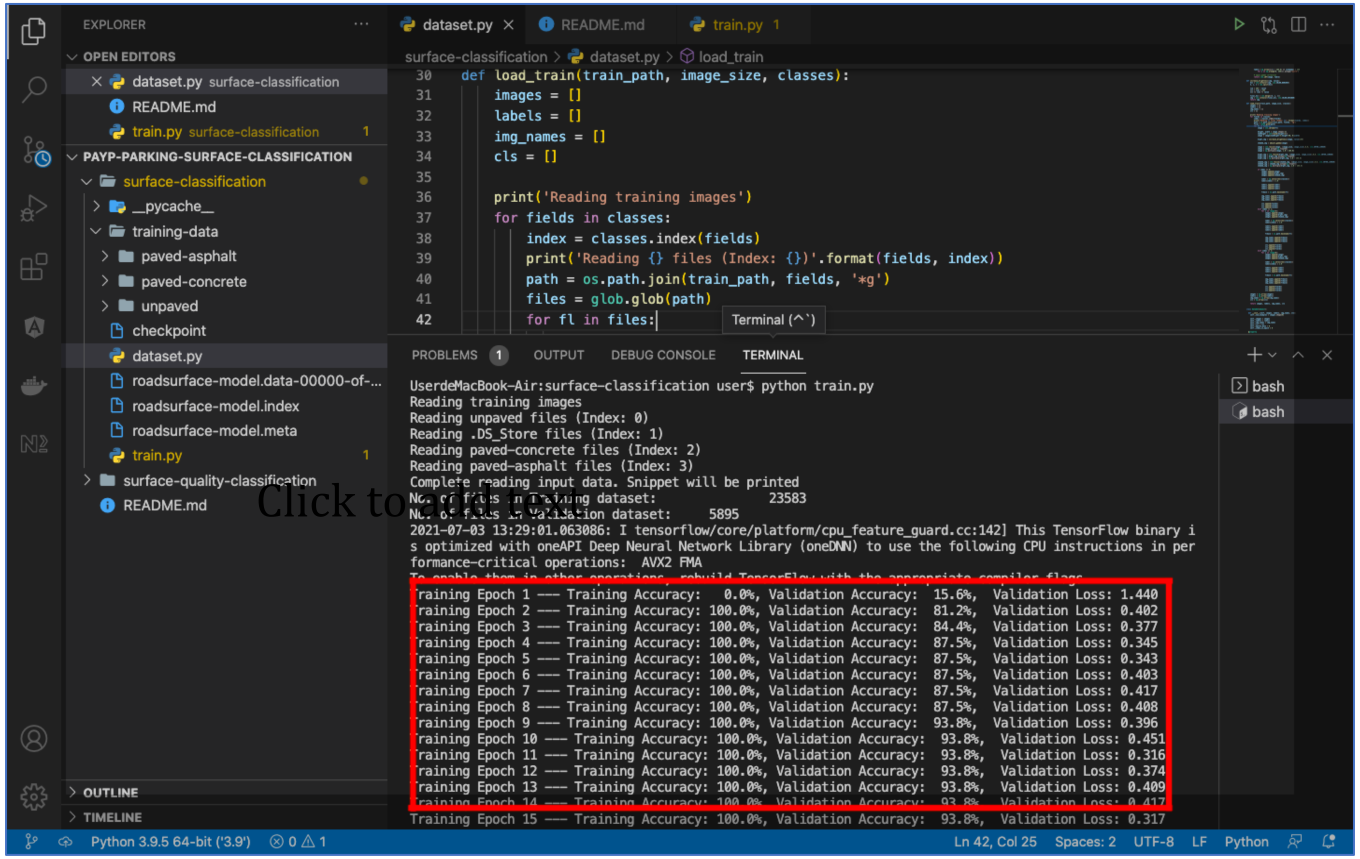
SYSTEM FLOWCHART DIAGRAM



TECHNOLOGY AND TECHNIQUES

- Used Road Traversing Knowledge (RTK) Dataset
- Region of Interest (ROI) is defined as a pre-processing step for each input frame
- The data augmentation consists of increasing and decreasing the brightness in each frame
- Input images are passed to the CNN structure containing three convolution layers and two fully connected layers.
- The flatten layer is used to transform the convolution multi-dimensional tensor into a one-dimensional tensor.
- Model training divided to two parts
  - Parking surface type model
  - Parking surface quality model

EVIDENCE FOR COMPLETION



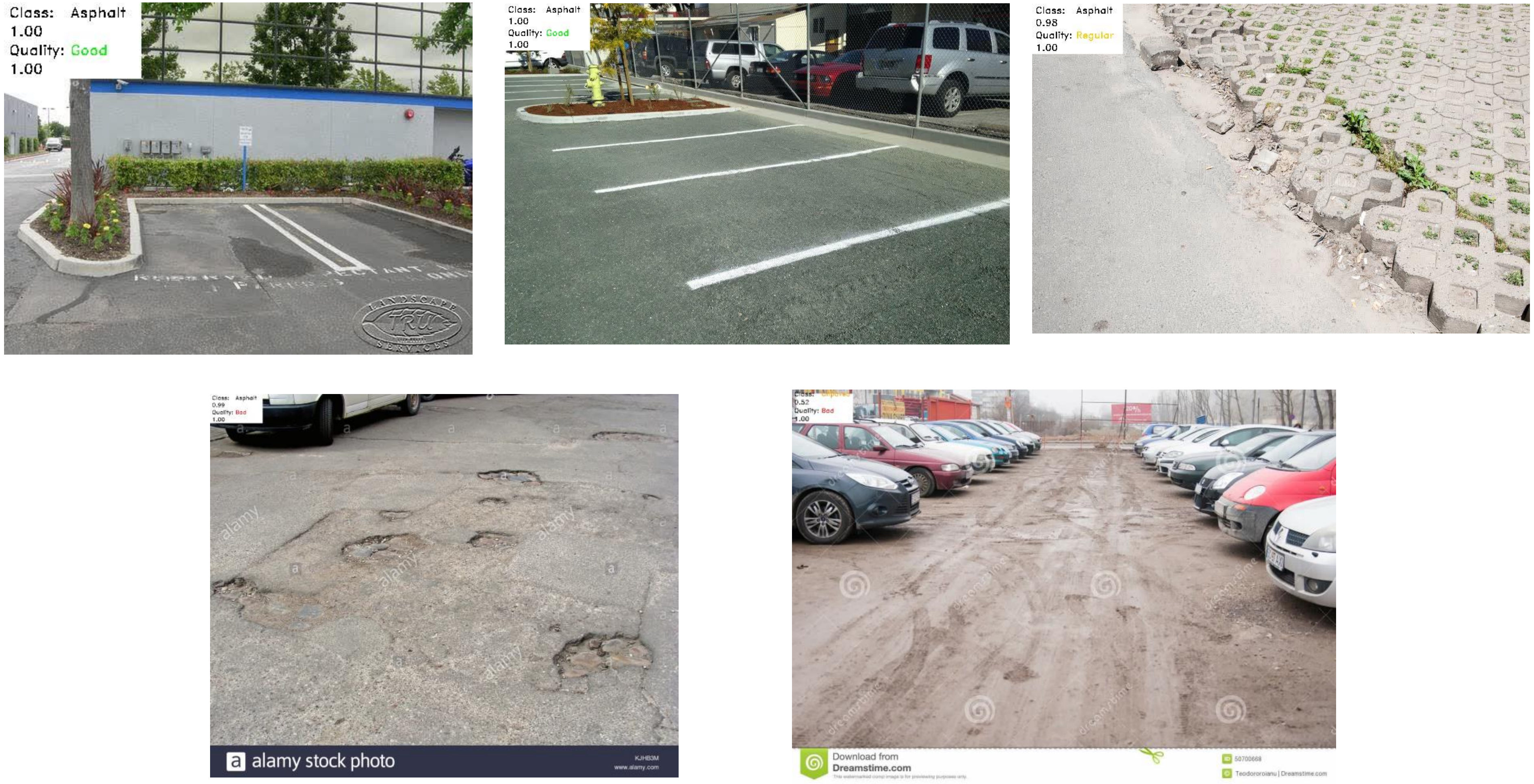
```python
def load_train(train_path, image_size, classes):
  images = []
  labels = []
  img_names = []
  cls = []

  print('Reading training images')
  for fields in classes:
    index = classes.index(fields)
    print('Reading {} files (Index: {})'.format(fields, index))
    path = os.path.join(train_path, fields, '*g')
    files = glob.glob(path)
    for fl in files:
```

```
UserdeMacBook-Air:surface-classification user$ python train.py
Reading training images
Reading unpaved files (Index: 0)
Reading .DS_Store files (Index: 1)
Reading paved-concrete files (Index: 2)
Reading paved-asphalt files (Index: 3)
Complete reading input data. Snippet will be printed
No. of files in training dataset:             23583
No. of files in validation dataset:     5895
2021-07-03 13:29:01.063086: I tensorflow/core/platform/cpu_feature_guard.cc:142] This TensorFlow binary i
s optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in per
formance-critical operations:  AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
Training Epoch 1 --- Training Accuracy:   0.0%, Validation Accuracy:  15.6%,  Validation Loss: 1.440
Training Epoch 2 --- Training Accuracy: 100.0%, Validation Accuracy:  81.2%,  Validation Loss: 0.402
Training Epoch 3 --- Training Accuracy: 100.0%, Validation Accuracy:  84.4%,  Validation Loss: 0.377
Training Epoch 4 --- Training Accuracy: 100.0%, Validation Accuracy:  87.5%,  Validation Loss: 0.345
Training Epoch 5 --- Training Accuracy: 100.0%, Validation Accuracy:  87.5%,  Validation Loss: 0.343
Training Epoch 6 --- Training Accuracy: 100.0%, Validation Accuracy:  87.5%,  Validation Loss: 0.403
Training Epoch 7 --- Training Accuracy: 100.0%, Validation Accuracy:  87.5%,  Validation Loss: 0.417
Training Epoch 8 --- Training Accuracy: 100.0%, Validation Accuracy:  87.5%,  Validation Loss: 0.408
Training Epoch 9 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.396
Training Epoch 10 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.451
Training Epoch 11 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.316
Training Epoch 12 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.374
Training Epoch 13 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.409
Training Epoch 14 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.417
Training Epoch 15 --- Training Accuracy: 100.0%, Validation Accuracy:  93.8%,  Validation Loss: 0.317
```

Click to add text

Model accuracy : ~93%

EVIDENCE FOR COMPLETION



Surface and quality measurement image output

UPCOMING DEVELOPMENTS

- Implement the mobile app to the parking lot registration and management section for the parking lot owner
- Implement the web app to manage newly registered parking lots for the moderator
- Implement parking mapping design toolkit inbuild to the webapp for the moderator of the application

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[2]. Nienaber, S & Booysen, M.J. (Thinus) & Kroon, Rs. (2015). Detecting Potholes Using Simple Image Processing Techniques and Real-World Footage. 10.13140/RG.2.1.3121.8408.

[3]. Taluja, Chandan & Thakur, Ritula. (2018). An Intelligent Model for Indian Soil Classification using various Machine Learning Techniques. 2250-3005.

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[5]. Bennett, Jordan. (2019). Smart (Ai) Pothole Detector (Powered by "Tensorflow/TensorRT" on "Google Colab" and or "Jetson Nano" via a Convolutional Artificial Neural Network).

Thank You !

Q & A