

Memorial University of Newfoundland

Faculty of Engineering and Applied Science

Engineering 6806 ---- Engineering Design Labs, Fall 2007

Robot Control

Instructor: Siu O'Young and Dennis Peters

Objectives:

- Robot System Integrity Check
- Introduction to PIC Programming
- Design of a camera turret

Equipment

1. 1 - robot with encoders, gear boxes and charging system
2. 1 - PIC board
3. 2 - IR distance sensors
4. 1 - Ultrasonic sensor
5. 2 - Panasonic LC121R3P Batteries
6. 1 - charging unit
7. 1 - USB Web-cam
8. 1 – 25' Serial cable bundle (USB and serial combined)
9. 1 – RC Servo
10. Optional: discrete electronic components for testing servo: LM555 Timer, 50k linear pot, 0.033 and 0.1 uF capacitors, 18k and 6801 1/2W resistors, any signal diode e.g. 1N4148

Precaution

DO NOT burn out encoders by reversing the power supply polarity. They are very expensive to replace!

Procedures

Integrity Check of PIC controller board, motor and driver circuit

1. Power on the Robot and check that it will do the following self-check sequence:
 - straight run in the forward direction for approximately 1 m;
 - turn around and come back;
 - clockwise spin around the center drive shaft for approximately 5 seconds
 - stop

Use of the PIC C compiler and Bootloader

The PIC Controller board can be programmed via a PC serial port using the CCS-C compiler installed on the desktop PC in the lab. The TA will give a demo on how to compile the C source code and download the compiled hex code to the robot.

1. Modify the C source code for the integrity check so that the robot do the integrity check sequence continuously.
2. Raise the driving wheels of the robot off the ground by using, e.g. a stack of books, and run the robot with the modified program.
3. Measure the running time of the robot for a fully charged set of batteries. Re-charge the batteries and repeat the test to get an idea of the condition of the batteries.

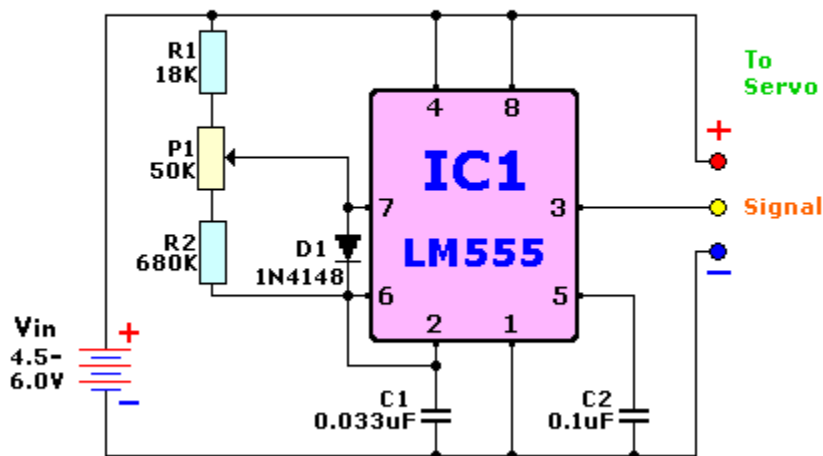
RC Servo Control

If the camera is fixed mounted on the robot, the robot will have to rotate at some waypoints in order to position the camera for reading the letters. A way to speed this maneuver is to build a turret mounted on the robot to rotate the camera in stead of the robot. A simple turret can be built using an RC servo.

1. Build an simple RC PWM circuit to study how an RC servo system works. A sample circuit is given below, and you might have to change the resistor values to get the range of the RC movement to the right scale. This circuit is from "Servo Driver #4" posted on <http://www.uoguelph.ca/~antoon/gadgets/gadgets.htm>. There is also useful information on driving an RC servo using a PIC microcontroller on this website.

Servo Driver

Original by Antoon "Tony" van Roon. Modified by Alan "A.J." Franzman.



2. Write a PIC program to turn the RC servo 90 degree clockwise and 90 degrees counterclock. The following is a sample subroutine written by Jeff Newhook. You can modify the Integrity Check program as the main program to call this routine to get familiarized with your first PIC programming.

```
/
*
* Turret routines
*
* Author: Jeff Newhook
*/
#define TURRET_PIN pin_c0
/
```

```
*
* Rotate turret
*
* Center: 1.5ms
* Left: 1.0ms
* Right: 2.0ms
*/
void TurretRotate(int degrees)
{
  unsigned int delay;
  int i;
  //delay = ((degrees / (float)90) * (float)0.5) + (float)1.5 * 10000;
  if(degrees == 0)
    delay = 1400;
  else if(degrees == -90)
    delay = 2200;
  else if(degrees == 90)
    delay = 500;
  printf("deg = %d delay = %Lu\r\n", degrees, delay);
  for(i = 0; i < 5; i++)
  {
    output_high(TURRET_PIN);
    TimeDelayUs(delay);
    output_low(TURRET_PIN);
    delay_ms(20);
  }
}
```