Temperature regulator

Tanner Howard
Yer Yang
Goals

- use PID control to create an accurate temperature regulator
- temperature setting can be changed while running and adjust quickly
- holds temperature indefinitely within +/- 1 degree celsius
- reacts quickly to any sudden changes resulting from external interference
- limits max overshoot when heating to less than 5 degrees celsius
- includes an “emergency shut off” if temperature rises 10 degrees higher than set temperature
Proportional integral derivative

After considering an number of different cases, it was determined a PID system would provide the greatest stability for the temperature regulator. This system will be implemented into code via the following equations:

\[ P = P_k \times (\text{set_temp} - \text{current_temp}) \]

\[ I = I_k \times (\text{accumulated_difference}) \]

\[ \text{accumulated_difference} = \sum (\text{set_temp} - \text{current_temp}) \]

\[ D = D_k \times (\text{current_temp} - \text{previous_temp}) \]

These terms will be used to set the duty cycle of a PWM output to the heating element.
Flowchart

Initialization

Read set temperature and current temperature in A/D converter

Compare Temperature

(Current Temp.)

> (10 deg. + Set Temp)?

Yes?

Turn off Heating Element

No?

Send an Error to LCD

Run Value in PID

Update duty cycle and LCD
Pseudocode

declare variables: set_temp, curr_temp, pre_temp, err, P_k, I_k, D_k,

Initialize ATD converter and PWM system

loop
  read in values for set_temp and curr_temp
  break if curr_temp exceeds set_temp by more than 10 degrees
  Perform PID equations to find values
  update duty cycle
  update LCD display
Timing Diagram
Circuit

- PT5
- PT4
- PT3
- PT2
- PT1
- PT0

LCD

AN02

25k POTENTIOMETER

AN01

thermistor

V1

5V
Questions