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

Company Information

Company Name	*ECE UNC Charlotte*	**Date Submitted**	*4/22/2021*
Project Title	Robotic Delivery System for UNCC Campus: Algorithm Design and Implementation **(UNCC_ECE_ALGO)**	**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 control and navigation algorithm to help navigate the robots through the campus. The second phase, which will be built upon the development of this phase, will be on the implementation of the algorithms into real robots.

Project Requirements:

The project has three parts and the requirement for each phase is described below.

In the first part (Fall 2021 Senior Design I), the students are required to design control algorithms for the robots to navigate on the path found from the previous path. The algorithms designed here should be able to incorporate different inputs from the robots' sensors to have swift maneuvering capabilities for emergency stops and collision avoidance. Students should have a good understanding on control systems to carry out the project of this part. Demonstration of the developed algorithms will be done in MATLAB and/or GAZEBO simulation environment.

In the next phase (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:

- Successful demonstration of the developed control algorithm in a high-fidelity simulation environment (preferably in Gazebo). For example, given a reference path for the robot, your algorithm should demonstrate that the robot is able to follow the given path closely.
- Implementation of your algorithms into a real robotic system. Students are required to show how to upload a reference trajectory into the robot (Turtlebot) and how to autonomously control the robot to follow the trajectory.

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.