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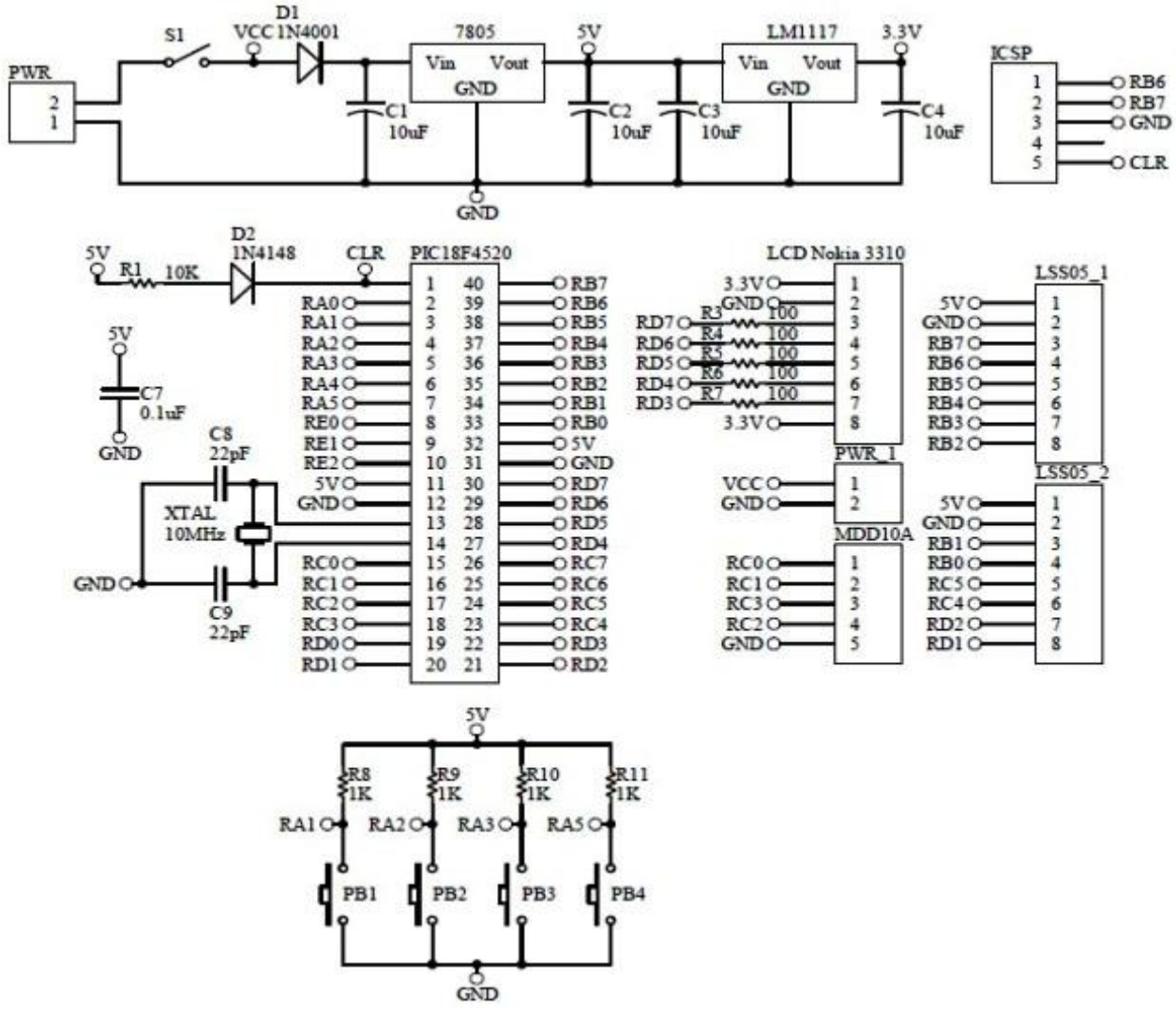
LSS05 Auto-Calibrating Line Sensor

Application Example

APPLICATION INFORMATION: LINE FOLLOWING ROBOT

Schematic Circuit:



The line following routine handles the calculations and error handling.

```
void follow_line(int line_position)  //follow the line

{
switch(line_position)
{
```

These two cases handle the situation where the line is lost and attempt to rotate back to the line

```
// line has moved off the left edge of sensor
case 0:

      digitalWrite(dir_a, LOW);
      analogWrite(pwm_a, 200);
      digitalWrite(dir_b, HIGH);
      analogWrite(pwm_b, 200);
      Serial.println("Rotate Left\n");
break;

// line has moved off the right edit of the sensor
case 7000:
     digitalWrite(dir_a, HIGH);
      analogWrite(pwm_a, 200);
      digitalWrite(dir_b, LOW);
      analogWrite(pwm_b, 200);
      Serial.println("Rotate Right\n");
break;
```

This line calculate the error for the control loop. 3500 is the "setpoint" and can be adjusted to move the line position the robot is shooting for.

```
default:
   error = (float)line_position - 3500;

  // set the motor speed based on proportional and derivative PID terms
  // kp is the a floating-point proportional constant (maybe start with a value
around 0.5)
  // kd is the floating-point derivative constant (maybe start with a value around 1)
  // note that when doing PID, it's very important you get your signs right, or else
the
  // control loop will be unstable
```

These are the variables that should be adjusted to fine tune the control loop.

```
kp=.5;      This is the proporational value
kd=1;       This is the derivative value

PV = kp * error + kd * (error - lastError);
lastError = error;
```

PWM values (motor speed) must be between 0 and 255. This code limits the values. It also limits the low end of the PWM value. Depending on the batteries, motors and load, the motors will usually stall at a value much greater the 0. In this example, the low end is 170.

```
//this codes limits the PV (motor speed pwm value)
// limit PV to 55
if (PV > 55)
{
  PV = 55;
}

if (PV < -55)
{
  PV = -55;
}
```

This calculated the individual PWM value for each motor, note the sign difference.

```
m1Speed = 170 + PV;
m2Speed = 170 - PV;

    //set motor speeds
```

This sets the updated motor speed and direction.

```
      digitalWrite(dir_a, LOW);
      analogWrite(pwm_a, m2Speed);
      digitalWrite(dir_b, LOW);
      analogWrite(pwm_b, m1Speed);
   break;
}
} // end follow line
```

Tune the Loop:

One approach is to set the kd variable to 0 and tune the kp term alone first. kp of 1 is a good place to start. If the robot reacts too slowly, increase the value. If the robot seems to react to fast and become unstable, decrease the value. Once the robot responses reasonably, tune the derivative portion of the control loop.

First set the kp and kd value each to the 1/2 of the kp value. For example, if the robot responses reasonable with a kp = .8, then set kp = .4 and kd = .4 to start. Increase the kd (derivative) gain to decrease the overshoot, decrease it if the robot become unstable.

One other component of the loop to consider is the actual sample/loop rate. Speeding this up or slowing this down can make a significant difference in the robot's performance. This is set by the delay statement at the end of the loop () subroutine.

Calibrating Line Following Sensor LSS05:

Press the calibration push button once or pulling down the Cal. for few milliseconds. Calibration will be start by exposing the sensor to the bright surface and then to the dark surface as indicated by the LEDs.

To calibrate the line sensor, you only need to push it ONCE, and then swing your LSS05 sensor left and right repeatedly with the sensor facing the line. Please keep the distance between robot and floor constant during calibration. Do not lift the base. The sensor is automatically calibrated so there is no need for us to worry about the calibration procedure. The indicator LEDs will blink while calibrating. After the indicator LEDs stop blinking, it's DONE.

The sensor also comes with extra 2 modes, namely dark line following mode and bright line following mode. It's easy to change the mode.

- Dark line following mode – Press the button twice within 1.5 second. Then the sensor indicator LEDs will light up when it detects a dark surface.
- Bright line following mode – Press the push button 3 times within 1.5 second. The sensor indicator LEDs with light up when it detects a bright surface.