1. Introduction :-

1.1 Purpose

The purpose of this document is to define the functional, non-functional, and system requirements for a Self-Driving Automation System. This system aims to provide autonomous vehicle control, navigation, and safety features with minimal human intervention.

1.2 Scope

The Self-Driving Automation System is designed for passenger and commercial vehicles. The system will use artificial intelligence (AI), machine learning (ML), and sensor integration to navigate roads safely, recognize objects, and comply with traffic regulations. Key functionalities include lane detection, obstacle avoidance, real-time decision-making, and emergency handling.

1.3 Definitions, Acronyms, and Abbreviations

- **ADAS**: Advanced Driver Assistance Systems
- **AI**: Artificial Intelligence
- **ML**: Machine Learning
- **LIDAR**: Light Detection and Ranging
- **GPS**: Global Positioning System
- **V2X**: Vehicle-to-Everything Communication

1.4 References

- SAE J3016 - Levels of Driving Automation
- ISO 26262 - Functional Safety for Road Vehicles
- IEEE 829 - Software Testing Standard

2. Overall Description :-

2.1 Product Perspective

The system is an embedded application integrated into a vehicle's computing unit, interfacing with hardware sensors, cameras, and cloud-based services.

2.2 Product Functions

- **Perception**: Identifies lanes, pedestrians, vehicles, and road signs.
- **Localization & Mapping**: Uses GPS and LIDAR for real-time positioning.
- **Decision-Making**: Analysis of traffic conditions and determines optimal actions.
- **Control & Actuation**: Manages steering, acceleration, and braking.

2.3 User Characteristics

- **End Users**: Drivers, fleet operators, and autonomous vehicle manufacturers.
- **Skill Level**: Minimal to no technical knowledge required for operation.

2.4 Constraints

- Legal and regulatory compliance.
- Hardware limitations and sensor accuracy.
- Network dependency for cloud-based processing.

3. Specific Requirements :-

3.1 Functional Requirements

- The system shall detect and classify objects using AI-based perception.
- The system shall follow traffic rules and road signs.
- The system shall provide collision detection and avoidance mechanisms.
- The system shall integrate with cloud services for software updates.
- The system shall support manual override in case of emergencies.

3.2 Non-Functional Requirements

- **Reliability**: 99.999% uptime.
- **Performance**: Real-time processing with minimal latency (<100ms).
- **Security**: Data encryption and secure communication protocols.
- **Scalability**: Adaptability to different vehicle models and road conditions.

4. System Features :-

4.1 Perception System

- Image recognition and object detection using deep learning models.
- Multi-sensor fusion (LIDAR, radar, and cameras).

4.2 Decision-Making Module

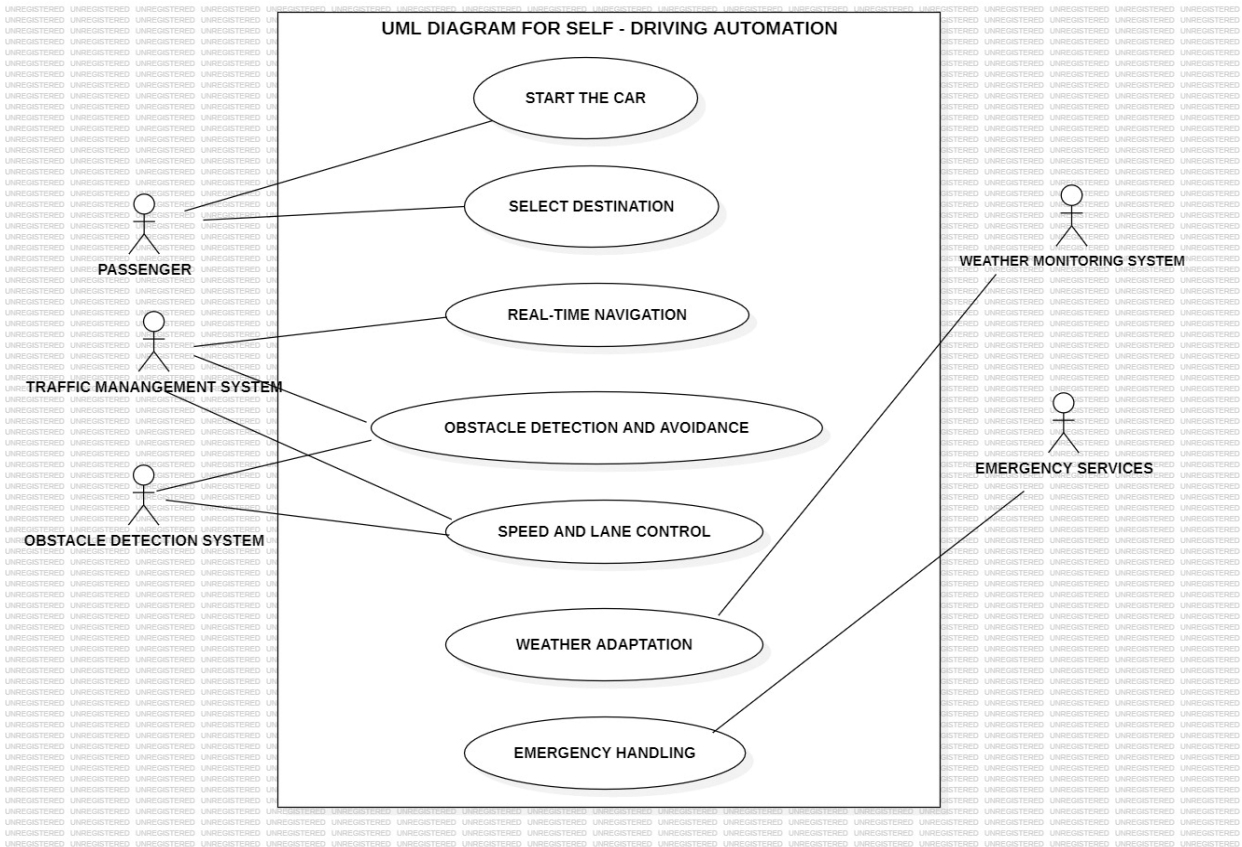
- Path planning using reinforcement learning.
- Dynamic traffic analysis and adaptive speed control.

4.3 Control & Actuation

- Real-time vehicle control through electronic steering and braking systems.
- Automated lane changing and overtaking.

5. Appendices :-

- Simulation test results and validation procedures.
- Regulatory compliance checklist.
- Hardware specifications and software stack details.



A use case diagram for the Self-Driving Automation System typically includes the main actors and their interactions with the system. The primary actors are:

- **Driver (Passenger)** – Can monitor the system and take control if needed.
- **Traffic Management System** – Provides traffic data and regulations.
- **Pedestrians & Other Vehicles** – External entities the system must detect and react to.
- **Cloud Services** – Handles software updates and data analytics.

Use Cases:

1. **Autonomous Navigation** – The system drives the vehicle autonomously.
2. **Obstacle Detection & Avoidance** – Detects and avoids objects.
3. **Traffic Sign & Signal Recognition** – Reads and follows traffic rules.
4. **Lane Keeping & Changing** – Maintains lanes or changes when required.
5. **Emergency Handling** – Takes corrective action in case of critical situations.
6. **Remote Monitoring & Updates** – Cloud services provide updates and diagnostics.