Subsystem 4: Guide-Path Tracking Using TCRT5000 Sensors

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Description

The purpose of this subsystem is to use TCRT5000 optical reflective sensors to generate a tracking error while in guide-path tracking mode of the robot. The assumed guide-path is a strip of black electrical tape, with a width of 18mm.

Two TCRT5000 sensors, Ch1 and Ch2, are interfaced to the PIC18F4431 in this application as seen in Schematic 1.1 in Appendix. The mid points of the sensors are spaced to 18mm to match the electrical tape width. The output of the sensors is read by analog pins AN0 and AN1 on port A of the PIC4431 and converted to a digital value. These digital values can be seen in Plot 1.1 in Appendix. The plot has four subplots, which demonstrate the outputs of sensor 1 and 2 as they pass over the strip of electrical tape. The distance shown is relative to the origin, which is the middle of the electrical tape. Positive tracking error is when the midpoint of the sensors is to the right of the tape; negative error is when to the left. In the plot of Ch1+Ch2, a spike is observed at the origin. This is caused by the high, but not maximum, outputs of the sensors when they are both detecting the edge of the tape.

It is clear from Plot 1.1 that when at least one sensor is detecting the tape (from approximately negative 18 to positive 18 mm), the tracking error is simply Ch1-Ch2. The value of Ch1+Ch2 is above 350 while the sensors are within this range – this information is used by the program. If the sensors are out of this range, the tracking error is set to a maximum or minimum value depending on the sign of the last calculated error from when the sensors were within the range. These minimum and maximum values are +100 and -100. The initial value of e (error) has a positive sign; this means that the robot must be to the right of, or above, the tape when this subsystem is initialized.

Appendix
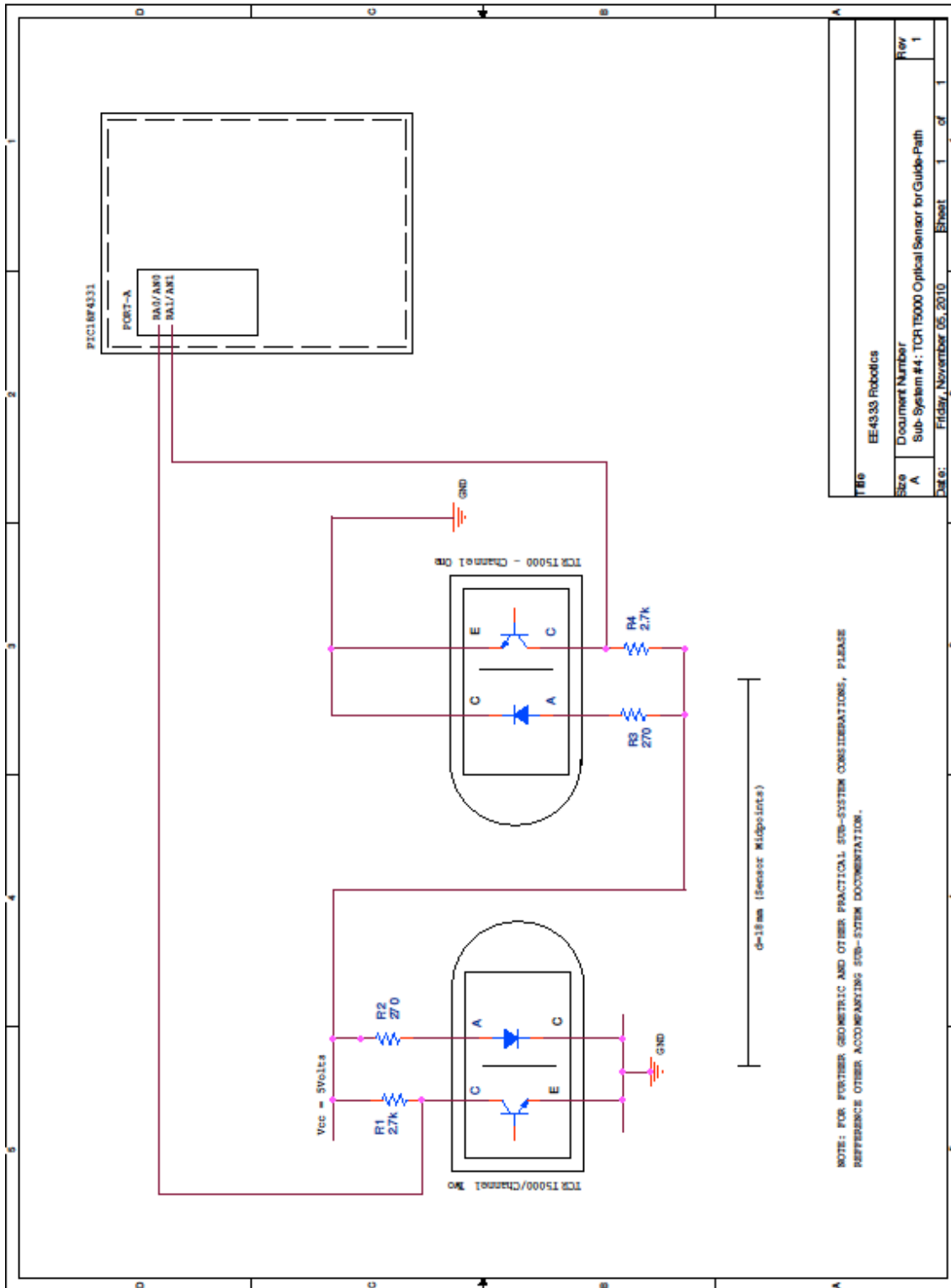
Schematic 1.1: Circuit Diagram
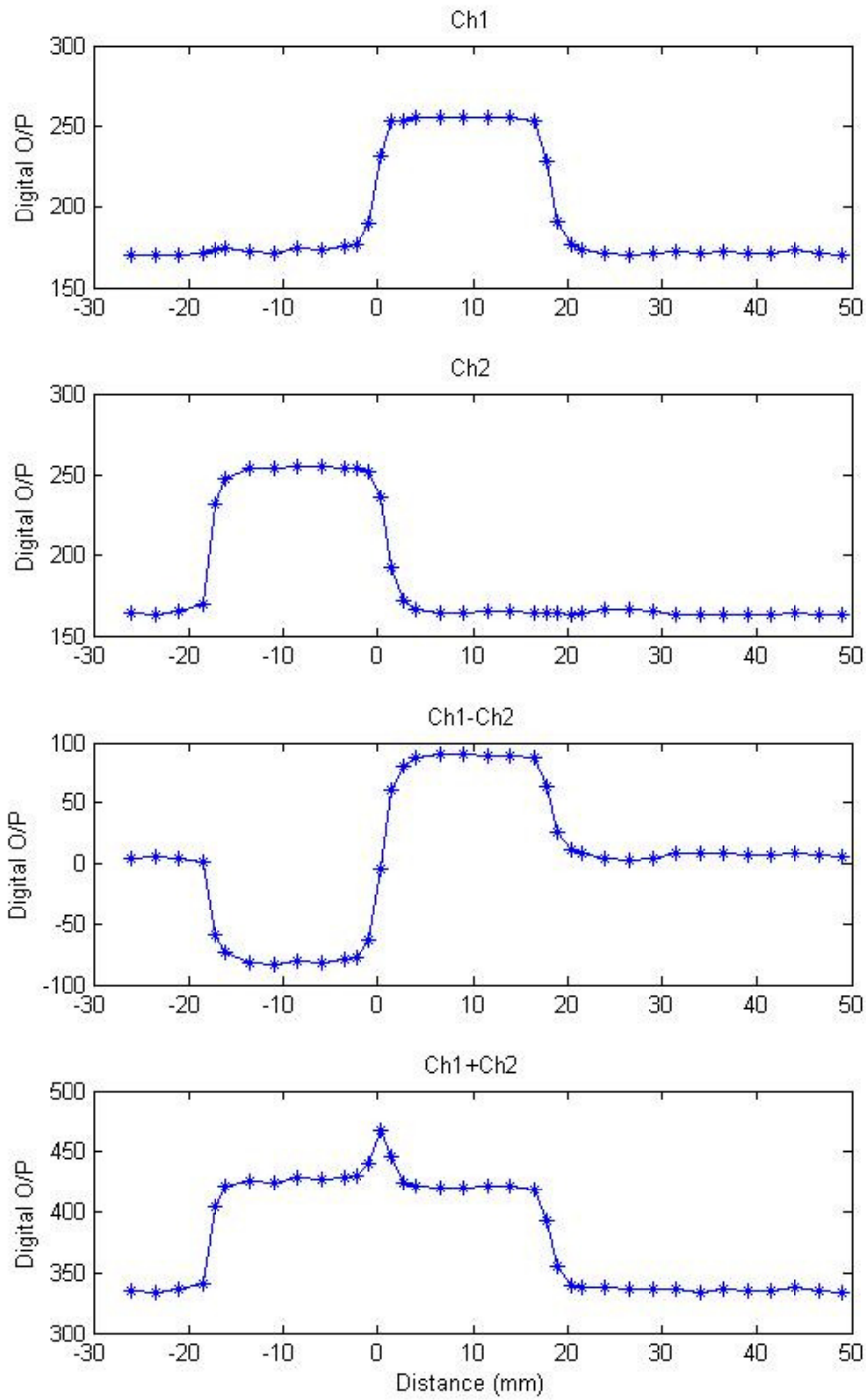
Plot 1.1: Sensor output data taken in lab