Twinkle Stare

An IoT device that reconnects me in New York and my dog in Taiwan to be able to feel her presence and recreate a moment we share together.

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Table of Contents

1. Preface

Our lives are comprised of relationships, whether it is your loved ones and friends or acquaintances at work or school. Everyday, we experience and deal with these relationships through social interactions with different people in life. While what we often talk about is that people build strong relationships with one another, it's also very common to see people grow close bonds with animals, particularly dogs. In fact, dogs have gained the title of being "man's best friend". Research has shown to have various physical, emotional, and social benefits of having a furry friend at home. Some of them include reducing everyday stress, decreasing blood pressure, lifting moods/letting people feel less lonely, and giving a sense of closeness and well-being (Alexandra Gekas).

2. Introduction

2.1 Domain Design Question & Main Argument

I have been around and owned a dog all my life since elementary school. In my opinion, dogs are some of the most healing and comforting animals in this world and have helped me gotten through some of the toughest times in my life. Last year, enrolling in graduate school in the United States meant a long-distance relationship with my family, as well as my dog. Long-distance communication with my family has been something I've gotten used to since high school because my parent spent a few years working in China while I went to school in Taiwan. However, long-distance with a sick family member is different, harder, and much more unbearable. This sick family member is my dog, Xing Xing, who was diagnosed with bladder cancer two years ago. This whole process was hard for our family because the tumor was malignant and would spread

and be unable to contain someday. With original intentions of bringing Xing Xing with me in New York while I study in Parsons, her sickness made this impossible.

2.2 Design Question & Main Argument

After coming to New York to study and leaving Xing Xing behind with my parents, I've always wished that I could somehow spend more time with her, if not actually be able to be there to take care of her. I wondered, how do I spend more time with her remaining days over long-distance? How do I recreate a moment with Xing Xing over long-distance to constantly remind me and feel that she is with me? With the convenience of internet and real-time devices such as webcams, I believe that an Internet of Things device would be able to help connect my dog Xing Xing and I. I would be able to feel her presence over the distance from New York to Taiwan and spend time with her.

3. Research

3.1 Precedents

There have been countless IoT project and devices built for long-distance relationships for people but much less for dogs. This is because of the difference in how our sensory systems are built. Dogs have poor eyesight and are colorblind but have excellent hearing and olfactory system. Dogs can hear 4 times further away and twice as high pitched as humans can. A dog's brain is 1/10 the size of humans but the part that controls smell is 40 times larger. They have 300 million olfactory receptors in their noses, compared to about six million in ours. As a result, dogs sense the world very differently than we do. It's not easy for them to feel our presence without us being physically there. With a lot of IoT projects, it's about creating presence over long-distance and for both ends to be able to feel that presence in order for it to be meaningful. Many IoT devices built for dogs are often just tracking devices that are put

onto dogs to track their health, location, or emotions. Others like Furbo is a camera treat-giving device which keeps your dog's company with tossing treats to your dogs. Again, your dog is unable to sense that it is you who is giving the treat and instead regards the device as something pleasant which continuously tosses treats. This device then becomes a tool that keeps your dog busy and less lonely when it waits for you at home. Because of this difference with dog's sensory system, there appear to be able many constraints when designing an IoT device between me and my dong Xing Xing. This means that this device will most likely be solely for me to feel her presence while I send back a reaction over long-distance without her actually knowing that it is from me. Nonetheless, the following are the projects built for people which I was inspired by in creating my device for me and my dog.

There have been many projects and devices built for long-distance relationships, especially couples. One of my favorite inspirations I have found is a device called Pillow Talk by Little Riot in 2015 for long-distance couples in which you can listen to your loved one's heart-beat when you sleep. The device has two parts. One speaker goes under your pillow to hear the heartbeat of your loved one and a wristband you wear to measure your heartbeat to send over to your loved one. The psychical presence aspect of this IoT device is particularly strong and is one aspect that I want to try to incorporate into my own device with my dog.

Another inspiration of mine is the series of devices called Personal Innovation Act, Analog Innovation, by SoftBank, a telecommunication company from Japan. Softbank created a series of prototypes for elders that do not know how to use smartphones, giving them a simulated experience of a world realized by smartphones. One device was a social media generated newspaper that prints new information in

their mailbox every morning. The grandma who is unable to use a smartphone to stay up to date on the news of her family now is able to know what their grandsons and granddaughters are doing. Another device is a real-time laser printer that is built onto one of the wooden poles situated inside of the grandma and grandpa's house where it would laser print the newest updated height of their grandsons and granddaughters. The parents can just input the newest height into an app that will automatically connect to the laser printer that would print when new height is inputted. The third device is a video sharing cloud that you can upload through an app on the phone and it would generate a QR code that is then stuck onto a video tape that can be scanned when put into the video player to open up the videos for the elders to watch. All three of these devices help not only to connect loved ones from far away but they also add quality time and minimize the technology gap between the older generation with the younger generation. With my dog Xing Xing, there seems to be an even bigger gap between the two of us as it is harder for me to communicate with her over technology. How am I able to spend more time with her and know more news and updates about her? Before thinking further, I conducted more research and analyzation studying my dog Xing Xing.

3.2 Analyzation of the Behavior of my Dog

My dog Xing Xing is 11 years old, a Shetland Sheepdog breed with black and white long-coated fur, who is shy, sensitive, and needy. She is more sensitive to sounds compared to most other dogs. As a result, I often play relaxing and soothing music for her when she keeps getting distracted with different sounds, for example, on nights with thunder or fireworks. She also is also a vocal dog and will bark when she hears a sound. Xing Xing constantly needs me to be around in her sight and follows me around everywhere in the house. There are many meaningful interactions we share together. One particular habit is that she loves to lay on her doll to rest her head while watching me. Somehow, instead of playing catch-and-throw with the dolls I bought for her, she

likes to use them as her pillow. With his habit of hers, it gave me the inspiration to incorporate this action of her into the concept of my IoT device with her.

4. Concept Proposal

Knowing from the start that I wanted to create an IoT device that reconnects me in New York and my dog in Taiwan, after research and different sources of inspirations, I want to create a device that will be able to feel my dog's presence and recreate a moment we share together. To do this, I decided to take the particular action of her always lying her head on her doll and making that as the trigger to connecting to New York. Thus, as Xing Xing lies her head or body on her doll, the doll will have a pressure sensor inside the cotton, which will activate the doll model of my dog to look at me which sits in front of my desk. The dog model will have a camera that inside the doll which will detect my face and will, in turn, move its head around as I move around. When I feel uneasy of this stare, I can deactivate the camera by patting its head, which will have any pressure sensor inside. This will turn off the camera and stop the face tracking by the camera. I can then press a button to turn on my dog's favorite soothing music. In this way, whenever my dog is resting, lying on the dolls, I will be able to know that by the model of the camera which will track me which is as if she is looking at me as she always does back home when we are in Taiwan. I can also choose to turn on the music that soothes her the most when she is resting.

5. Process

5.1 Prototyping - Technical + IoT Framework

After confirming my concept, I begin to think about the technical aspects of my project. My device's interaction has two parts with different interactions. One part will be my dog's end with her doll embedded with a pressure sensor on which she will lay on it

and a speaker. The other part is the model of my dog in my room in New York which will have a face tracking camera, a button, and a pressure sensor built into it. As I began searching online for the details of how to make these interactions work, I was also introduced to two tools that could help with the long distance IoT connection to work. One tool is the MESH sensors which consists of 7 block sensors which each has a built-in function such as tilt, led, button, motion, and more functions to make prototyping and building project easy for the Internet of Things. The other is the IFTTT the free web-based service to create chains of simple conditional statements, called applets, to connect with different applications and services over the internet. Both tools are extremely helpful for my IoT device, however, I want to make all my interactions work properly first offline. First of all, I decided to figure out how to get the face detection to work on camera. I used an Arduino controlling to a servo motor and connecting the servo motor to the OpenCV face detection on a program called Processing to track faces when it moves from left to right on the screen. Thankfully, I spent a few days studying the open source code example online and made face tracking work with no problem. Next was to get the pressure sensor connected to a trigger to open the face tracking camera to start tracking face detected when it is pressed. This was a part where I was stumped and frustrated because I could not get the code to work with my own ability. With some help from my peers, I was able to get the pressure sensors to work to open up the camera to start face tracking when it is pressed and another pressure sensor to turn in off. However, there was another one problem I encountered with my code which was that it can only be run once. If I want to try to press the pressure sensor to turn it on again, the sensor cannot read my pressures values anymore. I would have to rerun both the Arduino and Processing sketch for it to work again. After some debugging, I discovered that it was part of the Arduino code that made the instructions appeared to be stuck in a loop. After modifying my code, my code

was working fine, though, at times unstable, I decided that with the time I had, I would not make the IoT connection happen but just focus on the interactions and the physical doll of my device. My whole framework to make this IoT device work is displayed in the diagram below. What I'm focusing on is the interactions on the left. Ideally, I would incorporate this with the MESH sensors and by using the IFTTT webhooks service to send to communicate with my MESH sketch (Diagram 1.0. IoT Overall Framework).

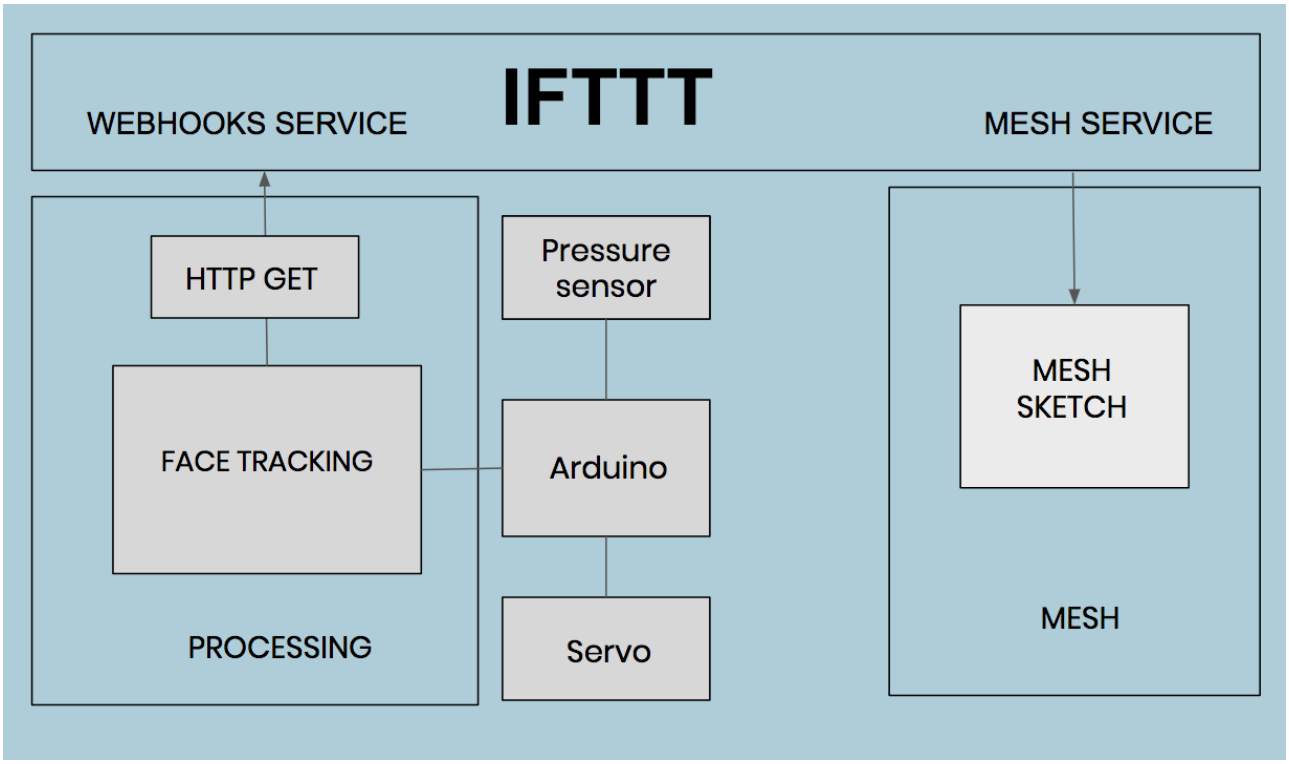

Diagram 1.0. IoT Overall Framework

5.2 Prototyping - Physical

After making the technical part of my device work, I decided to quickly move on to the physical enclosure. The physical enclosure of my device consists of two parts. One is the doll that my dog will lay on and the other is the model doll that sits in front of my desk. I completely underestimated how hard it is to put anything physical together, even if it is something cute and furry such as a doll. Somehow, the thought of making a doll to me seems simple to me. Not until I started a few tries with making a doll did I realize that I have a lot of practice to do. I thought of taking apart an actual doll but I

also wanted my doll to be customizable so I decided to make one myself. To start off, I used fluffy socks as my main material and stuffed it with polyester fiberfill. I made a koala doll as the doll that my dog lays on. This was easier to make as it is such a small doll with no body. Then, I moved on making the model doll of my dog. With my limited experience, it was hard to me to make a model of the dog that looks exactly like my dog. One of my first versions of my doll was unable to stand up properly so I had to make a stand stuck onto an acrylic board and put it inside the doll so the model doll could stand by itself by itself. I then glued the servo onto the board and cover it with polyester fiberfill and put the sock fabric for the model's head over it to make the model's head. After getting the body to sit properly on a flat surface, I moved onto making the head. I put a web camera into the head and cut a small hole for the web camera to be able to peak out through the sock fabric. The web camera, however, did not work well hiding inside. One problem is that the web camera is very sensitive to the lighting, the distance, and the height of where you stand. When testing with the web camera inside the head of the doll model, the camera had a hard time detecting face and would jump from different shadows in the screen which causes spasm of quick movements. Another factor that was contributing to this unstable web camera screen was the fur from the sock material I used. This seemed to disrupt the clarity of the screen with a few furs sticking out along the side of the hole I cut. Therefore, I made a hard decision to connect my device to my computer's camera to ensure the most stable and accurate face tracking. In the end, I was able to put together a functional model doll of my dog. The face tracking camera can be triggered by another doll when you press on it (when my dog lays on it) and you can turn it off by pressing on the model's head. You can also press a button which is using one of the MESH button sensors that will turn on music which will play in the speaker inside the doll.

6. Evaluation

6.1 Criteria for Evaluation

In evaluating the quality of my project, I gave an overall of 50% satisfaction. I broke the criteria into 4 parts: the aesthetics, interactions, main concept, and functionality. Out of the 4 parts, I was most satisfied with the concept of my device. I felt that the concept works and really does set out what it does, which is to remind me of my dog's presence and a moment we share together. I was mildly satisfied with the interactions. Although when testing technically, all of my interactions worked. When it is combined with my doll physically, the pressure sensor turned out to be not as sensitive inside the polyester cotton fills. As a result, you have to press really hard for the pressure sensor to work. Next, I was the most unsatisfied with the aesthetics and the functionality of my project. The aesthetic of my doll was not what I have imagined. I wish it looked more like my actual doll but for the given time I had, I decided to go with what I made with the socks material. Even though the IoT functionality of my project was one I did not try to explore and implement, since my project relies heavily on this long-distance IoT aspect, not having this part work was also something I regretted.

6.2 Reflection

Looking back, having a strong concept, one that I really love was really one of the biggest motivation that pushes me forward in continuing making this work. However, in my opinion, there are some decisions that I wish I made differently during my process. One of them was that when the camera did not work inside my doll's head and I decided to use my computer to track faces, maybe I should have just used an existing dog doll because all I needed was a head and a body. I did not need to customize the head anymore. The aesthetic of my device would have been more similar looking to my dog. Furthermore, I wish that I could have prototyped faster and tried the physical part of it

earlier in my prototyping process. Then, I could have greatly improved the aesthetics of my doll model.

6.3 Next Steps

My next steps for this IoT project of mine is to make the framework work over wifi. I also hope to improve the aesthetic of my model doll to make it wireless and more similar looking to my actual dog. I would also want to test out different materials that could make my pressure sensor more sensitive when put inside my model doll or explore different sensors that are more suitable for detecting pressure. Overall, there are still many aspects of improvement of my IoT device that will continue to work on in the future.

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