PROJECT

INTERNET OF THINGS

TITLE: TRAFFIC MANAGEMENT SYSTEM

SUBMITTED BY:

NAME: ARUN JETLY A

REGISTER NUMBER: 911921104002

NAAN MUDHALVAN ID: au911921104002

DEPARTMENT: B.E (COMPUTER SCIENCE ENGINEERING)

TRAFFIC MANAGEMENT SYSTEM

PROJECT DEFINITION: The project involves using IoT devices and data analytics to monitor traffic flow and congestion in real-time, providing commuters with access to this information through a public platform or mobile apps. The objective is to help commuters make informed decisions about their routes and alleviate traffic congestion. This project includes defining objectives, designing the IoT traffic monitoring system, developing the traffic information platform, and integrating them using IoT technology and python.

PHASE 1: PROJECT DEFINITION AND DESIGN THINKING

DESIGN THINKING:

1. **PROJECT OBJECTIVES:**
    - **Define objectives such as real-time traffic monitoring:**
        - Estimation of traffic bulkiness performed using real time video feed.
        - Vehicle recognition in order to differentiate between emergency and non-emergency vehicles.
        - The system proposed relies on the efficient det lite model, which later provides output in order to manage light switching for each lane.
    - **Congestion detection:**
        - The only way a sender can guess that congestion has happened is the need to retransmit a segment.
        - Retransmission is needed to recover a missing packet that is assumed to have been dropped by a router due to congestion.
    - **Route optimization:**
        - Route optimization is the process of planning the fastest and most cost-effective way for your mobile field service workers to get from one appointment to another.

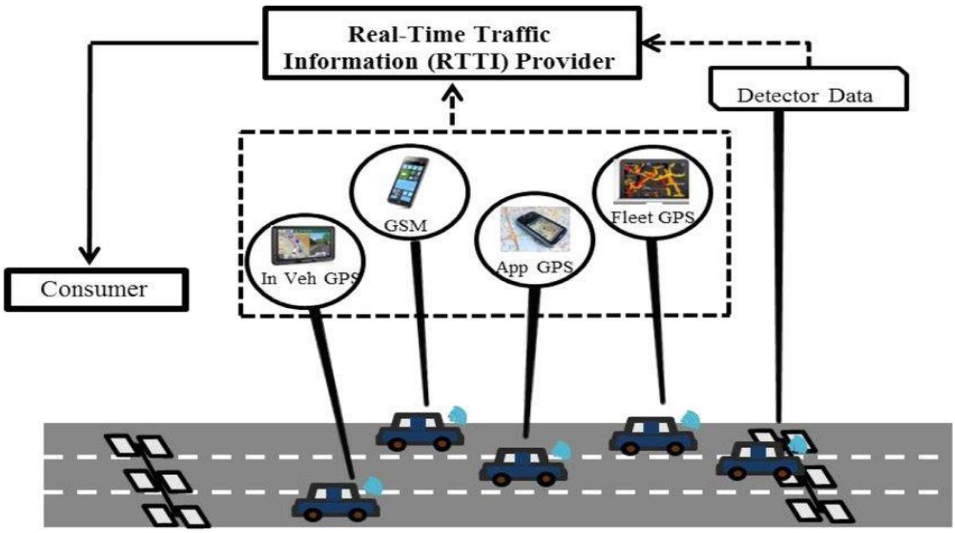
2. IoT SENSOR DESIGN:

- **Plan the deployment of IoT devices (sensors) to monitor traffic flow and congestion:**

- Sensors and cameras are deployed across cities to monitor vehicle movement and congestion levels.

3. REAL-TIME TRANSIT INFORMATION PLATFORM:

- **Design a web-based platform and mobile apps to display real-time traffic information to the public:**



- Real time traffic information helps you to keep a check on the traffic situation so that you can better plan your route.

4. INTEGRATION APPROACH:

- **Design a web-based platform and mobile apps to display real-time traffic information to the public:**

- Data is available on the TomTom map or via openLR format for map-agnostic delivery.
- When your website sends or receives information from another application, system, or website.

PHASE 2: INNOVATION

Consider integrating historical traffic data and machine learning algorithms to predict congestion patterns.

HISTORICAL TRAFFIC DATA:

SUMMARY:

Provides information about the historical traffic information stored in the network dataset such as the speed profile table and time slice durations.

PROPERTIES:

PROPERTY	EXPLANATION	DATASET
Time interval	The time interval of the traffic data.	Double
Time interval units	The units of the time interval of the traffic data. This property returns the following keywords: • Millisecond • Second • Minutes • Hours • Days • Weeks • Months • Years • Decades • Centuries • Unknown	String
First time slice field name	The field name of the first time slice of the given period in the profile table.	String
Last time slice field name	The field name of the first time slice of the given period in the profile table.	String
First slice duration in minutes	The duration of the time slice in minutes.	Integer
First time slice start time	The start time of valid period of day for traffic data.	String
Profiles table name	The name of the table containing profiles.	String

Join table name	The name of the table containing profiles.	String
Join table base travel time field name	The field name for base travel time in the join table.	String
Join table base speed field name	The field name for base speed in the join table.	String
Join table base travel time field name	The field name for base travel time in the join table.	String
Join table base travel time units	The units for the base travel time in the join table. This property Returns the following keywords: • Seconds • Minutes • Hours • Days	String
Join table profile Id field names	A python list containing field names of the join table pointing to speed profiles.	List
Join table base speed units	The units for the base speed in the join table. This property returns the following keywords: • Miles Per Hour • Kilometers Per Hours • Unknown	String

Code sample:

Historical traffic data properties example

Display a summary of the historical traffic information for the network dataset.

```
import arcpy
import sys
 {
arcpy.env.workspace = "C:/Data/SanFrancisco.gdb/Transportation"
desc = arcpy.Describe("Streets_ND") if
desc.supportsHistoricalTrafficData:     traffic =
desc.historicalTrafficData else:
    print("No historical traffic information")
    sys.exit() {
print("Historical Traffic Information ----") print("Time interval: " ,
traffic.timeInterval) print("Time interval units: " ,
traffic.timeIntervalUnits) print("First time slice field name: " ,
traffic.firstTimeSliceFieldName) print("Last time slice field name: " ,
traffic.lastTimeSliceFieldName) print("First time slice start time: " ,
traffic.firstTimeSliceStartTime) print("Time slice duration in minutes:
",traffic.timeSliceDurationInMinutes) print("Profiles table name: ",
traffic.profilesTableName) print("Join table name: ",
traffic.joinTableName) print("Join table base travel time field name: ",
traffic.joinTableBaseTravelTimeFieldName) print("Join table base travel
```

```
time units: ", traffic.joinTableBaseTravelTimeUnits) print("Join table
Profile ID field names: ", traffic.joinTableProfileIDFieldNames)
}
};
```

OUTPUT:

Vehicle_ID	Road_ID	Time_group	Start_time	End_time	Travel_time (min)	Velocity (km/min)
1	1	6	16:50	16:57	7	1.8725
2	1	6	17:20	17:31	11	1.1916
3	1	6	17:43	17:56	13	1.0082
4	1	6	16:02	16:11	9	1.456
5	1	6	16:16	16:32	16	0.8192
6	1	6	16:05	16:18	13	1.0082
7	1	6	17:03	17:10	7	1.8725
8	1	6	17:11	17:18	7	1.8725
9	1	6	17:35	17:46	11	1.1916
10	1	6	16:09	16:16	7	1.8725

MACHINE LEARNING ALGORITHMS TO PREDICT CONGESTION PATTERNS IN TRAFFIC DATA:

There are several types of machine learning algorithms that can be used for traffic prediction, including regression, time-series analysis, and artificial neural networks. Regression models use historical traffic data to predict future traffic conditions based on past trends.

SAMPLE CODE:

```
1. import numpy as np
2. import pandas as pd
3. import matplotlib.pyplot as plt
4. import seaborn as sns
5. import datetime
6. import tensorflow
```

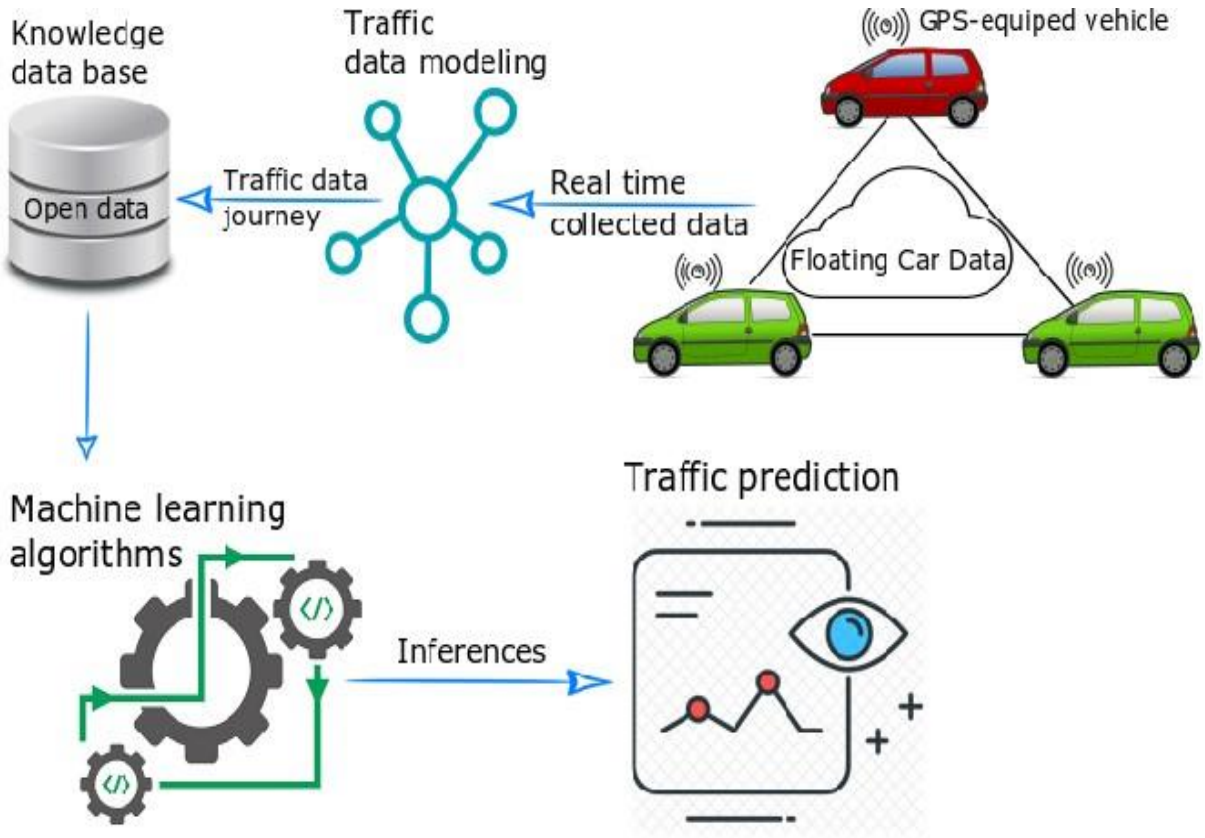
```
7. from statsmodels.tsa.stattools import adfuller
8. from sklearn.preprocessing import MinMaxScaler
9. from tensorflow import keras
10. from keras import callbacks
11. from tensorflow.keras import Sequential
12. from tensorflow.keras.layers import Conv2D, Flatten, Dense, LSTM, Dropout, GRU, Bidirectio
    nal
13. from tensorflow.keras.optimizers import SGD
14. import math
15. from sklearn.metrics import mean_squared_error
16.
17. import warnings
18. warnings.filterwarnings("ignore")
```

Loading the Dataset

```
1. dataset = pd.read_csv("traffic.csv")
2. dataset.head()
```

Output:

	DateTime	Junction	Vehicles	ID
0	2015-11-01 00:00:00	1	15	20151101001
1	2015-11-01 01:00:00	1	13	20151101011
2	2015-11-01 02:00:00	1	10	20151101021
3	2015-11-01 03:00:00	1	7	20151101031
4	2015-11-01 04:00:00	1	9	20151101041


Knowledge
data base
Open data
Traffic
data modeling
Traffic data
journey
Real time
collected data
GPS-equiped vehicle
Floating Car Data
Machine learning
algorithms
Inferences
Traffic prediction

PHASE 3: DEVELOPMENT PART 1

START BUILDING THE IOT TRAFFIC MONITORING SYSTEM:

1. **Define the Objectives and Requirements:**

   - Determine the purpose of the traffic monitoring system (e.g., managing parking lots, optimizing traffic flow, security, etc.).
   - List the specific requirements, such as the number of cameras, sensors, data storage capacity, and user interfaces.

2. **Choose Hardware and Sensors:**

   - Select cameras, sensors, and other hardware components based on your requirements.
   - Consider using video cameras, infrared sensors, ultrasonic sensors, or other appropriate technologies to monitor traffic.

3. **Set Up Data Collection:**

   - Install and configure cameras and sensors to capture data from the parking lot.
   - Ensure that the hardware is properly connected to the monitoring system.

4. **Data Transmission:**

   - Establish a reliable data transmission mechanism to send data from cameras and sensors to the central monitoring system.
   - Use wired or wireless communication depending on the infrastructure and range.

5. **Data Processing:**

   - Develop software for real-time data processing. This can include image recognition and analysis to count vehicles, detect parking violations, or identify security issues.

6. **Data Storage:**

   - Design a data storage solution to store historical data for analysis and reporting.
   - Consider using a database system for efficient data management.

7. **Real-time Monitoring and Alerts:**

   - Create a dashboard or user interface for real-time monitoring.
   - Implement alerting mechanisms for detecting unusual traffic patterns, security breaches, or parking violations.

8. **Reporting and Analytics:**

- Develop reporting features that allow users to generate traffic reports, occupancy statistics, and other insights.
- Consider implementing analytics to optimize traffic flow and improve the efficiency of the parking lot.

9. **User Interfaces:**

- Create user-friendly interfaces for administrators, operators, and end-users.
- Ensure that the system is accessible through web or mobile applications.

10. **Security:**

- Implement security measures to protect data and ensure the system's integrity.
- Use encryption, access controls, and authentication mechanisms.

11. **Integration:**

- If required, integrate the monitoring system with other systems, such as access control systems, payment systems, or security systems.

12. **Testing and Optimization:**

- Thoroughly test the system to identify and resolve any issues.
- Optimize the system's performance and accuracy.

13. **Scalability:**

- Plan for scalability as traffic monitoring needs may change over time.

14. **Documentation:**

- Create comprehensive documentation for users and maintainers.

15. **Maintenance and Support:**

- Establish a maintenance plan to ensure the system's continued functionality.

16. **Compliance:**

- Ensure that the system complies with relevant regulations and privacy laws.

17. **Training:**

- Train operators and users on how to use the system effectively.

18. Data Privacy:

- Address data privacy concerns and ensure that data is handled in a compliant and ethical manner.

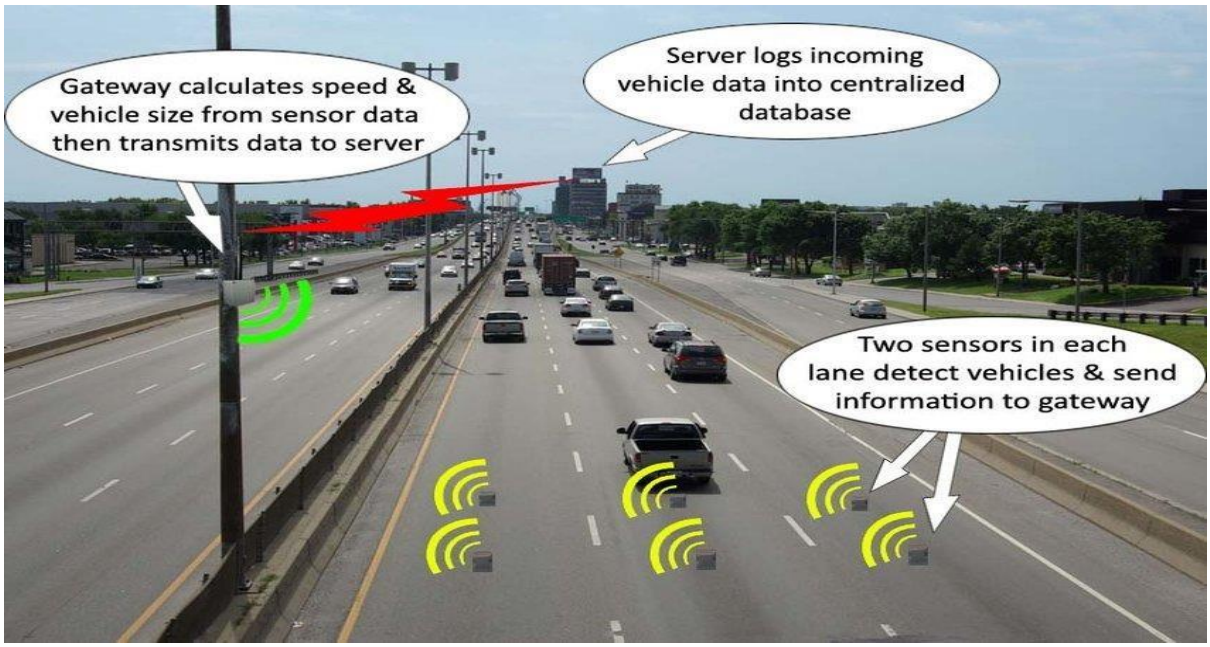
19. Deployment:

- Deploy the system in the parking lot, and monitor its performance in a real-world environment.

20. Continuous Improvement:

- Continuously gather feedback and make improvements to the system based on user and operational experiences.
- Remember that building a lot traffic monitoring system can be a complex project, and it's essential to plan, design, and implement it carefully to meet your specific needs and requirements. Depending on your resources and expertise, you may also consider partnering with experts or companies specializing in traffic monitoring

SAMPLE PICTURE:



SAMPLE PROGRAM:

Import necessary libraries

import datetime import

random class ParkingLot: def

init(self, capacity):

```
self.capacity = capacity
self.occupancy = 0
self.vehicles = []  def
is_full(self):
        return self.occupancy >= self.capacity


    def add_vehicle(self, vehicle_id):
        if not self.is_full():
            self.occupancy += 1
self.vehicles.append
          ({
              'vehicle_id': vehicle_id,
              'entry_time': datetime.datetime.now()
            })
            print(f"Vehicle {vehicle_id} entered the parking lot.")
def remove_vehicle(self, vehicle_id):
  for vehicle in self.vehicles:
   if vehicle['vehicle_id'] == vehicle_id:
            self.occupancy -= 1
      entry_time = vehicle['entry_time']
  exit_time = datetime.datetime.now()
     duration = exit_time - entry_time
  print(f"Vehicle {vehicle_id} exited the parking lot. Parking duration: {duration}")
self.vehicles.remove(vehicle)
              return
def main():
    capacity = 50  # Set the parking lot capacity
parking_lot = ParkingLot(capacity) while True:
        if not parking_lot.is_full():
            vehicle_id = random.randint(1, 100)
```

```
  parking_lot.add_vehicle(vehicle_id)
if parking_lot.occupancy > 0:
        vehicle_id = random.choice(parking_lot.vehicles)['vehicle_id']
parking_lot.remove_vehicle(vehicle_id)


if _name_ == "_main_":
    main()
```

OUTPUT:

Vehicle 12 entered the parking lot.

Vehicle 58 entered the parking lot.

Vehicle 94 entered the parking lot.

Vehicle 89 exited the parking lot. Parking duration: 0:00:05.171821

Vehicle 29 exited the parking lot. Parking duration: 0:00:03.435076 Vehicle 12 exited the parking lot. Parking duration: 0:00:01.857361

Vehicle 35 entered the parking lot.

PHASE 4: CONTINUE BUILDING THE PROJECT BY DEVELOPING THE TRAFFIC INFORMATION PLATFORM AND MOBILE APPS.

DEVELOPMENT PART 2:

PROJECT PLANNING:

- Define the project scope, objectives, and requirements.
- Create a detailed project plan with milestones and timelines.
- Allocate resources and budget for development.

MARKET RESEARCH:

- Analyze the target audience and their needs.
- Study competitors and identify unique features for your platform and apps.

DESIGN:

- Develop wireframes and prototypes for the mobile apps.
- Design the user interface (UI) and user experience (UX) for both the platform and apps.

BACKEND DEVELOPMENT:

- Set up the server infrastructure for the traffic information platform.
- Build a robust backend to handle data collection, storage, and processing.

MOBILE APP DEVELOPMENT:

- Develop separate mobile apps for different platforms (e.g., Android and iOS).
- Implement real-time traffic data retrieval and display.

INTEGRATION:

- Integrate the mobile apps with the backend for data synchronization.
- Implement third-party APIs for additional data sources if needed.

DATA COLLECTION:

- Set up mechanisms for collecting real-time traffic data, such as sensors, GPS data, and user reports.

DATA PROCESSING:

- Process and analyze the collected data to provide accurate traffic information.

USER AUTHENTICATION:

- Implement secure user registration and login mechanisms.

MAPPING AND NAVIGATION:

- Integrate mapping services and navigation features in the mobile apps.

ALERTS AND NOTIFICATIONS:

- Implement push notifications for traffic alerts and updates.

TESTING AND QUALITY ASSURANCE:

- Conduct thorough testing to identify and fix bugs.
- Ensure the platform and apps work well on different devices and screen sizes.

DEPLOYMENT:

- Deploy the platform to a web server and make the mobile apps available on app stores.

MARKETING AND PROMOTION:

- Develop a marketing strategy to promote your traffic information platform and mobile apps.

MAINTENANCE AND UPDATES:

- Provide ongoing support, maintenance, and regular updates to improve functionality and fix issues.

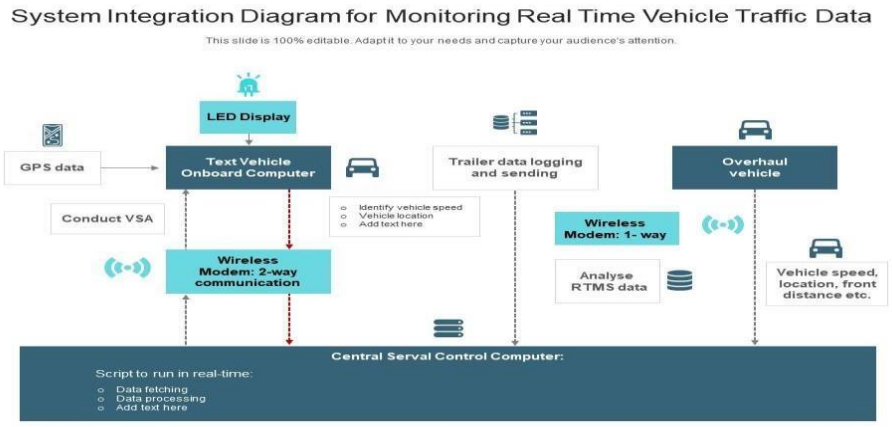
TRAFFIC INFO PLATFORM & APPS

PLATFORM DEVELOPMENT:

- Design the architecture for the traffic information platform.
- Develop the backend infrastructure, including servers, databases, and APIs for data collection and storage.
- Implement real-time data collection mechanisms, such as sensors, traffic cameras, and GPS systems.
- Utilize data analytics to process and analyze traffic data for insights.

DATA INTEGRATION:

- Integrate traffic data sources such as government agencies, navigation services, and user-generated content.
- Ensure data accuracy, reliability, and real-time updates.



MAPPING AND NAVIGATION:

- Implement mapping functionality for navigation within the mobile apps.
- Include features like turn-by-turn directions, traffic alerts, and alternative route suggestions.

USER ENGAGEMENT:

- Incorporate features to engage users, such as social sharing, user reviews, and community-driven updates.

TESTING AND QUALITY ASSURANCE:

- Conduct thorough testing of the platform and mobile apps to identify and resolve any bugs or issues.

MARKETING AND USER ADOPTION:

- Promote the mobile apps to attract users through various marketing strategies and advertising.

DEVELOPING A TRAFFIC INFORMATION PLATFORM AND MOBILE APPS INVOLVES SEVERAL KEY COMPONENTS AND CONSIDERATIONS:

DATA PROCESSING AND ANALYSIS:

- Implement algorithms to process and analyze traffic data, identifying congestion, accidents, and road closures.
- Utilize machine learning or data analytics to predict traffic patterns.

APIS FOR MOBILE APPS:

- Create APIs that mobile apps can use to fetch traffic data and interact with the platform.

MOBILE APPS:

PLATFORM SELECTION:

- Decide whether to develop separate apps for iOS and Android or opt for crossplatform development.

USER INTER FACE (UI) AND USER EXPERIENCE (UX):

- Design an intuitive and user-friendly interface.
- Consider features like real-time maps, route planning, and traffic alerts.

REAL-TIME UPDATES:

- Implement features to provide real-time traffic information.
- Notify users of accidents, road closures, and alternative routes.

CUSTOMIZATION:

- Allow users to customize their routes, preferences, and traffic alert settings.

SOCIAL COMMUNITY FEATURES:

- Include social sharing options, user reviews, and the ability for users to report incidents.

OFFLINE FUNCTIONALITY:

- Offer offline maps and route planning for users with limited internet connectivity.

SAMPLE CODE:

```
def traffic_advice(traffic_severity):    if
traffic_severity == "low":
    return "Traffic is light. You can stay on your current route."

  elif traffic_severity == "moderate":
    return "Traffic is moderate. Consider an alternative route if available."

  elif traffic_severity == "high":
    return "Traffic is heavy. It's advisable to take an alternative route."

  else:
    return "Invalid traffic information. Please provide 'low', 'moderate', or 'high'."
```

 # Input the traffic severity (e.g., 'low', 'moderate', or 'high')

traffic_severity = input("Enter traffic severity: ") advice =

traffic_advice(traffic_severity) print(advice)

-THANK YOU