Pan Pals

Examining The Comfort of Companionship

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ABSTRACT

We will explore the importance and physicality of companionship during isolation. Combining the use of sensors with interactive components and plush materials, we handcrafted two panda plush toys, the Pan Pals, a mid-fidelity prototype. Connectivity between disparate pen pals is a daily reality wherein Pan Pals showcases a bond between two panda plushies but also between the user and their Pan Pal.

KEYWORDS

Distance, Companionship, Comfort, Physical Prototyping, Interactive Plush

INTRODUCTION

We wanted to address the problems of isolation and disconnectedness during times of confinement and uncertainty. Therefore, we decided on creating a buddy, which you can have by your side when you need company. At first, came the concept of having a companion to bring with you wherever you want, then an interesting idea of having two of them connect to each other via Wi-Fi was suggested. But first of all, we had to address what interactions we could realize within the limitations of a plushie. The components we decided to look into were a 9DOF IMU sensor to detect the plush's movements, stroke sensors on the ears, heating pads underneath its eyes, vibration motors to imitate a purring sensation, RGB LEDs to illuminate the eyes and display different moods, and piezo speakers to make creature sounds. All of the components will be connected to a Particle Photon as its microcontroller. But most of all, we wanted our artifact to be cuddly, soft, and fluffy for maximum comfort.

METHODS

The two plush toys were hand-sewn using white fake fur, cotton fabric, conductive thread, conductive fabric, white yarn, upholstery fabric, plastic safety eyes and noses, a zipper, and a plastic lobster claw clasp (Figure 1).
On the fake fur of the plush, black thermochromic pigments were used to color the surrounding of the eyes and the ears (Figure 2).

The pigment was mixed with a transparent base for screen printing to be applied to the fake fur. After it dried, the fur was combed thoroughly to relieve it from having a sturdy, clumpy texture because of the process.
Combing through the fur was effective in making it soft and malleable again. The pigment fades from black to transparent when heated up, giving instant visual feedback when the area is pet depending on your body temperature (Figure 3).
A stroke sensor was made on the ears of the Pan Pal (Figure 4). The ears are a sandwich of non-conductive material, which consists of layers of pink cotton fabric, fake fur, and upholstery fabric. Woven into it were rows of conductive yarn alternating with rows of white yarn (non-conductive) with two strips of fabric conductive tape at the back and upholstery fabric (non-conductive) in-between (Figure 15).
The electrical components (Figure 4 to 8) include a portable battery, a Particle Photon as a microcontroller, a breadboard, a vibration motor, a piezo speaker, heating pads, RGB LEDs connected to three 1kΩ resistors, and lots of color-coded wires. It also includes an accelerometer and gyroscope that provide data which are accounted for using two different versions of similar sensors (LSM9DS0 and SEN-10724) which are capable of 9DOF (3axis Gyroscope, Accelerometer, and Compass module) and IMU (Inertial Measurement Unit).
Using a breadboard, all the components were plugged into the Particle Photon (Figure 9).
Since we used the Particle Photon as a microcontroller, to program it we decided to use Visual Studio Code with the Particle Workbench extension. We compiled the data obtained from the sensor stick and the stroke sensor and we output data onto the vibration motor to make a purring sensation and into the LED eyes to indicate the function. The heating pad activates as soon as the plush is powered to make it a warm plush to hold at all times.
To make the plush portable, we plugged a power bank into the Particle Photon, a lithium-ion battery with 5V output but ideally, we would like to use the Photon Battery Shield to connect it to a case of three AAA batteries which would significantly reduce the weight of the plush.

It took hours to craft two of the Pan Pals (Figure 16 to 19), especially because everything was hand-sewn to allow for more control and precision, and it was Melissa's first time making plushies from scratch, working with fake fur, and fabric dyeing.

Figure 1 - Plush fabrication material


Figure 2 - Fur dyeing process

Figure 3 - Thermochromic pigment response to heat

Figure 4 - Stroke sensor

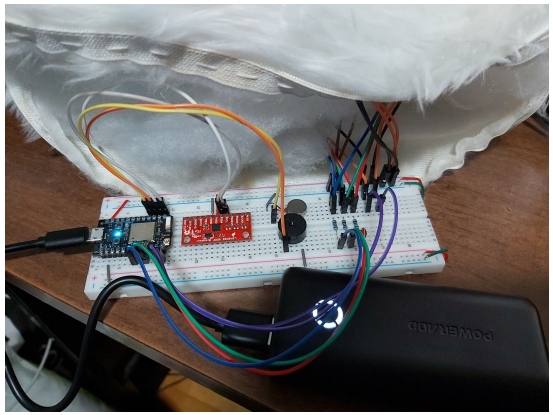

Figure 5 - Interior components of the plush (Melissa's)

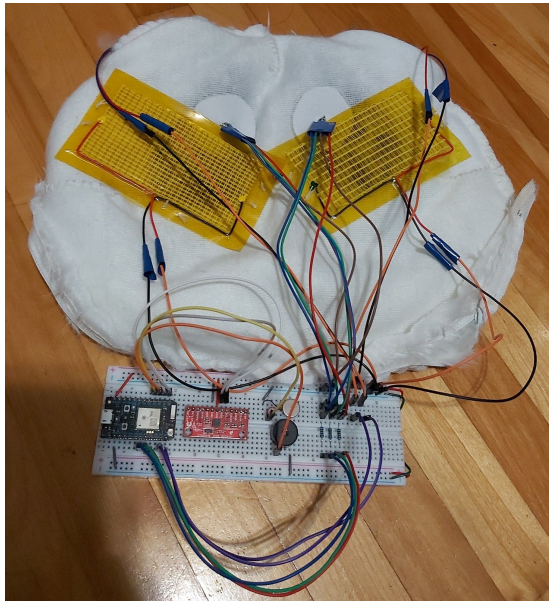

Figure 6 - Flipped inside-out plush (Melissa's)

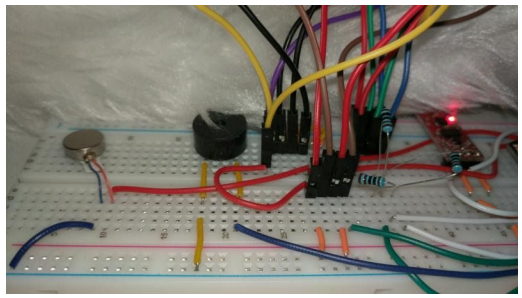

Figure 7 - In-progress wiring of particle photon with wires from the plushie (Sol's)

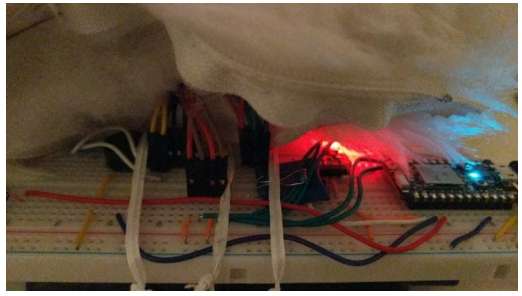

Figure 8 - Sensor stick final portable particle photon setup (Sol's)

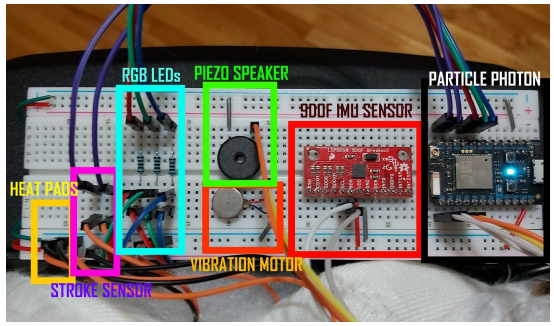

Figure 9 - Breadboard setup (Melissa's)

ITERATIONS

The proposal for this artifact was only a companion and didn't have much of a personality other than being "cute". It had a creature-bunny shape and an alarm component that we completely dropped (Figure 10 and 11). The first prototype was of low fidelity. It only showcased different parts of the plush to test components separately (Figure 12). The changes of material that has been made include the switch from white felt-like fabric to white fur and the replacement of the black rubber-like material (Figure 13) with a white upholstery fabric (Figure 14) because we figured out that rubber wasn't completely non-conductive unlike the upholstery fabric was. We also changed the conductive fabric from copper fabric to fabric adhesive tape just because the structure of the fabric felt less flimsy and the adhesive back helps to keep it in place (Figure 15). We tried to adjust the ratio of the thermochromic pigment to transparent base but it didn't make the fabric darker as we would've liked, the result stays gray instead of black. The googly eyes from the prototype were replaced by plastic safety eyes made for plush making. It had a transparent shell around the pupil which was perfect for an LED to shine through (Figure 16 and 17). The only downside to that was that the only eyes we could find were a bit too small for our liking, thus making the panda look a bit creepy. If we ever come across bigger plastic eyes we would want to replace the current ones with them.

And the last significant change made was to go from the Arduino Uno to a Particle Photon so that we can one day explore its feature of making two Particle Photons communicate via Wi-Fi. However, this decision downgraded our power output from 5 Volts to 3.3 Volts, but that doesn't affect any component's behavior except for the heat level of the heating pads. We also encountered the issue of not being able to make the heating pad work by a pin of the Particle Photon because it wouldn't output the full voltage. Therefore, since we couldn't control the activation of the pad, we decided to connect the heating pad directly to the 3.3V output and so the heating process activates as soon as the artifact is powered on. We like that idea because it would make the plush a warming heating source at all times. Furthermore, thanks to using the Particle Photon instead of the Arduino Uno, we could use Visual Studio Code as an IDE instead of the Arduino IDE which is a friendlier development tool.

In our final artifact, the LED eyes light up blue when the Pan Pal has been moved and green when the stroke sensors are activated but since they are RGB LEDs, many more color combinations could be used as well. And as per our initial pitch, the vibration motor activates a purring sensation when the stroke sensor is activated as well. We also kept one of our initial ideas of adding a clasp at the top to allow people to carry the plush wherever they wanted.

After going through those iterations, the Pan Pals now feel like they have found their purpose and identity. The changes that have been made were necessary for going further ahead with our ideas.

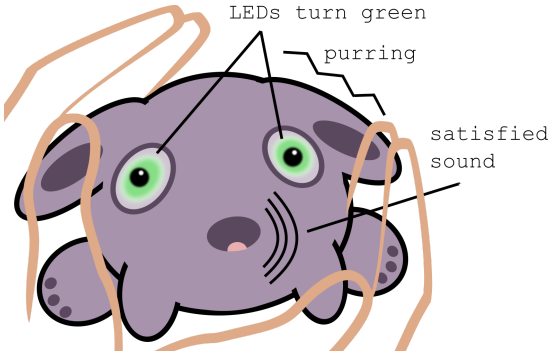

Figure 10 - Artifact design proposal illustration

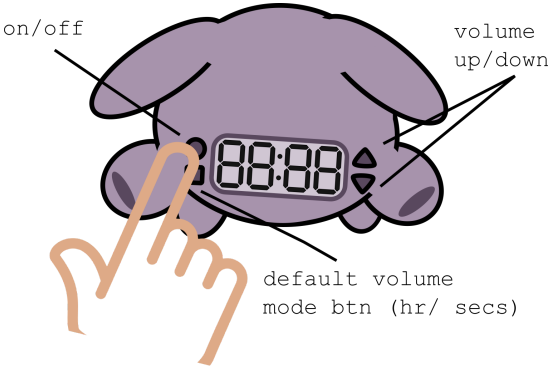

Figure 11 - Artifact alarm component that was dropped

Figure 12 - First Pan Pal low-fidelity prototype

Figure 13 - Behind the scenes of the stroke sensor in the prototype

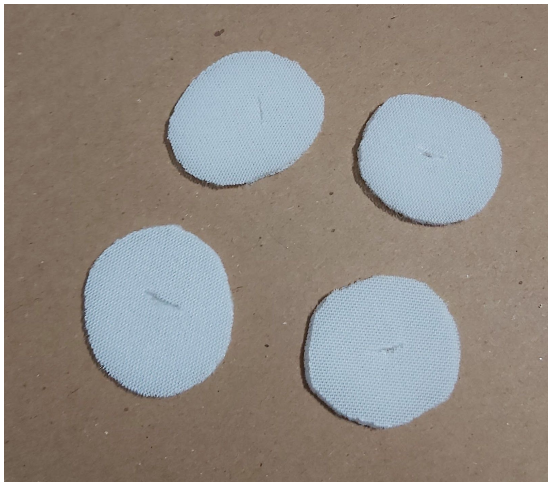

Figure 14 - Upholstery fabric cut-out for the ears and eyes

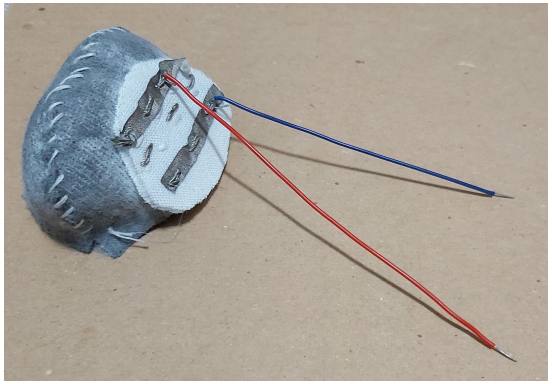

Figure 15 - Behind the scenes of the stroke sensor in the artifact

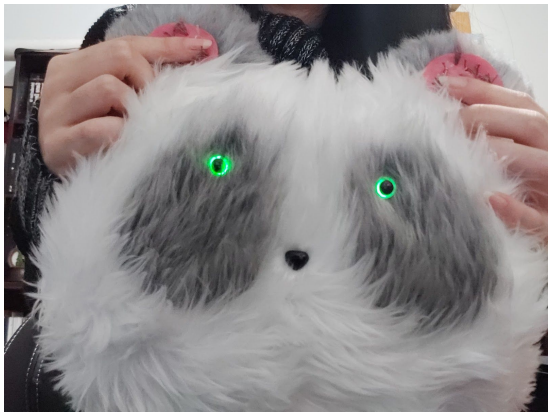

Figure 16 - Green LED when a stroke sensor is activated (Melissa's)

Figure 17 - Blue LED when 9dof sensor stick detects movement (Melissa's)

Figure 18 - Final Artifact: stuffed panda plush (Sol's)

Figure 19 - Final Artifact: stuffed panda plush (Melissa's)

SCENARIOS

A companion to a Pan Pal, which in this case is us, is able to try different things to make their Pan Pal react. The heating pads under the black fur of the eyes are on while your companion is running, which you can feel a bit through the fur. This feels a bit uncanny in that it is a warm furry thing. Without our foresight or knowledge of working with microcontrollers, this is uncanny in that it feels quite life-like.

Firstly, one can interact with the stroke sensor and pet its ears which will set off a purring effect generated by a vibration motor.

Also, you are able to move around the Pan Pal and see when it notices you, this is taking into account the sensor stick that was used to measure acceleration and rotation. Taking a large difference in the pitch, roll, and yaw, the eyes will light up as if it notices you when you move it around a bit.

FINDINGS

Pan Pals underline a more whimsical nature to ascribed relationships that we have to certain objects. It allows us to appreciate this artifact and become attached to it without working hard for it. The grooming and brushing of the ear threads and the rest of the fur are almost ritualistic and is reminiscent of caring for a live animal.

DISCUSSION

The concept and result are nostalgic of a plushie of a dog that each of Sol's classmates would have to journal about in his 2nd grade class which was cycled through each week. The plush's name was "Homer" and you took him home... he gained quite the reputation and people would love to spend time with him and wash him, feed him or take him places. There were also a few generations required since it was easy for him to go missing from time-to-time, maybe some of his caretakers got over-attached.

It was definitely a challenge to work as a team on the same tangible media project over the internet. We had only met twice to exchange components for the prototype and the artifact. But by separating our tasks efficiently, we were able to organize ourselves to be able to work on our own parts without affecting the other too much. Another challenge was dealing with shipping delays (the reason we couldn't implement the Photon Battery Shield in time for the Artifact and the Particle Photon for the prototype). However, by working together on this project remotely, it made us realize that the Pan Pals were quite relevant in our situation as well. It made us talk more and learn about each other, which we, unfortunately, haven't taken the time to do before. It was quite eye-opening.

CONCLUSION

It was quite an adventure, all the way from the proposal to the final artifact. A lot of push backs made it so some functionalities had to be put on hold for the time being such as the online feature and the speaker sounds. Time management and constraints were difficult to deal with during this entirely online semester. But overall, the whole process was a good learning experience. Working on tangible media manipulations without a studio was a challenge, but even if the online lectures felt disconnected, the process we had making the artifact didn't. The hands-on experience made us learn how to manipulate circuits and bring the things we had imagined into reality.

REFERENCES

9DOF IMU Sensors libraries used:
https://github.com/sparkfun/LSM9DS0_Breakout/tree/V_H1.0_L1.0.1
https://github.com/alrevuelta/SEN10724

INSPIRATION PHOTOS