

# ECSE211 – Client Needs

## Final Project Description for Students

### Background

Lots of retailers now offer online shopping opportunities. Once a customer places an order, the goods are packaged into cardboard boxes in warehouses and then delivered manually by human drivers to people's homes. While much of the warehouse tasks – such as finding and packaging items – have already been automated, delivery of the packaged goods have yet to benefit from the recent advancements in robotics. At the same time, hiring drivers willing to do the delivery task is becoming increasingly difficult. Therefore, your client – a large robotics company – plans to develop a fully automated mobile robotic system that can take deliver goods to people's homes without the need for human drivers.

### Problem Description

The executives at the client company want to see a prototype of such a system in action. The prototype should load the items from the Loading Bay (done manually by robot operators) and deliver the items to their respective delivery zones.

Having a fully working system in the real world is a difficult task. Therefore, for this prototype, the client has created a map for the Delivery Robot to travel in. The map consists of two coloured lines (blue & red), marking the street that the Delivery Robot can drive on. Alongside the streets are six coloured markings that indicate locations for the robot to drop off items for delivery. Figure 1. presents a sample schematic of a map.

#### Delivery Route & Map:

- The route/street is indicated by 1.5in thick boundary lines (red and blue)
- The distance between the two lines is 1.5in (+/- 0.5in)
- The maximum size of the map is 8ft x 8ft
- Figure 1 is only a sample map. The map used to test the performance of the Delivery Robot during the final demo will be different.

#### Delivery Zones:

- This is where the robot should drop off respective items.
- Delivery zones will always on the side corresponding to the red boundary.
- The minimum size of a Delivery Zone is 2x2 inches.
- A green line perpendicular to the route boundary lines will indicate that a delivery zone is nearby.
- The location of the delivery zones can be anywhere on the map. All delivery zones will be reachable by the delivery route. There can be a maximum of six delivery zones, and the colour of delivery zones will always be different from one another (i.e., there won't be two delivery zones of the same colour).

#### Items for Delivery:

- Items for delivery will always be coloured cubes of fixed size (1 inch<sup>3</sup>). There are six possible colours.
- Delivery location for the cube correspond to the colour of the cube. That is, a red cube should always be delivered to the red delivery zone, and yellow cube to the yellow zone etc.
- Items can only be loaded onto the Delivery Robot at the Loading Bay.



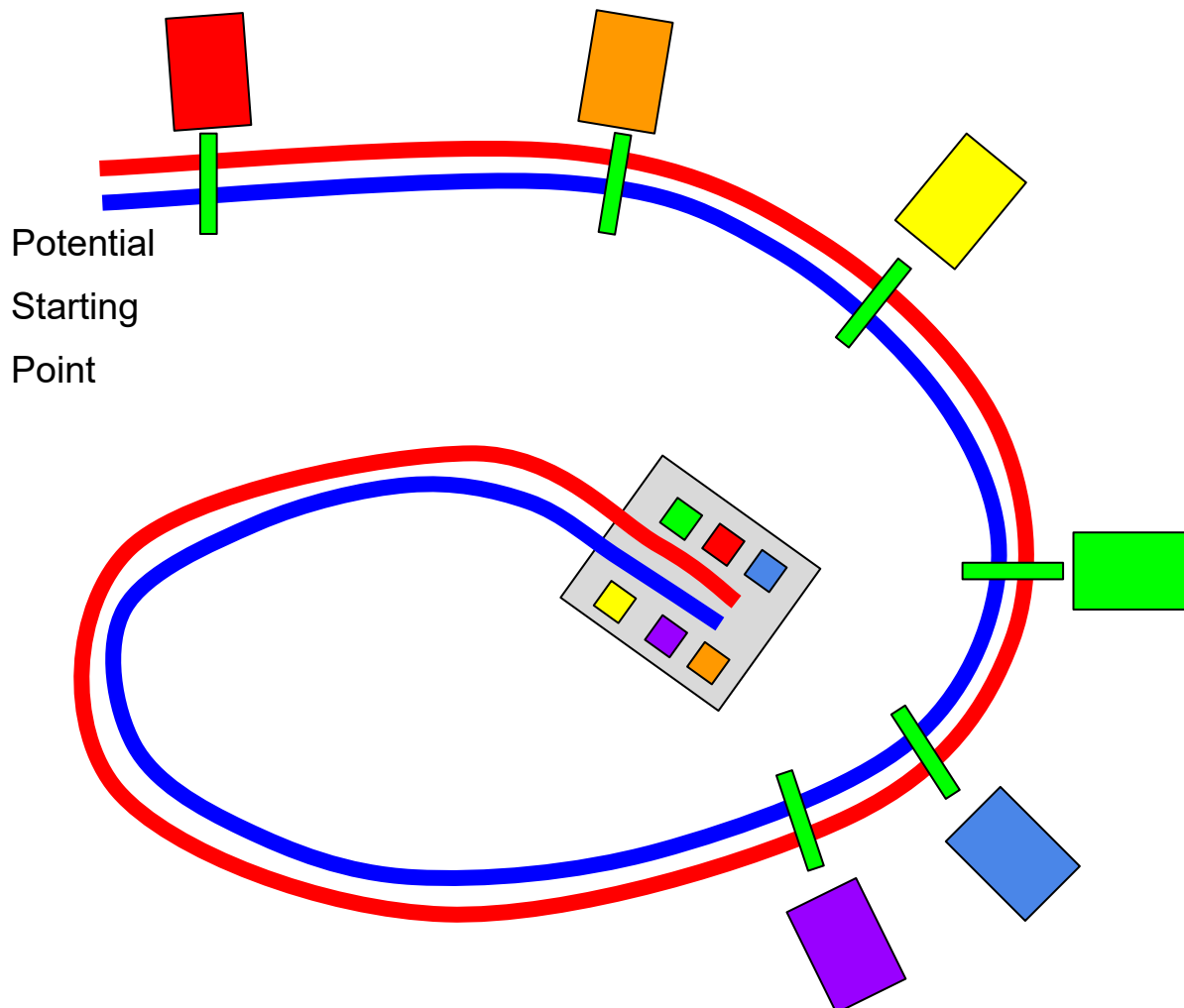
- A maximum of six cubes can be loaded onto the Delivery Robot.
- Cubes will be loaded onto the robot in a predefined, 3x2 order, where each location is dedicated to a designated colour (see Figure 1 for an example).

#### Quality of Delivery:

- Each coloured package must be delivered to the delivery zone of matching colour.
- The package must be delivered within the marked zone and not fall outside the coloured delivery zone area.

#### Quantity of Delivery:

- The client values efficiency. They are interested in seeing a prototype that can deliver as many items as possible in a given time without making delivery mistakes. Within a 5-minute window, the client wants to see how many you can deliver accurately. If your Delivery Robot is very efficient, you may come back to the Loading Bay to reload for a second batch of cubes for delivery.



*Figure 1. A sample schematic of a map. The street is marked with the two coloured lines (blue & red side by side), and coloured areas alongside the streets indicate different locations where the robot may drop off items. Green lines perpendicular to the street indicate the presence of a delivery zone nearby. The grey area marks the location of a Loading Bay where the Delivery Robot can load items for delivery. In this sample map, there are six delivery zones.*

## Material and Budget

At the start of the project, each team will be distributed 20 foam cubes. The client budgeted 0\$ to cover the cost of material. The teams are expected to deliver a solution using the two LEGO + BrickPi kits available to them. Teams can choose to use additional material (e.g., tape, paper, etc.). However, as start-ups, the cost associated with the material will imply that the team is operating at a loss for the project; therefore, spending large expenses are not encouraged. Same goes for any additional hours spent toward the project above the budget outlined in the Design Week Information document.

The material provided by the university are expected to be returned in its original condition. Therefore, students should not make permanent modification to any part of the DPM kit provided to them.

Within the DPM lab, there will be sample maps on the round tables for each team to experiment with. Teams should be able to create new maps for their own testing needs.

## Evaluating success

Teams will demonstrate the performance of their final design to the client and other students on the Final Demo Day.