EN2533 Robotics Design and CAD Design Report

Physical Task

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1 Usage of sensors

Line Maze

We are planning to use a QTR-8RC Reflectance sensor array for our robot to identify lines. This module has 8 IR LED/ phototransistor pairs mounted on a 0.375" pitch, making it a great detector for a line following robot. We are planning to mount the sensor array at the bottom of the front of our robot. We decided to keep about 3.5mm between the sensor array and the floor to ensure that the robot to follow the line accurately

Curved Wall

Our Robot has to do two tasks at the same time

1. Follow a curved wall to the left of the robot to reach the blind box
2. It should not touch or go beyond the red line

We planned to use an ultrasonic sensor in the side of the robot to detect the wall and use RGB sensor (TCS32000) to detect the red line while following the wall

Navigation through the Blind box

After entering to the blind box, our robot should find the correct exit where a line will be located on the floor near the exit. We use a TCRT5000 IR Sensor to detect the wall and a QTR-8RC Reflectance sensor array for our robot to identify lines.

2 Motor, Arduino and Motor Drives

Arduino Board

Arduino is a development board. This small computer is used as the brain of the robot. It can be programmed to get inputs from sensors and then control the motors and other electronic parts.

In our project we use an Arduino uno board which is based on an ATmega328P microcontroller. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

Arduino Uno Specifications

1. Operating Voltage: 5V
2. Input Voltage (recommended): 7-12V
3. Digital I/O Pins: 14 (of which 6 provide PWM output)
4. PWM Digital I/O Pins: 6
5. Analog Input Pins: 6
6. DC Current per I/O Pin: 20 mA
7. DC current for 3.3V Pin: 50 mA
8. Length: 68.6 mm
9. Width: 58.4 mm
10. Weight: 25 g

Motors

Two real wheels are driven by two separate motors (left side motor and right-side motor) because then only the robot can be turned right and left by making a velocity difference among motors.

This gearmotor consists of a high-power, 6 V brushed DC motor combined with a 34.014:1 metal spur gearbox, and it has an integrated 48 CPR quadrature encoder on the motor shaft, which provides

1632.67 counts per revolution of the gearbox's output shaft. The gearmotor is cylindrical, with a diameter just under 25 mm, and the D-shaped output shaft is 4 mm in diameter and extends 12.5 mm from the faceplate of the gearbox.

Using the Encoder(If applicable)

The versions of these gearmotors with encoders use a two-channel Hall effect sensor to detect the rotation of a magnetic disk on a rear protrusion of the motor shaft. The quadrature encoder provides a resolution of 48 counts per revolution of the motor shaft when counting both edges of both channels. To compute the counts per revolution of the gearbox output, multiply the gear ratio by 48.

Motor Drive

The intermediate device between Arduino, a battery, and motors. Provides current to motors according to the signal given by the development board. This L293D is a high voltage, high current, 4 channel driver. With this we can use DC motors and power supplies of up to 36 Volts. It can drive some big motors and it can supply a maximum current of 600mA per channel.

L293D Motor Drive specifications

1. **Current :** Maximum Current per channel / 600 mA Peak current : 1.2 A
2. **I/O pins :** Directly plug into Arduino Uno, Arduino Mega, etc. 4 Channels for DC motors and stepper motors (can drive 4 DC motors or 2 Stepper motors in the same time)
3. **Input Voltage** 4.5 V - 3.6 V
4. **Operation VOltage** 5V
5. **Speacial Features** Pull down resistors External power terminal for motors Support unipolar and bipolar stepper motors

3 Power Source

We are planning to use a battery pack with 3 rechargable 3.7V Li-ion Batteries as the power source for the mobile robot.

For Arduino Board

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. Therefore from our battery pack, we are giving 11.1V (3.7V x 3) to the arduino board.

For the Motors

The voltage of our battery pack is 11.1V and the output voltage of the arduino board is 5V (or 3.3V). For the motors, 6V should be supplied. For that purpose, we are using a 9-12V to 6V Converter (LM7806). Using the converter, we can give 6V from the 11.1V battery pack.

4 Mechanism

Actuators and Sensors Mechanism

One definition of a robot is a machine that can sense, think, and act. The thinking is handled by computation, but the other two capabilities require hardware. The motors are kept in the upper part of the robot base frame, because then only we can make the base frame closer to the ground where robot moving and which helps us to detect the line, dotted line using IR sensor become easier when distance between IR sensor to line less it will detect efficiently.

Driven Mechanism

Four wheeled robots are more stable than the three wheeled robot, because the center of gravity (COG) is located inside the rectangle formed by the four wheel rather than a triangle. Mobile robots come with a variety of drive mechanisms. Wheels may be drive wheels or free spinning. We are planning to use Ackerman steering which is similar to a pair of bicycles – two parallel fixed wheels in back and two steered wheels in the front.