# Project Plan Draft:

## Introduction

The overarching objective of this research project is to substantively improve the navigational efficacy of autonomous vehicles through the implementation of Language Logic Models (LLMs). The confluence of robotics, machine learning, and sensory technology offers an ideal landscape to explore and innovate within this sphere.

## Expected Outcomes

The apex of this project will manifest in a sophisticated simulation, wherein an autonomous car navigates through a simulated environment. This vehicle will be equipped with advanced sensory systems, including cameras and LiDAR technology, enabling it to traverse from Point A to Point B while confronting and adapting to a variety of obstacles and constraints.

## Navigation Decision-Making

The vehicle's decision-making process will be steered by the LLM. The model will evaluate textual data, processed from the sensory inputs, to generate real-time navigational instructions. These instructions will encompass strategies for route adjustment, obstacle avoidance, and possibly rerouting, should conditions demand it.

## Data Handling and Processing

Two primary sensory systems feed data into the LLM:

* **LiDAR Sensors**: Provide granular, real-time data about the vehicle's surroundings. This data will be directly interfaced with the LLM.
* **Cameras**: Capture visual data which, through a dedicated machine learning algorithm, will be transmuted into textual descriptions before reaching the LLM.

## Prompt Engineering

A critical aspect of the project lies in the 'prompt engineering,' which facilitates the seamless communication between the LLM's output and the vehicle's controller. Special attention will be paid to ensure that the LLM-generated textual instructions are both syntactically and semantically harmonious with the parsing capabilities of the vehicle's control system, thereby enhancing real-time navigation.

## LLM as the Brain

There is an ongoing debate between academics and researchers for the best way to architect a system using LLMs. The overall project a

In the initial stages, the project will be undertaken with a modularised approach in the sense that each area will only be expanded upon when it is tackled, otherwise it will be ignored. This approach will assist in keeping with software development best practices such as Separation of Concerns, Domain Driven Design with Bounded Contexts.

## Aims:

* **Evaluate Performance**: Assess current autonomous vehicle navigation systems to establish a baseline.
* **Develop Interface**: Create a robust interface between sensory data (Cameras & LiDAR) and LLMs.
* **Enhance Navigation:** Utilise LLMs to improve navigation decisions in an autonomous vehicle.
* **Optimise Latency:** Minimise time lag between data acquisition, processing, and action execution.
* **Simulate Environments:** Model urban landscapes to test vehicle navigation capabilities.
* **Validation:** Compare the LLM-enhanced system to the baseline and other state-of-the-art methods.

## Objectives:

**Literature Review:**

* Survey existing research on autonomous vehicle navigation and LLMs.

**Data Preparation:**

* Design a data pipeline from Cameras and LiDAR to LLMs.
* Implement machine learning algorithms to convert image to text.

**LLM Development:**

* Train LLMs with real-world or simulated data, or find a suitable LLM that will be able to perform the task and fine tune it if possible
* Implement LLMs to process and interpret sensory data.

**Controller Interface:**

* Engineer prompt systems to convey LLM decisions to the vehicle's controller.
* Ensure the prompt instructions are syntactically and semantically compatible with the LLM.

**Performance Metrics:**

* Identify key performance indicators (KPIs) for evaluating navigation, e.g., speed, accuracy, safety.

**Simulation:**

* Build or employ an existing simulated urban environment.
* Conduct tests to measure the LLM system's effectiveness.

**Data Analysis:**

* Analyse the results using predefined KPIs.
* Address issues like conflicting data and latency.

**Validation and Comparison:**

* Validate the improved system against the baseline.
* Compare with other state-of-the-art navigation techniques.

**Documentation and Presentation:**

* Compile findings into a comprehensive report.
* Present results to stakeholders or an academic panel.