III[rd] Semester B. Tech - Computer and Communication Engineering

19CCE201 Microcontroller and Interfacing

Term Work

Line Follower Robot

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Motivation:

We took this project because generally Line follower robot can be implemented using Raspberry Pi module but we want to implement this in LPC 2148, so we took this project.

We saw this project as an interesting one and we want to learn more coding in keil software to implement this project and that's why we took this project.

Theory:

1. LPC 2148

The LPC2148 microcontroller is based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and an accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

Due to their tiny size and low power consumption, LPC2148 is ideal for applications where miniaturization is a key requirement, such as access control. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways, voice recognition and low-end imaging, providing both large buffer size and high processing power.

- Up to 21 external interrupt pins available.
- CPU operating voltage range of 3.0 V to 3.6 V (3.3 V ± 10 %) with 5 V tolerant I/O pads.

2. L293D Motor Driver IC

The L293D is characterized for operation from 0°C to 70°C.

The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays,

solenoids, DC and bipolar stepping motors, as well as other high-current/high-voltage loads in positive- supply applications.

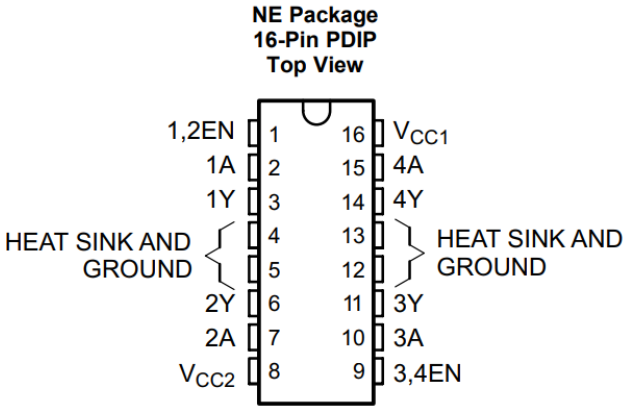
Features:

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Output Current 600 mA for L293D
- Peak Output Current 1.2 A for L293D
- Output Clamp Diodes for Inductive Transient Suppression

Applications:

- Stepper Motor Drivers
- DC Motor Drivers
- Latching Relay Drivers

Pin Configuration and Functions



3. DC Motor

A DC motor or direct current motor is an electrical machine that transforms electrical energy into mechanical energy by creating a magnetic field that is powered by direct current. When a DC motor is powered, a magnetic field is created in its stator.

The motor can be rotated at a certain speed by applying a fixed voltage to it. If the voltage varies, the speed of the motor varies.

Thus, the DC motor speed can be controlled by applying varying DC voltage; whereas the direction of rotation of the motor can be changed by reversing the direction of current through it.

Features:

- Runs on DC power or AC line voltage with a rectifier
- Operating speeds of 1,000 to 5,000 rpm
- 60-75% efficiency rate
- High starting torque
- Low no-load speeds

4. IR Sensor

Line **F**ollower **R**obot (LFR) follows a line, and in order to follow a line, robot must detect the line first. The reflection of light on the white surface is maximum and minimum on the black surface because the black surface absorbs maximum amount of light. So, in order to use this property of light to detect the line, we need IR sensors.

Infrared sensors consist of two elements, a transmitter and a receiver. The transmitter is basically an IR LED, which produces the signal and the IR receiver is a photodiode, which

senses the signal produced by the transmitter. The IR sensors emits the infrared light on an object, the light hitting the black part gets absorbed thus giving a low output but the light hitting the white part reflects back to the transmitter which is then detected by the infrared receiver.

IR Sensors are more accurate, cheap, small sensors often used in robots, and Arduino project to detect objects near the sensor.

The IR sensor has **Power**, **Ground**, **Signal**, and **Enable** pins.

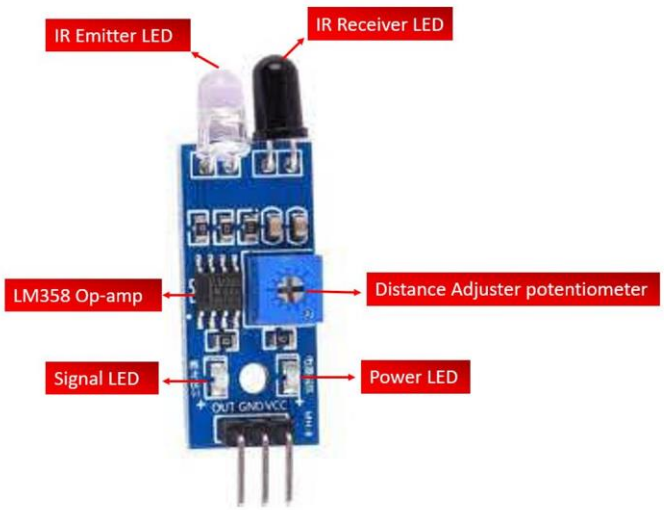
There are also **2 potentiometers**, and **one jumper** on the board.

Features:

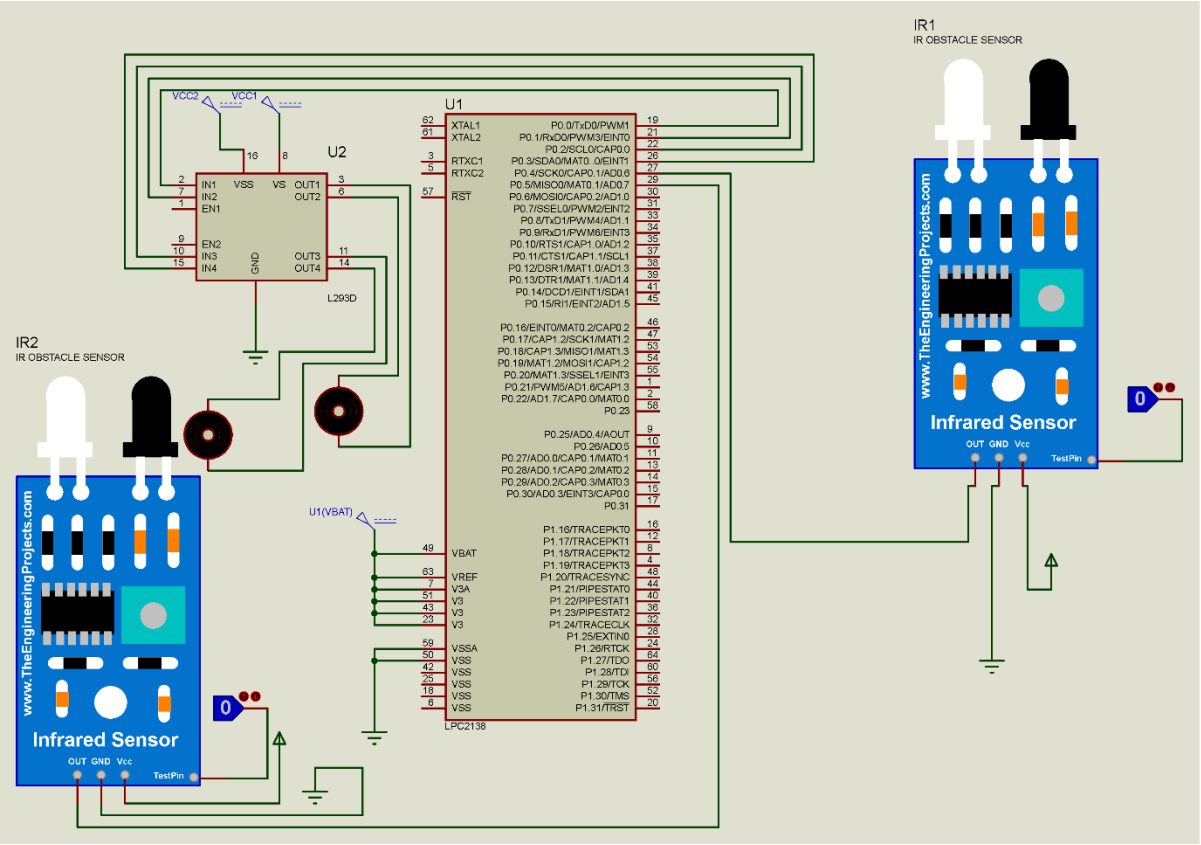
- Easy to assemble and use
- Onboard detection indication
- The effective distance range of 2cm to 80cm
- A preset knob to fine-tune distance range
- If there is an obstacle, the indicator lights on the circuit board.
- It can easily detect the object from 2 to 30 cm area and its detection angle is 35º**.**

Applications:

- Object detection
- Motion detection
- Obstacle avoidance robot
- Gas leakage detection
- Smoke detection
- Distance measurement
- Robotics



Design:



Code:

```
#include <lpc214x.h>
#define LEFT_SENSOR_THRESHOLD 500
#define RIGHT_SENSOR_THRESHOLD 500

void init() {
  // Set P0.0 and P0.1 as digital outputs for left motor
  IO0DIR |= (1<<0) | (1<<1);

  // Set P0.2 and P0.3 as digital outputs for right motor
  IO0DIR |= (1<<2) | (1<<3);

  // Set P0.4 and P0.5 as digital inputs for IR sensors
  IO0DIR &= ~((1<<4) | (1<<5));
}

void set_motor_speed(int left_speed, int right_speed) {
  // Set left motor speed
  if (left_speed > 0) {
    // Forward
    IO0SET = (1<<0);
    IO0CLR = (1<<1);
  } else if (left_speed < 0) {
    // Reverse
    IO0SET = (1<<1);
```

```
    IO0CLR = (1<<0);
  } else {
    // Stop
    IO0CLR = (1<<0);
    IO0CLR = (1<<1);
  }

  // Set right motor speed
  if (right_speed > 0) {
    // Forward
    IO0SET = (1<<2);
    IO0CLR = (1<<3);
  } else if (right_speed < 0) {
    // Reverse
    IO0SET = (1<<3);
    IO0CLR = (1<<2);
  } else {
    // Stop
    IO0CLR = (1<<2);
    IO0CLR = (1<<3);
  }
}

int main() {
  init();

  while (1) {
    int left_sensor = (IO0PIN & (1<<4)) >> 4;
    int right_sensor = (IO0PIN & (1<<5)) >> 5;

    if (left_sensor > LEFT_SENSOR_THRESHOLD && right_sensor > RIGHT_SENSOR_THRESHOLD) {
      // Both sensors detect line, go straight
      set_motor_speed(50, 50);
    } else if (left_sensor > LEFT_SENSOR_THRESHOLD) {
      // Only left sensor detects line, turn right
      set_motor_speed(-50, 50);
    } else if (right_sensor > RIGHT_SENSOR_THRESHOLD) {
      // Only right sensor detects line, turn left
      set_motor_speed(50, -50);
    } else {
      // No sensors detect line, stop
      set_motor_speed(0, 0);
    }
  }

  return 0;
}
```

Results:

The design of the line follower robot has been done using proteus with the hardwares LPC 2148(LPC 2138 in proteus), L293D Motor Driver, IR Sensors, DC motors with the required power supply of 3.3V. The simulation has also been done with the code using c programming language.

Inference:

The robot is able to detect and follow a line with the help of infrared sensors and motors. The robot is able to respond to changes in the line's position and adjust its direction accordingly. The robot is able to maintain a consistent speed while following the line. The robot is able to avoid deviations from the line.