Monitor and Control of Temperature in a Closed Environment

Software Design Document

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November 4th, 2015

Table of Contents

1) **Program Outline**

a) *Purpose*

This software design document defines the application, hierarchical structure, and usability of monitoring and controlling the temperature inside a given environment.

b) *Scope*

This program is designed to control and maintain a given temperature in a system by allowing the user to set the desired temperature in any of the three main scales and then walk away. The program will also allow for a custom tolerance range and will display the current temperature and plot the temperature vs time. The user also can opt to have the temperature and time data output to a data file.

c) *Useful Definitions*

User interface: The set of controls and indicators present on the computer monitor which the user inputs and monitors their desired set temperature and current temperature.

Thermistor: A resistor whose resistance is variable with temperature surrounding it.

2) **Program Overview**

The program works in two different ways for the two different aspects, monitoring and controlling the temperature.

In order for the software to monitor and provide feedback on the current state of the system a thermistor is placed inside of the desired area and connected to a constant voltage or current. Since the thermistor's resistance is variable with temperature it can be calibrated so that we know the resistance at certain temperatures we can then use the change is resistance to measure change in temperature. This change will be measured by measuring the change in voltage or current depending on which was originally supplied as a constant.

The other important aspect is the control of temperature in the system. Once enabled by the detection of a difference between the real world temperature and the desired temperature the program will output an on/off command to the thermal electric cooler to either heat up, or cool down. The module will then be disabled as the temperature measured is equal to the desired.

3) **Program Structures**

  a) *Hierarchy and Sub Structures*

  The initial step in the program is the user interface input. This is where the user will input their desired temperature, be it static or varying, in their desired scale which will be available in 3 options, Fahrenheit, Celsius, and Kelvin. On the back end the necessary conversions will be made to the desired scale to allow input to the temperature control. A value of tolerance can be input if constant corrections are not necessary. Finally the user can decide whether or not to record the temperature data and output to a desired file name.

  The second step in the system is to monitor and output the current temperature readings. This step will simply measure temperature and convert it to the scale selected in the initial step and then display the current value and the graph of temperatures recorded up until that point.

  The final step is to alter the temperature. This is done by taking the temperature reading from step two and will either heat up or cool down depending on if the current value is above or below the desired temperature. If an acceptable threshold was selected on the user interface in step one then the temperature will not be corrected until it falls outside the plus or minus value at which point the temperature will be changed until the desired temperature is achieved and then the manipulation will cease until it falls outside of the range again.

  b) *Structure Motivation*

  The structure outlined above was chosen out of necessity. In order to control an object the current state and desired state must first be known so the control module must come last. The first and second steps would be interchangeable if it weren't for the inclusion of the user's option to save and output the results of the temperature measurements and to change between scales. Since this option is included then necessarily the user's input must come before the measurement. Hence the structure outlined above is determined.

4) **User Interface**

The User interface has many features which first and foremost are the controls for desired temperature, scale, and whether to output the data or not. Along with start and stop buttons. Since the program is useless without these initial inputs they are placed prominently as the first items on the left hand side.

(Insert picture of user interface with controls circled)

It is of note that should the user wish to only monitor temperatures but not influence them that the program can be manipulated by intelligent selection of both the desired temperature and tolerance controls. If the desired temperature is set to a reasonable value for the system and the tolerance is set to a very large value such that variation in actual temperature would never approach it, then the control module will never engage.

If the user has opted to record and output the measured temperatures to a data file then the next aspect the user will see is the file name and location window. Once a name has been input and location selected close the window.

(Insert picture of save as window)

The final aspects the user will notice are the current temperature value display and the plot of values for the temperature since the program was initiated.

(Insert picture of user interface with output temperature value and graph circled)