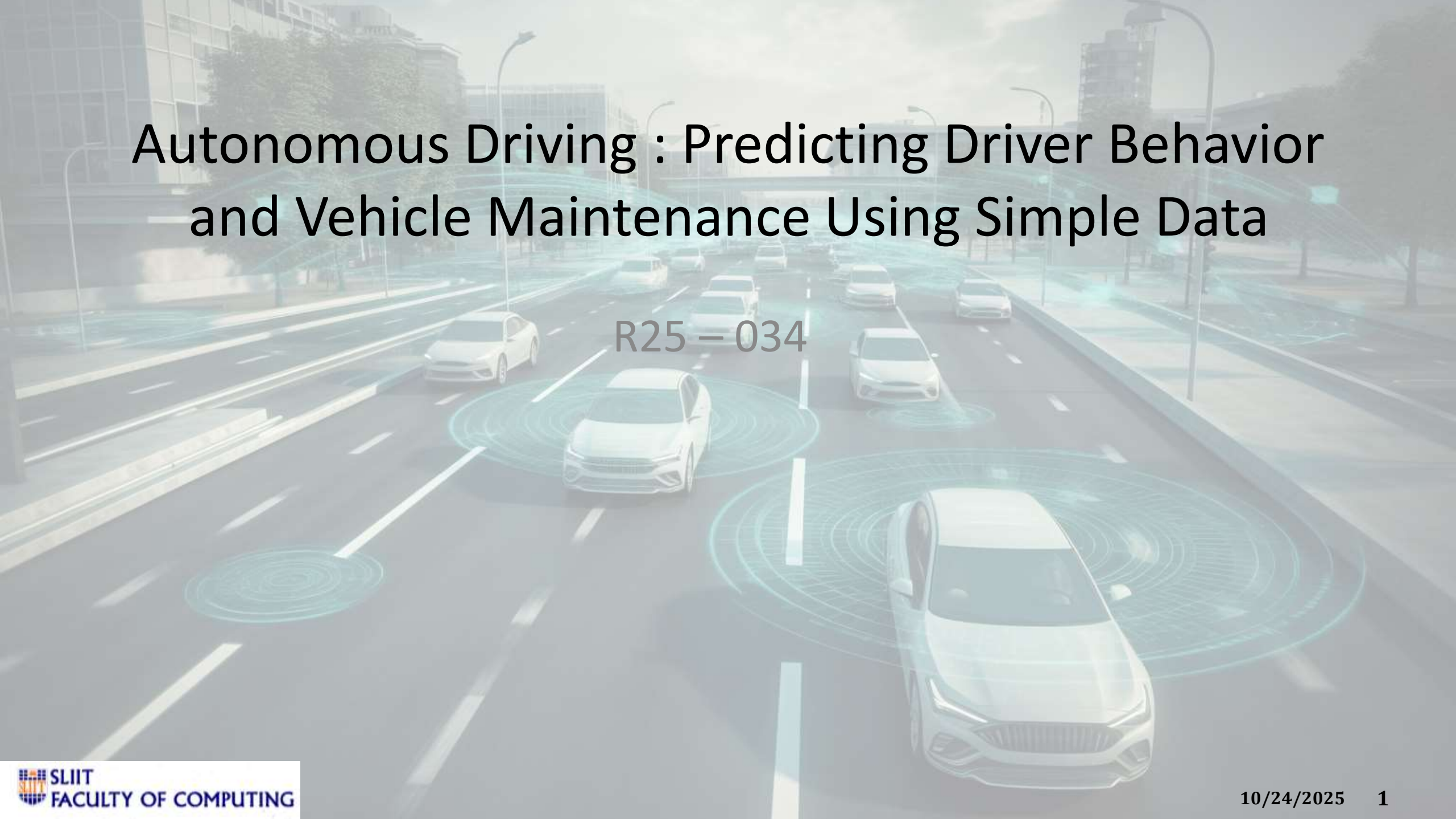
Autonomous Driving : Predicting Driver Behavior and Vehicle Maintenance Using Simple Data

R25 – 034



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Our team

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Introduction

- Our research focuses on using simple on-board data to predict driver behavior and vehicle maintenance needs.

- We identified four key components:
  1. analyzing driving styles (Driver Behavior)
  2. predicting vehicle maintenance
  3. studying how weather impacts driving
  4. improving fuel efficiency

- This work aims to create affordable, scalable solutions to enhance driving safety and efficiency.

Research Questions

- How can predict driver behavior and detect distractions in autonomous driving?
- Can we predict engine condition using basic sensor data like RPM, oil pressure, and temperature?
- How do weather, road, and traffic conditions affect driving patterns, and how can machine learning be used to detect abnormal driving behavior based on these factors?
- How can we predict a vehicle's fuel efficiency using its basic specifications through regression models?

Research Objectives

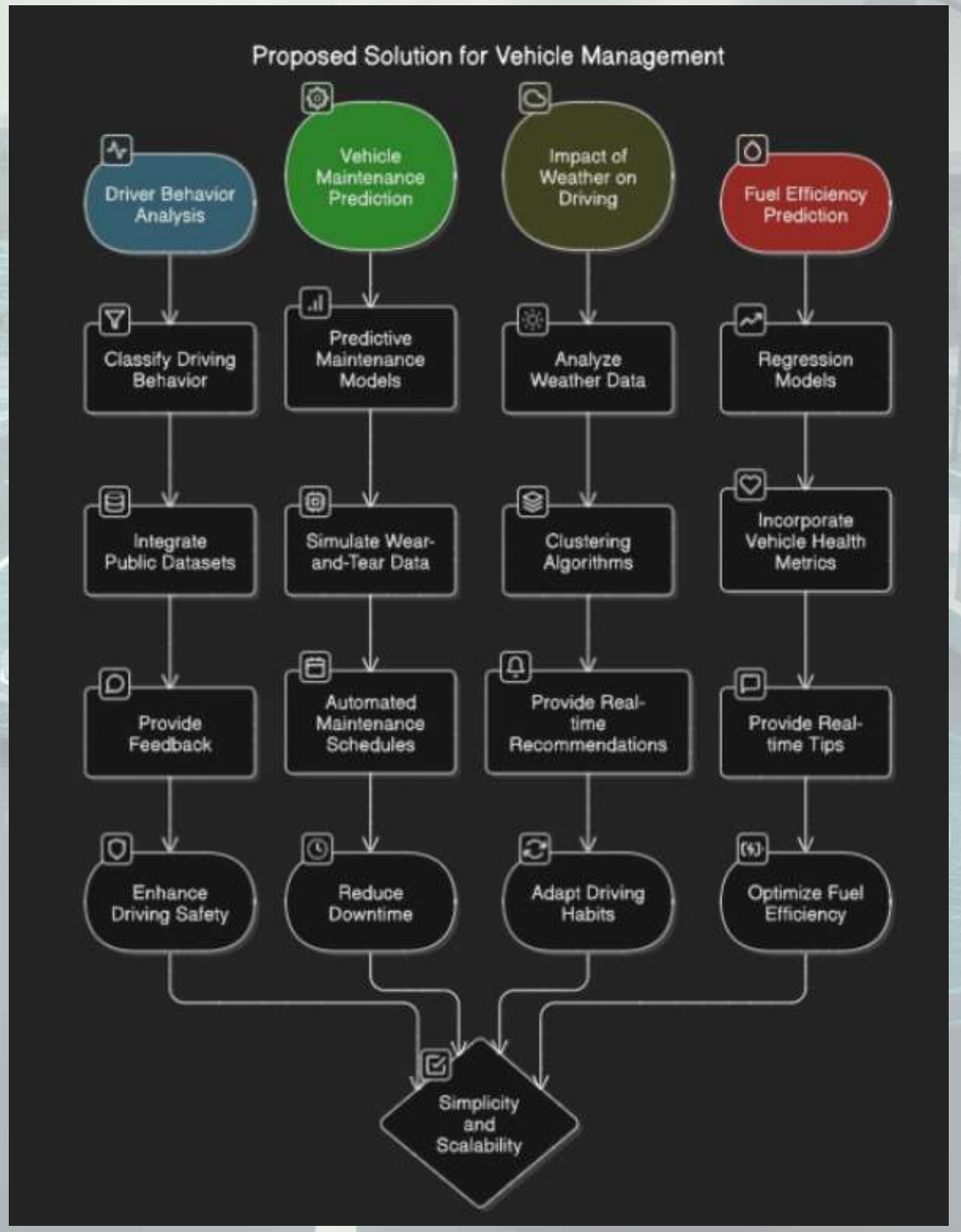
Main Objective

Develop a model to analyze simple data to predict driver behavior and detect distractions.

Sub Objective

- Predicting Driver Behavior and Detecting Distractions: Develop machine learning models to detect distracted states using real-time telemetry and behavioral data.
- Predicting Engine Condition Using Basic Sensor Data: Analyze patterns in sensor data (e.g., RPM, oil pressure) to identify early signs of engine malfunctions.
- Analyzing Weather, Road, and Traffic Conditions on Driving Patterns: Train anomaly detection algorithms to flag abnormal driving patterns caused by adverse conditions.
- Predicting a Vehicle's Fuel Efficiency Using Specifications: Fuel Efficiency: Use regression models to establish relationships between basic vehicle specifications and fuel consumption.

Overall System Diagram



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Driver Behavior Analysis

- Driver behavior analysis helps classify driving styles (aggressive, moderate, cautious).
- Focuses on non-invasive, affordable technology like mobile sensors (GPS, accelerometer).
- Reduces reliance on expensive hardware and is suitable for non-connected vehicles.
- Combines public driving datasets and simulated environments for training ML models.

Research Question

How can predict driver behavior and detect distractions in autonomous driving?

Specific Objectives

- To identify key features of simple data (e.g., images, sensor inputs, or vehicle dynamics) that can effectively predict driver behavior.
- To develop and evaluate machine learning models for detecting driver distractions using minimal and easily accessible data.
- To explore the integration of behavior prediction and distraction detection in enhancing autonomous driving systems' safety and responsiveness.
- To analyze the impact of real-time driver monitoring systems on the accuracy of distraction detection and behavior prediction.

Methodology

Functional Requirements

- Detect and classify driver behaviors (e.g., texting, eating, safe driving).
- Identify and alert for driver distractions in real time.
- Process simple data like images and sensors efficiently.
- Provide feedback to autonomous systems for safer operation.

Non- Functional Requirements

- Ensure fast, real-time performance.
- Maintain high accuracy in predictions
- Be reliable under different conditions
- Protect driver data and ensure system security.

Methodology

Tools
Colab
Jupyter Notebook.

Web Server (Backend)
Python

ML Libraries
DenseNet
EfficientNet B0
MobileNet V3

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Vehicle Maintenance Prediction: Develop predictive Maintenance models accessible to non-connected vehicles

- Analyze driving data patterns to identify behaviors that impact vehicle performance and safety.
- Assess historical maintenance records to predict part failures and recommend proactive solutions.
- Develop predictive models to enable efficient scheduling and reduce unexpected downtimes.

Research Questions

Can we predict engine condition using basic sensor data like RPM, oil pressure, and temperature?

Specific Objectives

- To analyze the relationship between engine sensor data (RPM, oil pressure, fuel pressure, coolant temperature) and engine condition.
- To develop a predictive model for classifying engine condition using machine learning techniques.
- To evaluate the performance of the model and identify the most influential features affecting engine condition.

Methodology

Functional Requirements

- he system shall collect and process engine sensor data such as RPM, oil pressure, fuel pressure, coolant pressure, and temperatures.
- The system shall predict the engine condition using a trained machine learning model.
- The system shall display the predicted engine condition to the user in a clear and understandable format.

Non- Functional Requirements

•Ensure quick processing of data for timely maintenance predictions.

•Protect sensitive vehicle and user data with strong privacy measures.

•Maintain high system availability with 99.9% uptime for reliability.

•Design a user-friendly interface that is simple and intuitive for vehicle operators.

Methodology

Tools

Colab

Jupyter Notebook.

Web Server (Backend)

Python

ML Libraries

Random forest classifier

GradientBoost classifier

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Impact of Weather and Environmental Conditions on Driving Patterns: Integrate weather data for personalized driving safety recommendations.

- Analyze real-time weather data to identify its influence on driving behavior and road safety.
- Identify patterns and predict risks under different driving environments.
- Support safer driving by providing intelligent insights based on environmental conditions.

Research Questions

How do weather, road, and traffic conditions affect driving patterns, and how can machine learning be used to detect abnormal driving behavior based on these factors?

Specific Objectives

- To collect and preprocess driving behavior data along with weather, road, and traffic conditions.
- To identify patterns in driver behavior under different environmental and road situations.
- To train a machine learning model to detect and classify abnormal driving behavior.
- To improve model accuracy by balancing the dataset using SMOTE.

Methodology

Functional Requirements

- Read driver data with weather, road, and traffic details.
- Analyze how these conditions change driving behavior.
- Train a model to detect risky driving.
- Fix unbalanced data using SMOTE.

Non- Functional Requirements

- Work fast with big data.
- Give correct and steady results.
- Be ready to grow with more data.
- Be easy to understand and use.
- Be simple to update or fix.

Methodology

Tools
Colab
Jupyter Notebook.

Web Server (Backend)
Python

ML Libraries

Random forest classifier
XGBoost

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Fuel efficiency prediction: Create actionable fuel efficiency insights using regression models

- Use regression models to analyze driving behavior, vehicle health, and environmental factors for real-time fuel efficiency optimization.
- Leverage simple, accessible data to provide scalable insights without expensive tools.
- Deliver actionable recommendations to reduce fuel costs and promote eco-friendly driving.

Research Questions

How can we predict a vehicle's fuel efficiency using its basic specifications through regression models?

Specific Objectives

- To build regression models that can predict vehicle fuel efficiency using basic vehicle specifications.
- To analyze the impact of engine size on fuel efficiency across various vehicle types.
- To examine the relationship between the number of cylinders and fuel efficiency in different makes and models.
- To evaluate whether transmission type has a significant influence on fuel efficiency.

Methodology

Functional Requirements

- Predict fuel efficiency using regression models and real-time data..
- Provide a simple interface for user input and insights.
- Collect data from OBD-II devices and weather APIs.
- Offer actionable fuel-saving tips.

Non- Functional Requirements

•Efficient data handling.

•Protect user data.

•Ensure 24/7 availability.

•Simple and user-friendly design.

•Easy to update and support

Methodology

Tools

Colab

Jupyter Notebook.

Web Server (Backend)

Python

ML Libraries

Numpy

Pandas

Matplotlib


THANK
YOU!