INTELLIDRIVE

CS250 Final Project Report

JOSHUA CONCEPCION

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INTRODUCTION

Welcome to the Autonomous Vehicle System, IntelliDrive. In this document, we explore the exciting world of autonomous transportation, where modern technology and ambitious innovation reinvent the way we move.

IntelliDrive aims to close the gap between transportation, efficiency, environmental sustainability, and safety. With our users and stakeholders in mind, we are able to provide self-driving, electric four-wheel commercial vehicles, available for both the average consumer, as well as for carpool and/or taxi services.

At IntelliDrive, we are always looking for new ways to innovate the transportation experience, and while some features are not currently available, such as a complete self-driving mode, we have plans in the near future to push out software updates that make this dream a reality.

Furthermore, we are looking into ways to implement our AVS in non-electric/hybrid vehicles to reach a larger market and provide our services and conveniences to as many people as we can.

However at the current time, we plan to only be available for electric four-wheel commercial vehicles, but do project that we will be able to expand towards larger vehicles such as semi-trucks for cargo transportation businesses. Additionally, only electric vehicles that currently support more modern GPS systems (such as Apple Maps, Google Maps) will be able to support our AVS. Older vehicles do not contain the technology sufficient to implement our system.

USER MANUAL

This section provides a holistic view at all updated user information, including details regarding functionality and requirements

IntelliDrive aspires to provide consumers with an easy-to-use, straightforward, and efficient system that easily integrates with existing technology in modern electric commercial vehicles. To ensure the safety of our consumers, as well as other drivers on the road, all users will be required to possess a valid driver's license, as well as watch instructional content in order to use the AV system.

With the safety of our users in mind, our system will have exceptional lane and object detection, road stability, and real-time data gathering through the use of a variety of cameras, sensors, and other similar components. Furthermore, we include an emergency mode that will transmit data between satellites, as well as our staff at the nearest IntelliDrive center, and ping authorities in case of emergency or an accident. This function is also capable of detecting obstacles along the path of the car, and sending that information to the vehicle's computer in order to adjust course/road stability.

At IntelliDrive, nothing is more important than user safety and satisfaction. With all of the components in place, our AVS is able to handle a variety of complex situations and process large amounts of data/information in order to provide our customers with a safe and enjoyable autonomous driving experience.

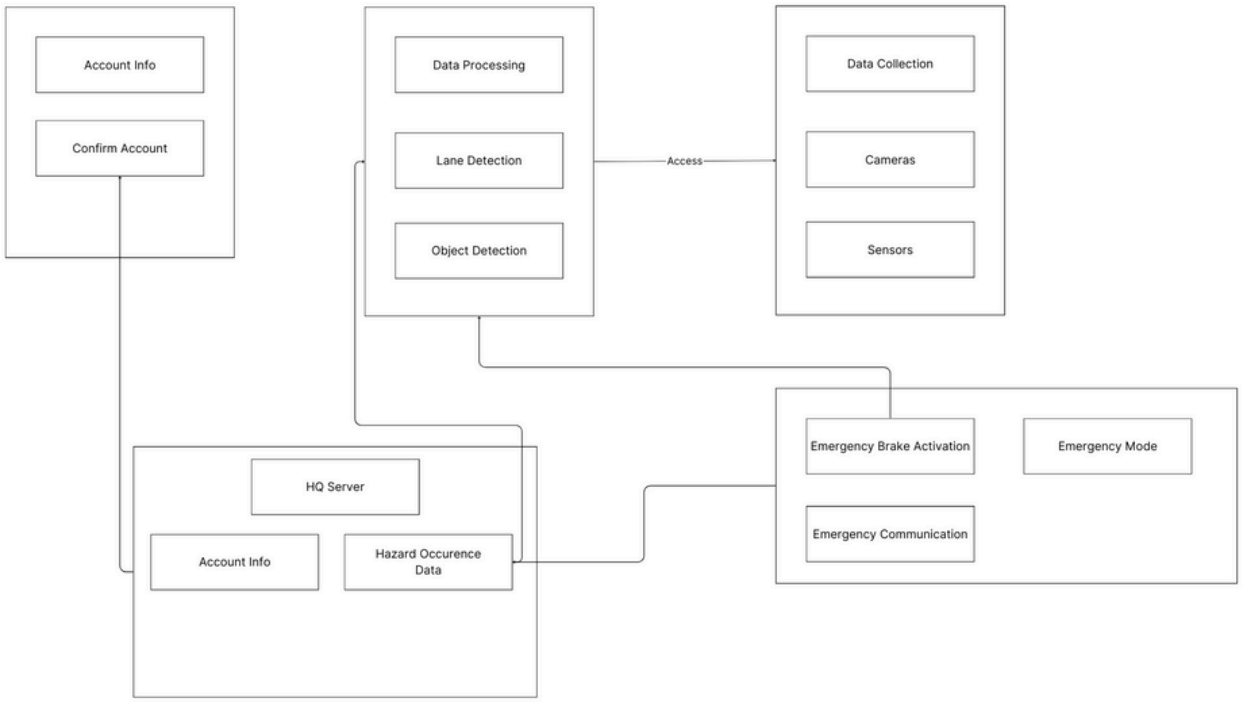
However, there are limits to our system that we do intend to expand upon in the future. For the time being, our AVS does not provide complete self-driving functionality, and users will be expected to handle a variety of aspects when operating the vehicle; the user is responsible for reacting to traffic signs, making turns, merging/exiting freeways, as well as accelerating or braking.

The system as a whole, however, is very reliable, thanks to the use of satellites and our 24/7 support contact, making sure that user safety is the number one priority.

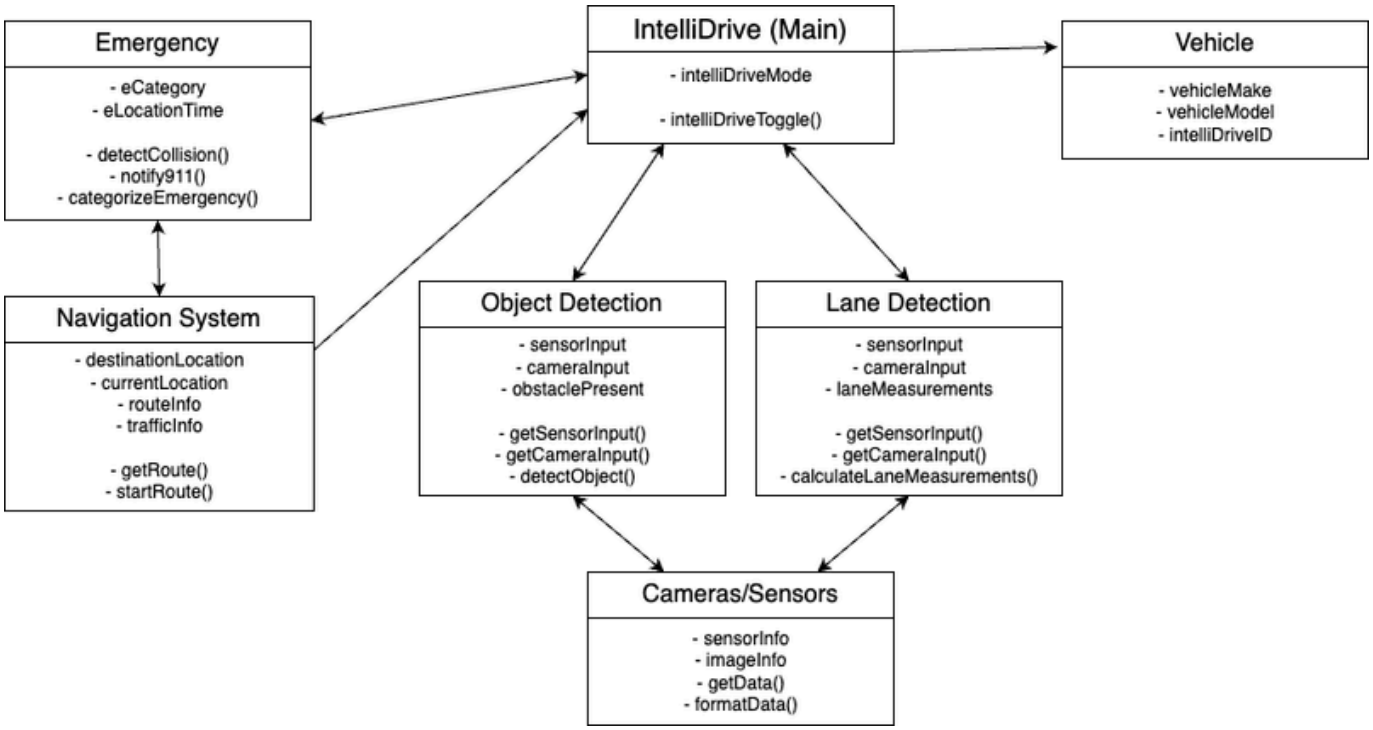
SOFTWARE ARCHITECTURE

The following section will overview all related software architecture diagrams, accompanied by thorough outlines and descriptions regarding integral features of the software system

01 Architectural Diagram of All Major Components



02 UML Class Diagram



FEATURE DESCRIPTIONS

01 Description of Classes

Classes	Descriptions
IntelliDrive (Main)	Contains method toggling of autonomous driving mode, calls classes such as object detection, lane detection, camera/sensors, and navigation system
Navigation System	Contains methods for retrieving current location, determining efficient route
Vehicle	Contains information regarding the vehicle's make, model, and registered IntelliDrive account
Lane Detection	Calls cameras and sensors. Contains methods for processing information from the cameras and sensors, as well as methods for determining the shape of the lane
Object Detection	Calls cameras and sensors. Calls Satellite class for information on the set route
Camera/Sensors	Provides information used for lane and object detection. Contains methods for reading/processing information about scanned areas or images
Emergency	Calls Navigation System to update route info and notify of accidents/obstacles. Contains methods for determining accidents, system failures, and notifying authorities

FEATURE DESCRIPTIONS

02 Description of Attributes

Classes	Attribute	Description
IntelliDrive (Main)	IntelliDrive Mode	• Boolean that determines whether the autonomous driving mode is on
Navigation System	• destinationLocation • currentLocation • routeInfo	• The address of the desired destination • The address/coordinates that indicate the vehicle's current location • The route that the vehicle will take to reach the destinationLocation
Vehicle	• vehicleMake • vehicleModel • IntelliDriveID	• Provides basic information regarding the make of the vehicle • Provides basic information regarding the model of the vehicle • The registered ID for the IntelliDrive user's vehicle
Lane Detection	• sensorInput • cameraInput • laneMeasurements	• Receives information from the sensors • Receives information from the camera • Information regarding the size and shape of the lane

FEATURE DESCRIPTIONS

02 Description of Attributes (Continued)

Classes	Attribute	Description
Object Detection	• sensorInput • cameraInput • obstaclePresent	• Receives information from the sensors • Receives information from the camera • Boolean that indicates whether there is an object in the road
Camera/Sensors	• sensorInfo • imageInfo	• Information regarding what the sensors have detected • Information regarding what the cameras have detected
Emergency	• eLocation • eCategory	• Information regarding the type of emergency (i.e., accident, system failure, etc.) • Information regarding the location of the accident/failure, as well as timestamp

TEST PLAN & DATA MANAGEMENT STRATEGY

In this section, we discuss the steps we take to make this project into a reality, along with time projections and outlines.

Develop Software

9 - 12 Months

- Develop all classes, attributes, and operations mentioned previously in pages 6-8.

6 - 9 Months

- Install hardware into select vehicles to run software
- Install software into select vehicles for testing

Implementation

Testing

2- 3 Years

- Ensure safety of program used in vehicles
- Ensure program works as intended

Driving Innovation for a Safer Future: Committed to pioneering intelligent transportation solutions, we aim to redefine the driving experience through advanced technologies. Our vision is to lead in autonomous driving, seamlessly integrating navigation, object detection, and emergency response for a safer, more efficient, and enjoyable future of transportation, fostering connectivity and sustainability.

SECURITY ANALYSIS

Compliance with local and international regulations pertaining to autonomous driving and data privacy is non-negotiable. Staying updated on relevant standards and legal requirements is crucial for ensuring IntelliDrive's adherence to industry norms.

Data Security:
Threats/Vulnerabilities:
- Confidentiality: Unauthorized access to sensitive user and vehicle data.
- Integrity: Tampering or unauthorized modification of data.

Countermeasures:
- Implement strong access controls and encryption for data in transit and at rest.
- Regularly audit and monitor access logs to detect and respond to unauthorized access.

System Security:
Threats/Vulnerabilities:
- Autonomous Driving Systems: Exploitable software vulnerabilities leading to system compromise.
- Authentication and Authorization: Weak authentication leading to unauthorized system access.

Countermeasures:
- Regularly update and patch the autonomous driving software to address vulnerabilities.
- Enforce multi-factor authentication and least privilege principles for system access.

Privacy Concerns:
Threats/Vulnerabilities:
- User Privacy: Unauthorized access to personally identifiable information.
- Data Retention: Insecure storage and handling of user data.

Countermeasures:
- Anonymize user data to protect individual privacy.
- Clearly communicate data collection and retention policies to users.

Compliance and Regulations:
Threats/Vulnerabilities:
- Legal Compliance: Failure to adhere to local and international regulations.

Countermeasures:
- Regularly review and update policies to align with evolving legal requirements.
- Conduct regular compliance audits to identify and rectify potential issues.

LIFE CYCLE MODEL

For IntelliDrive, we adopted the Waterfall Software Development Life Cycle (SDLC) model, a linear approach consisting of distinct phases, including Requirements, Design, Implementation, Testing, Deployment, and Maintenance.

The Waterfall model worked well for IntelliDrive in providing a structured and organized approach to development. It facilitated a clear understanding of requirements and design specifications before moving on to the next phase. However, challenges included the potential inflexibility in accommodating changing requirements and a lack of user involvement in later stages.

While the Waterfall model was effective for IntelliDrive, considering the dynamic nature of intelligent driving systems, adopting an Agile approach might enhance adaptability to changing requirements. Iterative development cycles and frequent user feedback could lead to quicker responses to evolving needs. However, the modified approach would need to balance flexibility with the need for a structured development process.