INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*ECE UNC Charlotte*	**Date Submitted**	*5/1/2022*
Project Title	Robotic Delivery System for UNCC Campus: Algorithm Design and Implementation - Phase 2 **(UNCC_ECE_ALGO2)**	**Planned Starting Semester**	*Fall 2022*

Funding

Students will use the facilities available in the COAR 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 COAR lab machines. Necessary hardware will be purchased and provided by Prof. Maity based on the need for the project.

Is this source of funds already secured? Yes

Faculty Mentor

Faculty Mentor/Grading Instructors *

	Name	Email	Phone
1	Mentor Prof. Dipankar Maity	dmaity@uncc.edu	
2	Grading Instructor/ Nan BouSaba	nbousaba@uncc.edu	

Senior Design Project Description

appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical		Electrical	2
Computer	2	Systems	
Other ( )			

Company and Project Overview:

This project will be developed in the Control, Optimization, Autonomy and Robotics Laboratory (COAR-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. These algorithms will be implemented on real robots for testing. This phase will build upon the work performed by the senior design team during AY 21-22. In the second phase, which will be built upon the development of this phase, will be on the implementation of the image processing algorithms to detect and avoid obstacles.

Project Requirements:

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

In the first part (Fall 2022 Senior Design I), the students are required to design control algorithms for the robots to navigate on the path found from the previous path. A preliminary algorithm has already been designed by a senior Design (SD) team during 2021-22. The students in this phase are expected to get familiar with the algorithms and codes available and start testing the robots inside the lab and around the campus. Students should have excellent skills in python and a willingness to learn some basics of control systems and robot motion planning. This will require the students to have/develop some knowledge in robotic operating system (ROS) to integrate their algorithm into the actual robots. Simulation of the developed algorithms will be done in ROS environment.

In the next phase (Spring 2023 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 using GPS sensors. This phase will require students to have the knowledge of how to interface hardware/sensors with the robots.

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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.
- Testing the robots around the campus and analysis of the data.

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.
- Proficiency in Linux operating systems, good knowledge in Matlab, and excellent programming skill in python are expected.
- Students should be open minded about learning new mathematical concepts and implementing them.