ELEC 390 – PROJECT PROPOSAL

This assessment aligns with the following course learning outcomes:

- **CLO 1**: Apply ethical frameworks and decision-making within academic and project environments and assess such decisions' impacts, fairness, and outcomes.
- **CLO 3**: Equitably interact and collaborate with multidisciplinary teams with professional group dynamics.
- **CLO 4**: Reflect on one's own and others' skills inventory and performance.
- **CLO 5:** Prepare engineering documents, including project proposal, and final report
- **CLO 6**: Develop documentation for the project planning, management, progress, and evaluation of the results.
- **CLO 7**: Apply engineering design theory and methodology to the project

Overview

Your engineering project proposal needs to outline the development of a self-driving taxi that meets the requirements set out in the course competition materials. Your aim is to design, build, and test a fully autonomous vehicle capable of navigating complex urban environments safely and efficiently to pick up and drop off passengers. The project will focus on integrating technologies such as computer vision, machine learning, and other sensors to create a robust autonomous driving system. By leveraging these technologies, your project needs to address critical challenges in safety, reliability, and real-time decision-making. Your proposal should provide a detailed roadmap for the project, including project scope and objectives, technical details, budget, and timeline. Detail on team management aspects of your project, e.g. professional standards, ethical code of conduct, team dynamics, and equitable workload, should also be included.

Report Format

Below is a list of elements and sections that should be included in your report. Please refer to the rubric at the end of this document for more information.

General Specifications

- **Font**: A Sans Serif font should be used[1] for the body of the text. Acceptable fonts include: Calibri, Aptos, Helvetica, or Open Sans[2]. A minimum 11 pt font is required.

[1] As a rule of thumb, Serif fonts (e.g., Times New Roman, Georgia), are typically used for hardcopy engineering reports and documentation. When documents are written for electronic media, however, a Sans Serif typeface is typically used for easier readability.

[2] FYI: this is Queen's University's official font as described here: https://www.queensu.ca/brand-central/visual-identity/typography and is also used for the body of this document. You can download the font from Google Fonts: https://fonts.google.com/specimen/Open+Sans.

- **Line Spacing:** 1.5x line spacing (except for the Executive Summary, which by convention should be single-spaced)
- **Margins**: 1"
- **Page Numbering**: Lowercase Roman numerals for pages before the report's main body and Arabic numbering after) in the footer.
- Headers, footers, etc., only included in report body;
- **Captioning:** caption figures below the image and caption tables above the table.
- **Narration:** Use third-person passive voice (e.g. "it', "the decision", etc.). First person/personal voice ("I", "we") is appropriate for some sections of the proposal (e.g., executive summary, footnotes).
- **Length:** Aim for ~5-10 pages for the report body (excluding appendices). Concise writing is highly valued.
- Do not underestimate the importance of editing. Get team members (and possibly LLMs such as Grammarly, ChatGPT or Claude)[3] to read and edit the document thoroughly.

Cover Page

The cover page should include, at minimum the following information (in order from top to bottom):

- **Course Number and Name:** ELEC 390: Principles of Design and Development
- **Project Title:** Create a name for the title of the document that is reflective of the project and purpose of the document. For example, a title could be, "Proposal for the Development of an Autonomous Taxi to Enhance Public Road Safety in Quackston". The title will reflect the attributes of the project that your team has chosen to emphasize (e.g., public safety, efficiency, sustainability etc.)
- **Assigned Team Number:** As much as we don't want to reduce your team to just a number, having a number makes it much easier to assign grades.
- **Company Name:** A creative name for your group's "company"
- **Names and NetIDs of Team Members**
- **Date of Submission**
- **'Prepared For: [Name of Section Leader]' Field**: Your team will have an assigned Section Leader/Instructional Team Member in which this document will be prepared for. Enter the name of your section leader here.
- **There should be no page number on the cover.**

Statement of Originality

A statement of originality not to exceed one page is to immediately follow the cover page (this page should be numbered 'i.'). This page should have a breakdown of each team member's contributions to the report and that this document upholds the principles of academic integrity

[3] The rules regarding the use of generative AI for engineering documents are clear: you may only use AI for spellchecking, proofreading, and clarifying your writing. Using AI to generate text and ideas for you is a violation of academic integrity. Please see the course syllabus for more information and examples of appropriate/inappropriate uses of AI in this course.

(see: https://www.queensu.ca/academicintegrity/). Indicate if Generative AI was used and how (refer to the course syllabus for appropriate and inappropriate uses of Generative AI in this course). This page should be e-signed and dated by all team members, indicating that all contents reported are your own unless otherwise referenced.

Executive Summary

This is a one page maximum single-spaced[4] overview of the proposal. In the executive summary, you will want to share all of the information your readers and important stakeholders need to know. Imagine it this way: if your high-level stakeholders were to only read your executive summary, would they have all of the information they need to succeed? If so, your summary has done its job.

Introduction

The introduction section should provide the foundation for your project proposal and marks the beginning of the body (i.e., start page numbering here at '1'). It sets the stage for the reader by outlining the context, problem, and goals of your project. This section should include:

- **Background Information**: Describe the field of autonomous driving, its current state, and its significance. Discuss relevant trends, challenges, or innovations in the field. Provide context for your project (e.g., the need for autonomous taxis in urban environments).
- **Problem Statement**: Define the specific problem your project aims to address. Be concise and ensure the problem is clearly framed as a gap or need in the current state of technology.
- **Objectives**: State the primary objectives of your project, such as developing an autonomous vehicle capable of safely navigating urban environments, improving passenger safety, or enhancing efficiency.
- **Scope**: Clearly define the boundaries of your project, including what it will and will not address. Ensure this aligns with the course requirements and competition guidelines.

Technical Specifications and Design Overview

This section describes the constraints and requirements imposed (both by the competition and by your team's strategy) to solving the design problem. This section includes:

- **Functional Requirements**: What the system is expected to do (e.g., navigate autonomously, detect traffic signs).
- **Performance Requirements**: Quantitative benchmarks (e.g., detection accuracy, response time). A performance requirement should be specific, measurable (e.g., quantifiable via test), achievable and relevant to the design objectives.
- **High-Level Design Description**: An overview of the system's architecture, including a diagram.

[4] It is common for the executive summary to be single spaced, whereas the rest of the report is 1.5 spacing.

Methodology

This section describes the methods and strategies employed by your team to solve the design problem. Your methods and strategies will naturally develop and refine as your knowledge and understanding grow throughout the course. This section is designed to showcase the preliminary critical thinking and research you have conducted to identify the methods and strategies you plan to use to meet your design requirements. This section includes:

- **Technologies and Tools**: Detail the hardware (e.g., Raspberry Pi, PiCar-X, Coral Edge TPU) and software (e.g., TensorFlow, OpenCV) you will use.
- **Algorithms**: Briefly describe key algorithm that you will be using, such as object detection, lane following, obstacle avoidance, brake light activation etc.
- **Data Sources**: Identify data needed for training/testing (e.g., traffic sign datasets) and how you will collect or preprocess it.
- **System Integration**: Explain how the components will interact (e.g., camera feeds processed by machine learning models, control decisions sent to motors).

Ethical and Risk Considerations

State the ethical considerations of your design strategies in how they affect stakeholders, society, the environment etc.

- **Ethos (Guiding Principles, Core Values, or Value Statement)**: An organization's ethos is the shared values and behaviors of its members. It underpins the organization's culture and guides member engagement. What are the guiding principles of how your group acts and makes design decisions?[5] What's the rationale behind this ethos?
- **Ethical Considerations**: Address safety, privacy, fairness, and transparency in decision-making.
- **Risk Assessment**: Identify potential risks (e.g., hardware failures, data issues) and mitigation strategies.

Project Management

This section defines how your team will manage elements of the project:

- **Team Roles and Responsibilities**: What are the skills of each team member and who is responsible for each part of the project? How do you ensure roles are fair and balanced? How is leadership within the group structured?
- **Decision and Conflict Management**: How will your group make decisions? What is your plan for handling team member conflicts that may affect the performance of your team? What strategies are in place for resolving conflict?

[5] For example, guiding values may be based around accountability, innovation, collaboration, democratic values, customer focus, excellence, respect, sustainability, diversity and inclusion, agility, and empowerment. To illustrate - Walmart's ethos centers around "service to the customer, respect for the individual, strive for excellence, act with integrity", Subaru's value statement is: "Enjoyment and Peace of Mind."

- **Timeline**: Provide a high-level schedule or Gantt chart with key milestones. Explain techniques used to generate the timeline (e.g., CPM, PERT), any risks associated with timeline slippage, and your teams strategy for ensuring timeliness of milestones, and the case where not all milestones can be met in time (specifically, how might you decide how to cut tasks that you do not have time to complete).
- **Budget**: Outline expected costs for components or other resources (if applicable).

Expected Outcomes and Impact

This section should lay out what you expect to achieve from the project (perhaps in terms of standing in the design competition, your learning and understanding). It should include:

- **Anticipated Results**: What you aim to achieve by the end of the project.
- **Impact**: How your project contributes to the field of autonomous driving or engineering education.

Furthermore, it would be helpful to the teaching team if your team could indicate whether you think this project is valuable to your education/intended career path and why.[6]

Conclusions

This section should summarize the problem, objectives, and proposed approach and reinforce the significance of the project and its potential contributions.

Citations

Ensure that all material that isn't your own is cited, regardless of whether the information is quoted or paraphrased – this includes content generated via artificial intelligence. Use IEEE format for citations.[7]

Submission Instructions

- Project proposals need to be uploaded by one team member to the OnQ submission folder by the deadline.

Grading

- The project proposal is a group project and is worth **10%** of your ELEC 390 final grade. See grading rubric for marking expectations.

Non-Compliance Penalties

- 25% per day late (i.e. per 24-hour period).

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[6] Of course, this element won't be graded, but will be immensely helpful in helping us understand student motivations in the course as part of the Reimagining Engineering Education program at Smith Engineering.

[7] The IEEE citation format is fairly common in the engineering community. A guide on this format of citation can be found here: https://guides.library.queensu.ca/apsc/ieee.

- Submissions more than 3 days late will not be assessed.
- Up to 20% deduction for not adhering to formatting requirements.

Grading Rubric

Criteria	Excellent (4)	Proficient (3)	Satisfactory (2)	Needs Improvement (1)	Unsatisfactory (0)
Background Research [CLO6]	Demonstrates thorough and comprehensive research using a wide range of reliable sources. Shows understanding, relevance, and connection to the design problem. Clearly integrates key theories and concepts into the design process.	Includes sufficient research from multiple reliable sources. Demonstrates a good understanding of the design problem with relevant context and concepts but lacks minor details or depth.	Provides basic research using a few reliable sources. Shows general understanding of the design problem but lacks depth, context, or significant integration of key concepts.	Displays limited research with minimal or questionable sources. Shows superficial understanding, lacking context, and minimal or incorrect integration of relevant theories or concepts.	Lacks evidence of research or relies on unreliable sources. Shows little to no understanding of the design problem and fails to include any relevant context, theories, or concepts.
Design Criteria and Specifications [CLO6]	Clearly defines specific, measurable, realistic, and comprehensive design criteria and specifications aligned with project goals. Justifies criteria with detailed rationale considering multiple factors.	Defines relevant and mostly specific, measurable design criteria and specifications that align with project goals. Provides a reasonable level of detail and justification, missing minor considerations.	Provides basic design criteria and specifications that align with some project goals. Criteria are somewhat specific and measurable but lack detail, justification, or consideration of all aspects.	Outlines vague or incomplete design criteria and specifications that are loosely related to project goals. Lacks specificity, measurability, and adequate justification. Misses several key considerations.	Fails to provide clear or relevant design criteria and specifications. Criteria are unclear, not measurable, or not aligned with project goals, with no supporting rationale.
Description of Design Process [CLO6]	Provides a detailed, logical, and clear description of each stage of the design process, including ideation, development, prototyping, testing, and refinement. Demonstrates critical thinking, creativity, and problem-solving.	Describes the main stages of the design process with clarity and logical flow. Includes most elements like ideation, development, testing, and refinement. Shows understanding of decisions but lacks minor details.	Offers a general description of the design process, covering some stages but missing others. Demonstrates basic understanding of the process but lacks clarity and detail in explaining decisions or iterations.	Provides an incomplete or unclear description of the design process. Covers few stages with minimal detail, lacks logical flow, and shows limited understanding of decision-making or problem-solving.	Fails to provide a coherent description of the design process. Missing key stages, lacks clarity, logical flow, and explanation of decisions or iterations. Shows little to no understanding of the process.
Identification of Considerations [CLO1]	Clearly identifies multiple ethical considerations relevant to the design. Explains their potential impacts on stakeholders with detailed examples specific to the project context.	Identifies relevant ethical considerations and explains their impacts on stakeholders with reasonable clarity. Examples are included but may lack depth or direct connection to the project.	Identifies at least one ethical consideration relevant to the design. Provides a basic explanation but lacks depth, specific examples, or clear relevance to the project context.	Mentions ethical considerations but provides minimal explanation. Connections to the project are unclear or too general.	Fails to identify ethical considerations or provide meaningful explanations. Shows little to no understanding of ethical issues.

Criteria	Excellent (4)	Proficient (3)	Satisfactory (2)	Needs Improvement (1)	Unsatisfactory (0)
Teaming (Team Style, Equity, Conflict Resolution, Leadership) [CLO2]	Demonstrates an inclusive and collaborative team style that effectively engages all members, promotes equity, and values diverse perspectives. Successfully identifies and resolves conflicts through constructive dialogue. Shows strong leadership by clearly delegating tasks, fostering team cohesion, and motivating members to achieve shared goals.	Displays a collaborative team style that engages most members and promotes fairness. Resolves conflicts effectively, with minor issues. Shows leadership by delegating tasks and maintaining team cohesion but may lack in some areas.	Demonstrates a generally positive team style with some attempts at inclusion. Resolves conflicts with moderate success but may avoid or inadequately address certain issues. Displays basic leadership but lacks consistency.	Shows a limited or inconsistent team style with minimal attempts at equity and inclusion. Has difficulty resolving conflicts, often relying on external intervention. Displays weak leadership with unclear delegation of tasks.	Fails to demonstrate effective team collaboration. Lacks equity, often excluding members or perspectives. Unable to resolve conflicts constructively and shows little to no leadership or coordination within the team.
Project Documentation [CLO5]	Provides comprehensive documentation that clearly articulates all project components: objectives, problem statement, stakeholder needs, information analysis, and project planning. Each component is detailed, logically organized, and demonstrates a thorough understanding of the project's scope and goals.	Offers well-organized documentation that covers most project components with clarity: objectives, problem statement, stakeholder needs, information analysis, and project planning. Some elements may lack minor details or depth.	Provides basic documentation that includes some project components (e.g., objectives, problem statement, stakeholder needs) but lacks detail, depth, or clarity in presenting information analysis and planning.	Presents incomplete or unclear documentation with minimal details on several project components. Lacks logical organization and demonstrates limited understanding of the project's scope and goals.	Fails to provide coherent documentation. Lacks most project components, such as objectives, problem statement, stakeholder needs, information analysis, or planning. Shows little to no understanding of the project.
Writing (Organization) [CLO4]	Writing is clearly organized into logical paragraphs and sections including smooth transitions and clear links between sections.	Writing is clearly organized into paragraphs and sections, including transitions.	Writing is structured into paragraphs and sections, including transitions.	Writing is mostly organized at the document-level, however loosely organized at the sentence level.	Disordered document-level organization and loose sentence-level organization.
Writing (Reasoning) [CLO4]	Statements are well supported by evidence synthesized from quality analysis and consider how limitations and uncertainties affect conclusions.	Statements are supported with relevant evidence, including discussion of limitations and uncertainties.	Statements are supported with evidence, limitations and uncertainties are mentioned.	Statements are supported by evidence of varying quality. Limitations and uncertainties may not be included.	Message is presented, however not entirely supported.
Writing (Graphics) [CLO4]	Graphical elements are all carefully designed and support the main purpose.	Graphical elements are used to support the main purpose.	Graphical elements used appropriately but not consistently referenced in text and/or do not directly relate to purpose.	Some graphical elements not discussed and/or do not contribute to the report.	Graphical elements not understandable, not related to text.