Temperature flow - Visualization Project

The required task is to visualize the temperature change inside a room. The application allows the user to build the room structure by clicking on the room area (panel/simpleOpenGlControl) such that each click change the clicked cell into one of the following cell types:

- *Normal Cell*
  This cell represents default cell room with temperature of Tr. The temperature of this kind of cells is modified, over time, by averaging the temperatures of the rounding cells together with its own temperature.
- *Air Conditioner Cell*
  This cell represents an air conditioner that has a permanent temperature of Tc. The temperature of this kind of cells does not change over time.
- *Heater Cell*
  This cell represents a heater that has a permanent temperature of Th. The temperature of this kind of cells does not change over time.
- *Block Cell*
  This cell represents a wall that is heat-proof. The temperature of this kind of cells neither changes over time nor affect the surrounding cells.
- *Window Cell*
  This cell represents a window that has a temperature of Tw. The temperature of this kind of cells does not change over time but affects the surrounding cells over time. This cell shall have a border (or any other mark) to differentiate it from *Normal Cell*.

Cells Type Shortcuts:

Tr: Temperature of the Room. Same value of the color key average value
Tc: Temperature of the Air Conditioner. Same value of the color key minimum value
Th: Temperature of the Heater. Same value of the color key maximum value
Tw: Temperature of the Window. Same value of the color key average value

Project video here.

Required Inputs:

1. Cell edge length in pixels, Ex: 30
2. Min and Max Temperature, Ex: 0, 100.
3. Number of parallel Threads, Ex: 5.
4. Radio-button for Sequential or C++ or C# for parallelization

Required Functionality:

1. *Update the room with the new cell size*
   When updating to a new edge length, this shall re-initialize the room to the initial values and with the new cell size. Small cell size means more cells and large cell size means small number of cells in the room.

2. *Start/Stop visualization*
   Allows to start/stop the visualization of the temperature flow.

3. *Change the min and/or max value*
   Changes the colorkey scale. The room shall be re-initialized with the new average value.

4. *Start Visualization*
   Each cell is updated each iteration (can use timer with a tick each 10ms or let the user select the tick time) by averaging the values of the surrounded cells together with the cell value. While computing the average, you shall not use the new values of the surrounding cells for the same iteration.

Grades (out of 100):

- ***Grade: 10.*** Ability to draw all types of cells in the panel, with each having a different color (Note that the window cell must be different from the normal cell i.e. have a black border or inner rectangle/circle).
- ***Grade: 20.*** Sequential visualization of the flow of temperature
- ***Grade: 20.*** Parallel visualization of the flow of temperature using c++. (i.e.parallelism of the computations)
- ***Grade: 5.*** Parallel visualization of the flow of temperature using c#. (i.e.parallelism of the computations).
- ***Grade: 5.*** Selecting the number of threads for parallelization. (applicable for both c++ and C# parallelization modes).
- ***Grade: 10.*** Ability to draw while the applications is running.
- ***Grade: 10.*** Start/Stop visualization.
- ***Grade: 10.*** Update cell size.
- ***Grade: 10.*** Change Min/Max values of the color key. (Note: color key **must** be a user control)

Bonus Ideas:

- **Grade: 40.** When changing the cell size, you have the ability to spread the color of each cell to the new generated cells. i.e. change cell size from 40 to 20 shall spread the value of each cell to the new generated 4 cells. Thus the room state will keep the same and not re-initialized. The same when changing cell size from 20 to 40, each cell will be the average of the 4 cells constructing the new cell. Average is not the case when there is a any known cell type (Heater, Air Conditioner, Block, Window) in these 4 cells, rather, the new cell will be the same as the known cell type, and if there is many, use the following priority to update: (Heater, Air Conditioner, Window, Block)

- **Grade: 15.** Changing the color key Min, Max values will not re-initialize the room, but will transform each cell value to match to the new min and max interval.

- **Grade: 10.** Allows user to define a new type of cells {cell name, cell value} and use any of these user-defined cells in the visualization process. (Note this user defined cell will not change but affect surrounding cells, similar to heater source).

- **Grade: 5.** Clicking on any cell shows a *hint message* at the mouse location with its value.

- **Grade: 5.** Add Colors in the Color key at runtime.

- Any other bonus effort is more than welcome, and its grade will be evaluated when discussed. The bonus will only be given on any extra effort additional to the mentioned points.

Happy Visualization SC'ians
Best Wishes :)