Special Sensor Report

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Electrical Robot Collision Detection

1. Background

This sensor is based on one proposed by Jason Plew. His sensor consisted of a wire wrapped around the bump skirt of a robot that was pulled up to 5 V. A wire wrapped around another robot was pulled down to ground. Upon collision, the wires would touch and form a voltage divider. This could be detected by each robot by monitoring the voltage on the line. This was tested by pulling up a 10 K Ohm resistor using one battery pack and pulling down a 10 Kohm resistor to ground using another battery pack. The free ends of each resistor were connected and the voltage measured at this point. A multimeter was unable to detect an voltage across either resistor. This sensor is realizable but it requires an additional wire on each robot to act as a common ground.

2. Design

Two wires are wrapped in parallel along the bump skirt of a robot. One wire is attached to ground and the other is attached to a digital input pin on the AT-Mega163 microcontroller. Port B is used since it can be internally pulled up, reducing external circuitry needs. Another robot is equipped with a thick piece of foil tape wrapped around its bump skirt. Upon collision, the foil tape will short the two wires together. The input pin on the microcontroller is pulled to ground and software can be used to detect this.

3. Construction

Two pieces of wirewrap wire approximately 24 inches longer were cut. Each was stripped of its insulation. Occasionally the wire would break and the broken wire was reattached by soldering the ends together. Once stipped, each wire was wound around the bump skirt of a robot. The wires were held in place using hot glue. Thicker gauge wire was attached to the ends of each wire. One wire was attached to ground on the battery and the other was attached to Port B, pin 4. Figure 1 shows the sensor eqipped on two robots. The top robot is fitted with foil tape on the bump skirt and the bottom robot has the dual-wire system.

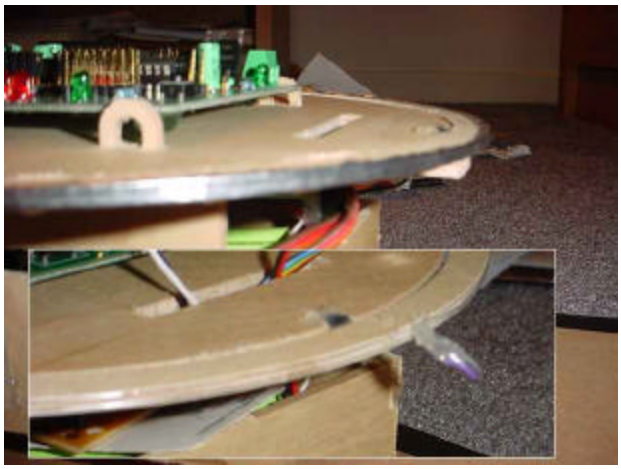

Figure 1

4. Testing and Results

To test the sensor, two robots were set up—one with the foil bump skirt and the other with the dual-wire configuration connected to Port B of the AT-Mega microcontroller. The two robots were pushed together manually to form a connection. Program code was written to display the status of Port B on the LED's. Upon collision, the LED signifying the pin connected to the wire sensor would diminish.

Upon final testing, it was determined that the sensor works correctly a majority of the time. However, sometimes the foil will fail to make a good connection to both wires. The castors had to be raised on each robot so that they sat as close to parallel to the ground as possible. This

prevented the incidences where one bump skirt would slide over top of the other. In practice, a robot collision will sparingly result in no detection. Only in a couple of rare instances were “false positives” detected.

5. Appendix: Test Code

```
// Bump Sensor Test

#include <io.h>
#include <sig-avr.h>

#define AVR_MEGA 0

typedef unsigned char  u08;

int main(void)
{
   outp(0x00,DDRB);
   outp(0xFF,PORTB);
   outp(0xFF,DDRC);

   for (;;) {
      register u08 led = inp(PINB); //read PORT B input pins
   outp(led,PORTC); //display PORT B values to LED’s

   }
}
```