Ormerod Modulated IR Sensor Plan

Objectives

1. To reduce the sensitivity of the IR sensor to ambient light, by modulating the IR LED output under control of the Duet firmware and looking for the increase in phototransistor output when the IR emitter is turned on.
2. To do this with as little hardware change as reasonably practical.
3. The associated firmware changes should be done in such as way so that the firmware can still be used with an unmodified sensor.
4. Diagnostic output should be available so that the effect of the change can be readily measured.

Hardware change plan

1. Decrease the IR LED series resistor from 165 ohms to 51 ohms. This increases the forward current from about 13mA to about 40mA (still below the device limit of 50mA), thereby increasing the IR output by a factor of 3.
2. Decrease the IR LED load resistor to compensate for the increased IR output. As the existing 15K load resistor is a little high for some sensors (causing the phototransistor to saturate at short distance), I propose a decrease of a little more than a factor of 3, to 4.3K. [These first two changes have already found to reduce the impact of ambient light.]
3. Insert a BC817 or BC337 transistor in series with the ground connection to the LED series resistor (emitter to ground, collector to resistor). A BJT is chosen in preference to a mosfet because the sensor is liable to be disconnected and reconnected by users, so the increased ESD resilience of a BJT is preferred.
4. Connect a 1K resistor to the base of the transistor. Run a wire from the other end of this resistor back to the Duet board. This additional wire will fit in the existing sheath.
5. At the Duet board, the wire will be connected to a spare Duet output pin. I suggest the pin immediately above the sensor input pin (pin 34 on the expansion connector), which is AD0/PA2 on the processor, aka Arduino analog pin 7 and digital pin 61. The pins either side of the sensor input pin serve as one of the TWI pins and one of the DAC pins, which are too valuable to use as simple digital output pins.

Firmware change plan

1. On receiving the command M558 P1, set pin A7 to mode OUTPUT and drive it HIGH. Leave the Z reading code unchanged. In this mode, the firmware can drive the original sensor board, or the modified sensor board in unmodulated mode.
2. On receiving M558 P2, this command will be taken to mean that a modified sensor board is attached and it should be driven in modulated mode. In unmodulated mode, the firmware sums 5 z-probe readings and divides the sum by 5 to get the average. In modulated mode, invert the state of the IR sensor drive pin after each reading. Readings taken when the drive was on before taking the reading will be added to the sum, and readings taken with the drive off will be added to a separate sum. When 3 of each have been taken, subtract the off-reading sum from the on-reading sum, then divide by 3 to get the average reading.
3. Change the behaviour of the G32 command such that when no parameters are received, if

modulated mode has been enabled, then as well as returning the Z-value it also returns the on-average and off-average. These values are useful for diagnostic purposes, in particular so that the saturation region of the phototransistor can be avoided.

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