UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING
Industrial Solutions Laboratory

Company Information

Company Name	*ECE UNC Charlotte*	**Date Submitted**	*4/23/2021*
Project Title	Robotic Delivery System for UNCC Campus: Map generation and Path Planning **(UNCC_ECE_MAP)**	**Planned Starting Semester**	*Fall 2021*

Senior Design Project Description

Discipline	**Number**	**Discipline**	**Number**
Mechanical	1	Electrical	1-2
Computer	1-2	Systems	
Other ( )			

Company and Project Overview:

This project will be developed in the Control Systems and Autonomous Robots (CSAR) lab in the Electrical and Computer Engineering Department at the University of North Carolina at Charlotte under the supervision of the Principal Investigator (PI) Dipankar Maity. In this project, the students are required **to develop a robotic autonomous delivery system for UNCC campus** where robots will be autonomously dispatched from one location of the campus to go to another location while carrying light-weight materials such as books, mails, small packages etc. This project will be done in two phases. Phase-1 with a senior design team will consist of designing a (GPS-enabled) campus navigation system which will produce a planned path for the robots to go from any campus location to any other location. The second phase, which will be build upon the development of this phase, will be on the implementation of the algorithms into real robots.

Project Requirements:

The requirement for each phase is described below.

In the first part of Phase-1 (Fall 2021 Senior Design I), the students need to develop a 'traffic network' model for the UNCC campus. The model will help finding the path between two campus locations, very similar to google maps. In order to generate such a model and to find paths between campus locations, students will need to use *graph search algorithms* such as Dijkstra, A*, or Probabilistic Road Map (PRM). This part of the project is purely algorithmic and requires implementation of such an algorithm in MATLAB (or in Python/java or something equivalent). The success of this part will be measured based on the implemented algorithm's performance to find a feasible path for the robots to move. A strong background in programming is desired.

In Phase-2 (Spring 2022 Senior Design II), the students will implement the developed technology into mobile

robots (Turtlebots) to demonstrate that the robot can navigate from one campus location to another safely. This will require the students to have/develop some knowledge in robotic operating system (ROS) to integrate their algorithm into the actual robots.

Students will use the facilities available in the CSAR laboratory directed by Prof. Maity. The lab will have enough computers for programming and simulations and mobile robots along with the state-of-the-art OptiTrack motion capture system for experiments and robot control. Students will also have access to tools such as MATLAB, SIMULINK, Gazebo and ROS in the CSAR lab machines. Necessary hardware will be purchased and provided by Prof. Maity based on the need for the project.

Expected Deliverables/Results:

- Development of the traffic network model and demonstrate its performance using a graphical user interface. For example, if I query for a path from EPIC to Motor Sport Research Building, the developed model should show me a path on a campus map.
- Successful demonstration of the developed algorithm in a high-fidelity simulation environment (preferably in Gazebo).
- Demonstration that your algorithm can update the map as needed when new location/landmarks are added.

Disposition of Deliverables at the End of the Project:

- Preparing a detailed report of the project into a conference/journal paper format which can then be submitted for publications.
- Throughout the projects the students are required to maintain a regular documentation of their progress as well as how the experienced difficulties have been alleviated by them.
- Preparing a presentation and a video demonstrating the final outcome of the project.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Students must be interested and possess some basic knowledge in control systems and/or robotics.
- Pre-/co-requisites: ECGR 4161. Students are encouraged to be familiar with the topics of ECGR 4111.
- Proficiency in Linux operating systems, good knowledge in Matlab, and good programming skill in C++/java/python are expected.