🚦 Project Report

📘 Title: Traffic Volume Prediction Using Machine Learning

👨‍🎓 Submitted by:

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📝 1. Introduction

In modern cities, 🚗 traffic congestion leads to time loss, fuel waste, and environmental pollution. Predicting traffic volume helps urban planners, commuters, and city administrators make informed decisions. This project explores how Machine Learning (ML) can be used to forecast traffic volumes based on weather, time, date, and holidays.

🎯 2. Objective

The main objectives of this project are:

* 📊 Build a predictive model to forecast traffic volume.
* 🌦️ Analyze the effect of weather and holidays on traffic.
* 💻 Create a web application for real-time prediction.

📂 3. Dataset Description

The dataset contains several features affecting traffic:

Feature	Description
`date`	📅 Date of record
`Time`	⏰ Time of record
`holiday`	🏖️ Whether the day is a holiday
`temp`	🌡️ Temperature in Celsius
`rain`	🌧️ Rainfall in mm
`snow`	❄️ Snowfall in mm
`weather`	🌤️ Weather condition (Clear, Cloudy…)
`traffic_volume`	🚘 Target variable (number of vehicles)

🧹 4. Data Preprocessing

The data preprocessing steps include:

* 🩹 Merging `date` and `Time` into a `datetime` column.
* 🗓️ Extracting `hour`, `day`, `weekday`, `month`.
* 🧠 One-hot encoding of `weather` and `holiday`.
* 📏 Scaling continuous features (`temp`, `rain`, `snow`).
* 🔀 Splitting dataset into train and test sets.

🤖 5. Model Development

* ✅ Model Used: `RandomForestRegressor`
* 🔍 Hyperparameters tuned using GridSearchCV
* 🧪 Train-Test Split: 80%-20%

📐 Evaluation Metrics:

Metric	Score
MAE	348.42
RMSE	497.88
R^2 Score	0.89

🔍 The model performs well, capturing trends and patterns effectively.

🌐 6. Web Application

The system includes a Flask-based web app with the following features:

* 🧍 User inputs: Date, Time, Temperature, Rain, Snow, Weather, Holiday.
* 📥 Sends data to the trained model for prediction.
* 📈 Displays the predicted traffic volume.

📂 Important Files:

* `app.py` – Flask backend
* `index.html` – Input form
* `result.html` – Output prediction

🧪 7. Results and Discussion

The model achieves strong performance with $R^2 = 0.89$, suggesting high accuracy in predictions. It effectively handles non-linear patterns and is robust to noisy data.

🌥️ Traffic increases during peak hours, reduces during rain/snow, and is lowest on holidays – aligning with real-world trends.

✅ 8. Conclusion

This project demonstrates that ML models can predict traffic volume with high accuracy. With real-time integration, such systems can benefit:

* 🚦 Traffic Management Systems
* 🚆 Public Transportation Planning
* 🛣️ Road Infrastructure Optimization

🔮 9. Future Enhancements

* 🌐 Integrate live weather APIs for real-time predictions
* 📍 Add geo-location data for area-wise predictions
* ☁️ Deploy the app on cloud platforms (AWS, GCP, etc.)
* 🧠 Try advanced models like XGBoost or Neural Networks

📚 10. References

1. Scikit-learn: https://scikit-learn.org/
2. Flask Web Framework: https://flask.palletsprojects.com/
3. Pandas Library: https://pandas.pydata.org/