UTSMA Software

Design Challenge Project Proposal

0. **Foreword**

Welcome engineers and researchers! Warm welcome to the UTSMA Design Challenge.

Writing project proposal is a professional approach that justifies your methodology, decision-making, and manages the progress of yourself, which contributes to the project management of the whole team.

UTSMA Software is setting up its own foundation, and this good practice is valuable for all engineers to grow their competency and professionalism. Strong members are the top asset of a strong and lasting team!

1. **Overview/Background**

- Reinforcement learning autonomous vehicle researcher/developer.
- Goals:
    - I wish to help the team in identifying whether AI RL is a viable option in helping to detect deviations in pathing due to tyre slippage and other vehicle dynamics factors.
    - Secondly, I hope to develop an RL model that can be used to select optimal racing lines with consideration of velocity and vehicle dynamic factors to help the team achieve the fastest lap times.
    - I hope to have a working simulation RL model, prior to implementation in the design challenge.

2. **Tasks List**

Task 1 – Additional research into RL in Autonomous Racing & an investigation into vehicle dynamics and optimal pathing

- Time Commitment:
    - 7-10 hours of additional research into DQN alternatives
- Relation to Design Challenge Timeframe:
    - Will be finished this week, i.e., prep week 4 of the Design Challenge Proposal
- Role relation to Design Challenge Project:
    - Will aid in identifying whether there are other alternatives to DQN that could be applicable to autonomous racing (specifically vehicle dynamics deviation predictions).

    - Desire to gain a higher-level view of how other projects have implemented RL into their projects and to also gain insight into other ways we might apply it (aside from vehicle dynamic predictions)
- Any ideas on where to get started and how the process should be?
    - I have reviewed a few research journals - I have shared this with my team manager in Google Drive.
- Can you foresee any potential problems with it?
    - Getting off track from team goal's/vision for the project, e.g., focusing too much on optimal pathing when the main requirement is for predicting deviations in vehicle dynamics such as tyre slippage.

Task 2 - Reinforcement Learning Simulation

- Time Commitment:
    - 15 hours
- Relation to Design Challenge Timeframe:
    - Will be finalized prior to the Design Jam on the 2/06/24.
- Role relation to Design Challenge Project:
    - Simulation will provide a framework for implementation into the scaled-down model car.
- Any ideas on where to get started and how the process should be?
    - Plan on adopting logic and some of the code from this project: https://github.com/jperod/AI-self-driving-race-car-Deep-Reinforcement-Learning/blob/master/dqn.py
        - Code will need to be updated for the most recent Tensorflow library.
    - I also have developed a car circuit simulation (AIIR project) where the car learns to stay within the boundaries of the circuit.
    - Any code used will need to be redeveloped for vehicle dynamics predictions.
- Can you foresee any potential problems with it?
    - My main concern is that I will deviate from the team's goals/requirements.
        - I want to explore RL application in car navigation, optimal path prediction, as well as the team's goals of using a RL model for vehicle dynamic deviation predictions.
- What other sections would you need to get advice/input from?
    - Other members of my team; namely Anthony Hawke
- Are there any ways that others (software/leads/other sections) can support you?
    - Quan and others can assist by updating me on current member progress and discussing the current team's goals for RL and Software.

Task 3 – Research into applications in a real-world vehicle, what sensors and additional hardware are required? Application to small-scale vehicle.

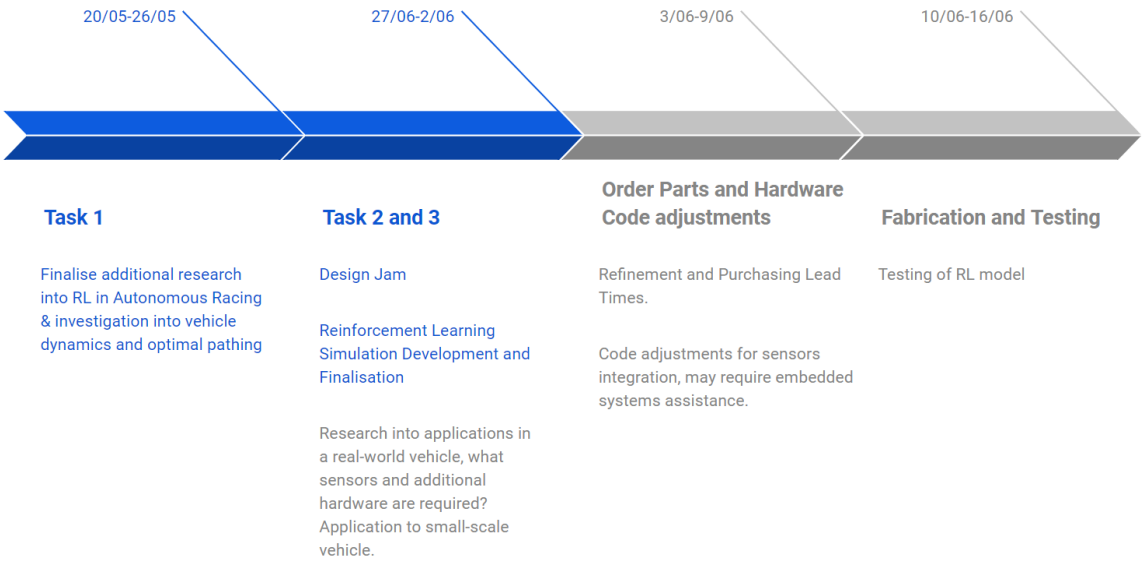
- Time Commitment:
    - 10-15 hours
- Relation to Design Challenge Timeframe:
    - Aim to be finalized prior to 2/06/24, which is the Design Jam commencement date.
- Role relation to Design Challenge Project:
    - Additional research into hardware requirements.
    - Adjust simulation code for hardware incorporation.
    - Incorporate into team's small-scale car and begin testing prototype.
- Any ideas on where to get started and how the process should be?
    - Research articles and journals will act as a starting point.
- Can you foresee any potential problems with it?
    - Issues with obtaining hardware; hardware costs, sourcing issues, time delays – Needs to be researched and ordered asap.
- What other sections would you need to get advice/input from?
    - Embedded systems unit, software members.

3. Technical Design Checkup

Getting all the past docs ready before moving to the design challenge. Document your past project here. Along with the outcome of the Design Challenge, this will later be a part of your own section proposal.

TBC

4. Timeline



- If a vehicle dynamics deviation prediction RL model is not finalized prior to 3/06, I'll try implementing a basic RL model for car navigation (only if this is useful to the team).