ELEC 3848 Integrated Design Project (IDP)
Second Semester 2024-2025
Group Project Description

Overview

In this project, you will be working in groups of 4 to 5 students to develop an Autonomous Mobile Robot (AMR) using Arduino Mega, servo/DC motors, sensors, and Nvidia Jetson Nano / Raspberry Pi (**please choose only one platform**), etc. The vehicle is programmed to move in an indoor environment simulating a real-life scenario and perform some tasks. Some examples of AGV:

- https://youtu.be/u6vxWCkN_HI?si=C61bDy3OTnnYLi0S
- https://youtu.be/DUrKvPSOL8U?si=fcKqQoMMuak8K2Kf

The project constitutes **54%** of the total course weight. You will demonstrate your system through three project components: project proposal (10%), required functions evaluation (10%), weekly meetings (8%) as well as final demonstration, video and final report (26%).

Project Proposal (10%, due on 16th Mar., 2025)

In the project proposal, you have to identify one innovative application (**ONLY ONE**), but this application can consist of several simple functions. Each student for one module, therefore 4 students need to use 4 (5 for a team with 5 team members) new modules that have not been used in laboratory sessions for the application. For example, the remote sensing function making use of sensors to detect the soil conditions to determine the actions required. This application is NOT included in the required functions (to be described in the next section). You have to justify why it is useful by referring to real life situations. You will then have to develop and simulate this application in your system.

The proposal is at least 3 pages but not more than 5 pages (1.5 line spacing). If new components are needed, please write a clear budget. In the budget, you do not have to include electronics that are available in the lab such as LEDs, resistors, pots, buttons, wires, etc. We will provide Nvidia Jetson Nano / Raspberry Pi upon your request hence your budget does not include this. Please limit your budget to HKD500. Do not purchase any item until you get our approval. ONLY THE FIRST APPLICATION IN THE PROPOSAL IS GRADED even if you have included more than one.

You have to include the following:

1. (1 points) a clear title and clear description of the proposed application you are going to develop in terms of what it does (e.g. title: music-playing car; description: my car will play a sonata when it detects an obstacle...);
2. (2 points) what practical situations that the application is useful (e.g. the music-playing car can alert people by playing music when a collision is about to happen);
3. (2 points) simple description and sketch/schematic of implementation (e.g. audio files will be put in an SD card. Arduino will then read the file from the SD and play it on a speaker that is carried on the car);
4. (2 points) Milestone Plan: a weekly milestone plan with detailed descriptions (i.e., indicates what to achieve each week, including but not limited to *hardware constructions*, *software development*, etc.)
5. (1 point) any new components you have to buy for the functions and budget (e.g. a speaker is needed to play beautiful music, SD card and reader are needed for keeping music files, etc.).
6. (2 points) will be given according to the novelty, complexity, and practicality of the application.

The Autonomous Mobile Robot (AMR) System and Required Functions

You will be provided with one set of components to assemble the vehicle. Tools and instructions will be provided for assembling the car. The set of components consists of the following:

- Arduino Mega to serve as the brain of the car
- Wheels to be driven by servo motors to move the car
- various sensors (line sensor, color sensor, ultrasonic, photo-resistor, Gyroscope, power module)
- other electronics (LEDs, pots, buzzers, buttons, OLEDs, resistors, breadboards, wires)
- ESP8266 for communication (in case needed)
- Nvidia Jetson Nano / Raspberry Pi (***one only for self-proposed function***)
- car frame and components
- 2 x power banks to power the motors and the main boards of the car

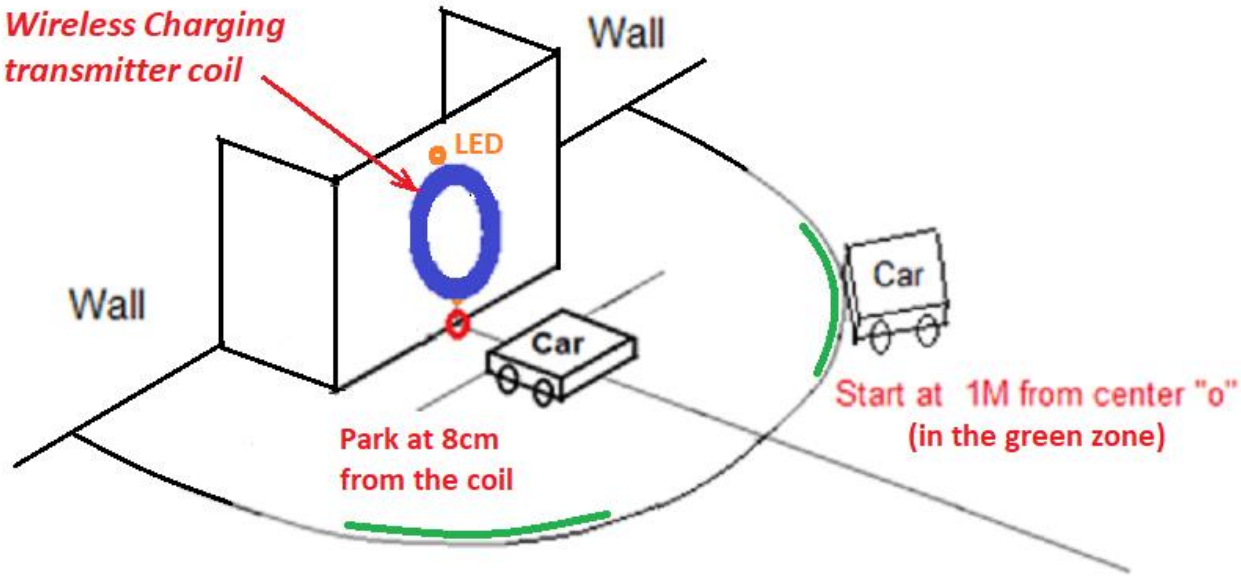
The car will be moving in an area of around 3Mx3M at the end of the Lab, simulating an arbitrary environment of interest. There are various signages and indicators in the area for the vehicle to identify specific locations for performing different types of tasks.

You can add in extra signage or components in the area for your proposed application. For example, you can add extra depot for the car to drop by and deliver a certain item to the depot.

Required function (10%)

Control and Parking application

In this task, the car would be installed with a light tracker, Ultrasonic sensors. The car is stationary and parked at a location of 1M away from the parking location with a wireless charging coil (with LED).



Your task is to move the car to the best location to the parking location. The car should be controlled by using Ultrasonic sensors, light tracker, Gyroscope, Bluetooth and etc.

1. Start the robot at 1m from the wall, positioned by TA
2. Move to the best location to the charging coil, wait for 10 sec to show the charging parameter in the computer. **During the alignment, the robot cannot touch the wall/charging station.**
3. Then park the robot 8cm perpendicular from the wall (Charging coil).
4. The data from ultrasonic sensor, Gyroscope, and power meter etc would be transmitted to the computer for record.
5. The location, charging parameter, and alignment will determine your marks.

Task 3: Weekly Meetings (8%: 2 x 4weeks)

After the car assembly demo, weekly milestone meeting will be held during lab sessions. In each meeting, we will review your progress according to the milestone plan indicated in your proposal.

Final demonstration, video and report (26%: 10: demo, 6: video, 10: report)

Final Demonstration of self-proposed functions (10%: demo)

The functions of your self-proposed application will be demonstrated in the last week of instructions. The format will be announced later. The performance score of the proposed application depends on the complexity and novelty of the final implementation. Besides demonstration, you will also need to submit a demo video and a final report on your function. The marks allocated for demonstration, report, and video are 10%, 10% and 6% respectively.

Final Report (10%: report. 6% demo video) (deadline 4th May., 2025)

Your document must consist of the following sections. Start a new page for each section. The maximum length is 20 pages (1.5 line spacing, font size: 11 point), including the cover page but excluding the references (if any).

1. Cover Page and Project Abstract (1 point)

   On the cover page, you should include your names, student IDs, and programmes. An abstract of at most 100 words is also included to briefly describe what you have done in the project.

2. System Description (5 points)

   Describe the implementation of the required functions and your self-proposed application. Make sure you explain clearly what your proposed application does. You do not need to describe the required functions, but explain how you achieve the tasks.

3. Changes to Proposal (2 points)

   A detailed description of whether your proposal has been fully developed. Changes should be clearly described and explain why changes are needed. If there are no changes, share how you avoid making changes. For example, did you research a lot when you wrote the proposal?

4. Reflection of Project (2 points)

   Describe the difficulties you encountered and how you resolve them. Identify limitations of your system and propose possible future development, etc.

5. Demonstration Video (6points)

   Record a 3-minute (but not more than 5 minutes) video to promote your product and demonstrate your proposed application (do **NOT** include required functions in this video). Be sure that your video includes a full verbal description of what is happening in the video, which is a narrative description of the visual information presented.

Whom to Ask for Questions?

Queries	Contact Person	Contact method
Car Assembling and sensor operations	Mr Alex Kiang	kiangyw@eee.hku.hk Before asking technical questions, please write down what you need to do, capture screen of the error, a short video (if possible) and what you think it may be the problem.
General electronics and part replacement	Mr Jacky Chow Mr James Koo	chowkh@eee.hku.hk lckoo@eee.hku.hk (CB 201A during office hours)
Moodle Submission	Dr WY Cheung	wycheung@eee.hku.hk
Task/Function Requirements	Dr Albert Lee Dr Sam Lam	tlalee@eee.hku.hk khlam@eee.hku.hk