Group 23
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Project Plan HCI & IV

1. Research question and motivation.

Converting Images to Temperature: ‘How can an image be expressed through sensation and perception of temperature, and can it be used as a new way to convey information?’

Temperature is something that is always present, you can constantly feel it, however in most cases it is almost never used as a way to convey information (outside of natural cases). Converting a painting in thermographic sensory could be seen as a new interaction, as the temperature is an unconventional and unused way of displaying art. The addition of temperature as a way of displaying or conveying something is to our knowledge a relatively unexplored area. This is an opportunity for a new interaction and the main motivation behind our project.

2. Description of interface design

As an input images or art pieces will be loaded in by live camera feed or preloaded in Unity. These images will then be converted into a lower resolution (see image 2), grayscale variant, lighter or brighter areas will be indicated as warmer, while darker areas are cooler. On a screen you will see this transformation but you will not interact with it. The interaction lies in the board of 36 by 36 grid of Peltier elements that will serve as a method of displaying images in a grid of temperature, instead of just visible light. Being something that you can actually feel instead of just seeing. Users will be able to choose between preloading images or load an image via a webcam.

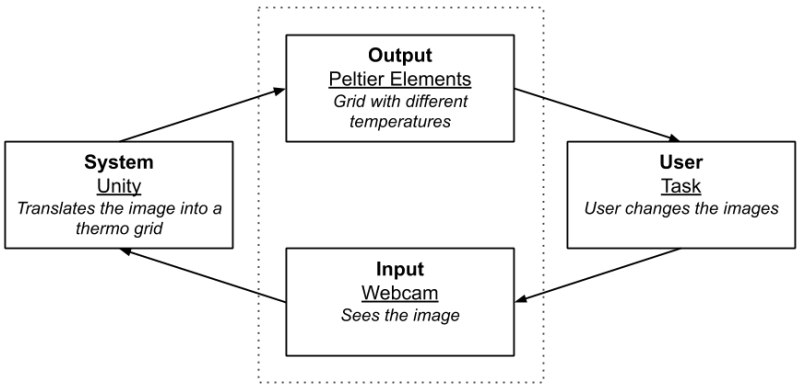


Image 1. Abowd & Beale interaction Framework

3. Low-profile functional design

Using so-called Peltier elements, it is possible to convert images such as paintings into something that you can feel. Peltier elements are small plates that are able to manipulate their surface temperature via different voltages. The temperature of the Peltier elements can be adjusted with Arduino PCBs, with the PCBs being controlled by Unity. This allows a grid of Peltier elements to “display” an image in heat.

3.1. Software

Unity is a viable platform to use in this case. When getting the input from, for example, a camera it will first grayscale it to a black & white image to highlight the lighter parts from the darker parts. This will then be converted into a temperature color map, where red is the lighter spectrum and blue is the darker spectrum, visualizing the colors. Finally, the image is downsized according to the size of the Peltier grid, where we are using the mean of an area to determine the value of each pixel. Each pixel in the final image would then correspond to the temperature a single Peltier element would have. Unity would then interpret this image and output the corresponding information needed.

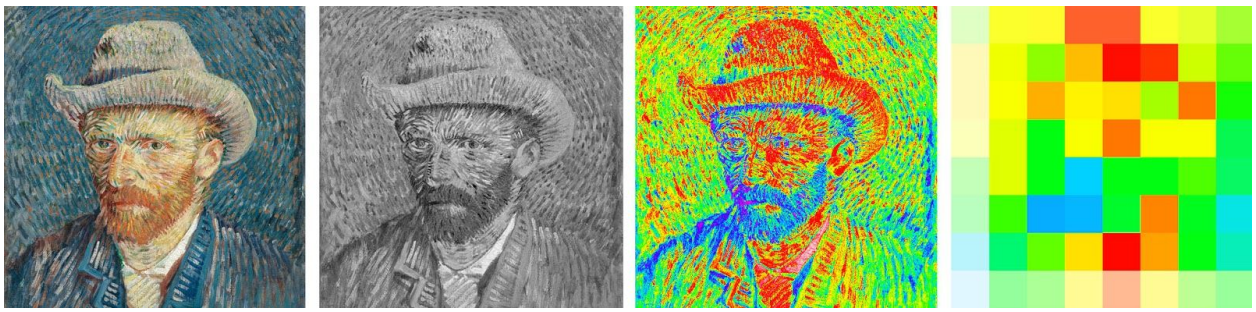


Image 2. Example of how Unity will interpret the image and convert it to a grid

3.2. Hardware

There is a lot of hardware involved in this part. As previously mentioned Peltier elements are used as an output. Unity will be used to communicate data to a set of Arduinos, which control groups of Peltier elements. Note that to make the effect and difference of these elements better, one side of the elements should be cooled. Water cooling similar to cooling a CPU is preferred. Additional hardware such as a high-wattage power supply and a webcam for the live feed.

The following flowchart (image 3) shows how this would be setup:

Hardware Overview

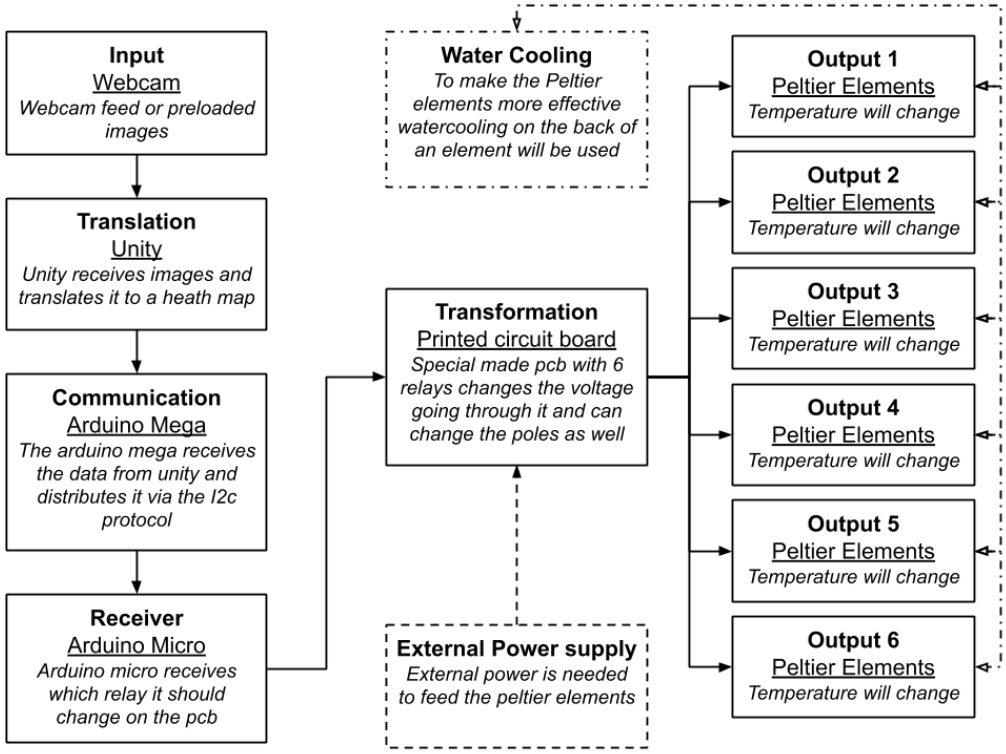
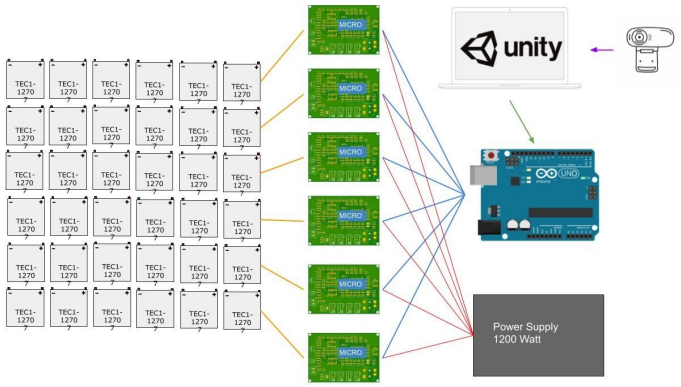


Image 3. Overview of how the I/O and communication will be for each step



Parts:

- Webcam
- PC with Unity
- 1 Arduino uno/mega
- 6 Arduino micros
- 6 PCBs with relays
- 36 TEC-12707 Peltier Elements
- Cooling elements
- 1200w power supply

Image 4. Visual overview of hardware setup

4. User group aimed at

Technically there isn't a specific user group we are aiming at, as experiencing art is a very general experience. Our user group could be defined as "Museumgoers", however it is important for us to take all kinds of users into account as our user group does not necessarily have to fill a certain niche. The user group we aim for isn't necessarily people who often go to museums, it can be any person interested at that moment in time. On paper this technology should be accessible to anyone and most people should experience this in mostly the same way.

5. Innovations aimed at

Image processing itself is not very groundbreaking, however as far as we know converting images into a temperature based grid is an unexplored area. The solutions to practical issues we run into may prove very useful should the technology be later used somewhere else.

The technology itself also has a lot of potential, it can have applications in museums for example, or allow for an alternative to braille for blind people. Image specific temperature manipulation could also have its applications in VR for example, where temperature is often not used at all.

6. Detailed time-table

Because Roman has prior experience with Peltier elements, a lot of practical aspects have already been dealt with ahead of time. Because of this, we are able to start prototyping relatively quickly, possibly ahead of schedule.

	Due Date	**Document or Product**
0	12-Oct-20	Start writing software prototype
1	16-Oct-20	Start Prototyping Hardware
2	2-Nov-20	Design Document
3	t.b.a	15 min Presentation
4	16-Nov-20	Finish first prototype
5	23-Nov-20	User Evaluation 1

6	30-Nov-20	Finish second prototype
7	7-Dec-20	User Evaluation 2
8	20-Dec-20	Hand in Concept Project Paper
9	6-Jan-21	Hand in Final Project Paper
10	7-Jan-21	Hand in Product Prototype
11		