EN2532 - Robot Design and Competition

Project Proposal

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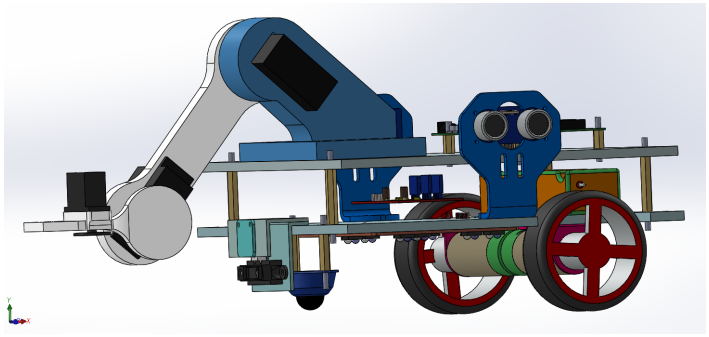
Overall Strategy

The overall task is subdivided into several sub tasks and they are executed one after the other where each sub-task can be considered as a function which will be called inside the main function of the control system. When one sub-task is over the control of the robot is handed over to the next sub-task. That is if robot starts misbehave in the middle of a task we have to start again from the very beginning.

- Proportional and derivative control schemes that is ***PD algorithm*** is used to follow the line using an IR sensor panel designed in a special arrangement using 8 IR sensors.
- Alternate Wall following part is also controlled by a similar ***PD algorithm*** and ultrasonic sensors are used for this as the task is not time critical.
- In order to follow circular paths ***differential drive algorithm*** is used.
- To identify the color of the bottom surface of the box we planned to use ***a robot arm of single degree of freedom*** with respect to its base with an attached gripper mechanism and a color sensor placed in front of the robot. The method will be explained in the algorithm section.

Robot Hardware Design

We used solid works as CAD 3D modeling software. After considering dimensions and weight of the all component we came up with our robot hardware design. All the component including PCB, sensors were drawn separately according to their actual/(approximated) dimensions and connected all together. There are 3 main parts in robot design as robot arm, lower platform, and upper platform. Robot arm will be made through 3D printing and platforms where all the components are mounted will be made by using ***Acrylic Plexiglases*** as we need strong and protective structure to hold each component. And other components like sensor holders are also going to made with Acrylic.



Sensors

Purpose	Sensor
Line Following	A sensor panel of 8 TCRT5000 IR Sensors
Wall Following	Two HC-SR04 Ultrasonic Sensors
Box detection	GP2Y0A21YK0F Sharp IR sensor
Gate detection	GP2Y0A21YK0F Sharp IR sensor
Color detection	TCS34725 - Color Sensor

Table 1: Used sensors in the design

Algorithms

For every sub task there is a unique algorithm to achieve the robot behavior of that particular sub-task. Within these algorithms the most basic controlling algorithms such as line following *PD algorithm*, *motor driving algorithm*, are combined together with the other unique algorithms to obtain the desired robot behavior. All the algorithms can be found at https://dms.uom.lk/s/3tqCf5aXDzK9eZZ and was not included here as it consumes a lot of space.

Actuators

Purpose	Actuator	Quantity
Motors for wheels	Pololu Metal Gear motor 25Dx67L mm HP 12V with 48 CPR Encoder	2
Robot arm	TowerPro MG996R servo motors	2
Gripper Mechanism	TowerPro MG90S servo motor	1

Table 2: Used actuators in the design

L298N motor driver will be used to control the motors while ***PCA9685 servo driver multiplexer*** which can drive up to 16 servos simultaneously will be used to control the servos in robot arm.

Power

We selected ***XK Detect X380 11.1V 3S 5400mAh Lipo*** battery as the power source for our robot. The voltage of battery is taken by determining the maximum voltage required which is 9V for for the motors. Capacity is determined by the total current required at the *worst case scenario* which is 9000mA and the time of running the robot which is 0.5h. The required minimum discharge rate is 1.667C. The discharging rate of this battery is 20C so it is more than enough. Some of the main advantages of using this Lipo battery are high energy density, high discharge rate and no memory effect.

Processing Unit

In our design there is only a ***centralized processing unit*** and therefore all the required data processing and calculations are done there. We have decided to use ***Arduino MEGA2560*** board which is an open source development board based on ATMEGA2560 microcontroller. Programming of the bard is done through ***ARDUINO IDE***. We have chosen this because it has ample of analog and digital input/output ports with several PWM supported digital pins, which are basic requirement in this robot implementation.

Task Delegation

Up to now only the algorithms are developed independently as given in the table and tasks related to initial stage of actual robot building such as hardware model designing were done by all the members together and therefore there was no specific task delegation. In addition to that task like PCB designing and real hardware design is not allocated to anyone yet.

Name	Index	Allocated Tasks
Sandeepa H.K.C.A	180564F	Line Following algorithm , Wall Following Algorithm
Hewavitharana D.R.	180241M	Algorithm related to the robot behavior in circular maze area
Thalagala B.P.	180631J	Robot arm design and its controlling algorithm
Nagasinghe K.R.Y.	180411K	Algorithm related to the robot behavior in Ramp area
Kumarasinghe H.A.N.H	180337M	Algorithm related to the robot behavior in gate area

Table 3: Task delegation among team members