PIKA POWER

ENGINEERING 10
DE ANZA COLLEGE

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Abstract

The effects of social distancing protocols due to the COVID-19 pandemic has led to an increase in mental health issues and depression. By choosing to utilize a stuffed Pikachu, we were able to harness our imagination, and help our users meet love and belonging needs as outlined by Maslow's Hierarchy of Needs. Making our Pikachu doll come to life involved using the Arduino Electronics Set in conjunction with the stuffed Pikachu doll**.** By utilizing a series of cleverly designed outputs – sound, lighting, and movement, our project was successful in humanizing a cartoon character, hopefully providing a ray of sunshine in a dark time.

Problem & Solution

Pika Power addresses the problem caused my COVID-19 - lack of human interaction. To prevent the spread of COVID-19, social distancing protocols were implemented by both the federal and local governments; citizens were required to stay at home most of the time. As such, human interaction has decreased in a major way. There have been findings that this decrease has a negative impact on adolescences ages between 10 to 24 years old. For example, adolescences are three times more prone to have a depression during this period of crisis. Once our team identified this issue, research was conducted and found scientific studies detailing the idea that owning a stuffed animal or a toy could potentially provide a feeling of love and belonging, which connects to decreasing negative mental health. Thusly, our group decided to make an interactive stuffed animal with the sole purpose of helping adolescents cope with the lack of social interaction due to the effects of COVID-19.

Introduction

In today's digital world, Pokémon is a constant presence in our lives. Whether it be on our mobile devices with Pokémon Go, our console games involved with Pokémon creatures and adventures, or even our physical Pokémon plushie companions, Pokémon exists.

Given the time constraints of a short 2020 Summer quarter at De Anza College, which is also impacted by the effects of Covid-19, our research group chose an engineering project that we believed to be both simple, but intellectually challenging. Hoping to capitalize on the current popular trend of decorative light-emitting diode (LED) lighting strips and design, our research group sought a project that utilized some sort of LED lighting pattern. While brainstorming, our research group talked about personal traits, hobbies, and enjoyments that might be applicable to our project. As such, we happily found many similarities – the primary one being our heritage. Though all of us hail from different ethnicities, we can all lay claim to being first-generation Asian Americans. As an Asian American growing up in a diverse community, Japanese culture of all sorts brought us together as children. This Japanese culture ranged from Japanese movies and music, Japanese comics, Japanese games, and Japanese food. Pokémon served as a conglomerate of all this Japanese culture – it was a scheme for our imagination as children.

With this commonality in mind, our group consequently chose to work with the most popular Pokémon, Pikachu. By adding an LED light pattern to the Pikachu doll, movement to its ears and tail, as well as a loveable squeak, our engineering group believes that this doll will bring continued happiness to millions worldwide.

Human Factor

With recent current events, strong mental health has become extremely important – it allows individuals from varying socioeconomic classes and walks of life to weather their own challenges, trials, and tribulations. Part of achieving strong mental health involves acknowledging and meeting Maslow's Hierarchy of Needs, which include physiological needs, safety needs, love and belonging needs, esteem needs, and self-actualization needs. While a simple doll cannot provide self-actualization or esteem needs, it can provide love and belonging needs of sorts to its user companion. These love and belonging needs include friendship, intimacy, and a sense of connection.

Dr. Kevin Tseng of the Ministry of Science and Technology in Taiwan found that introduction of play toys (dolls) seemed to "increase the degree of interaction between autistic children and their peers" (Tseng). Another study by Dr. Jiska Cohen-Mansfield from the University of Tel Aviv found that a different age group, seniors with dementia, demonstrated increased positive social interactions upon interactions with dolls that provided human interaction.

The Pika Power doll attempts to reach out to all age groups to help satisfy its users love and belonging needs. The multiple outputs – voice communication, soothing and attractive LED lighting, and interactive movement – bring a human element in to play. This method of providing companionship can perhaps serve as a medical device that works in hospitals.

Based on this research, the Pika Power project aims to provide an interactive and fulfilling toy for people of all ages and needs. It can respond to different actions through the usage of buttons, a tilt sensor and remote control to provide entertainment and value to the user.

Depending on the trigger the plush will respond with different reactions, a compilation of moving motors, emitting a unique sound and a lighting up of LED's inside the Pikachu doll. This is done through the use of several Arduino kits to complete a fully interactive toy.

Project Theory

The "Pika Power" project will feature three types of inputs, four different outputs, and an extensive coding design for customization. The colorful doll will serve as an exterior shell for the internal CPU, the Arduino kit.

Inputs

Inputs for the "Pika Power" Project will include three push buttons, a tilt sensor, and a remote control-- all input materials will be provided by the Arduino kit.

Push Buttons

The push button inputs will be physically located in right and left paws of the Pikachu doll. The right button will symbolize a happy Pikachu, while the left button will symbolize an angry Pikachu.

Tilt Sensor

The tilt sensor will be located in the main body of the doll. This input will symbolize an annoyed or bothered Pikachu.

Remote Control

The remote control will allow the user to utilize the Pikachu doll in a "no-contact" state and will be able to control which type of RGB LED lightning pattern Pikachu will emit through buttons 1, 2, and 3 on the remote control.

Outputs

The “Pika Power” project will feature three outputs: RGB lighting patterns, a servo motor moving the doll, and a speaker system exhibiting the doll’s vocal expression. These three outputs will provide a “human feeling” appeal to its users through a different pattern of each element. To convey different pattern, we will code using the Arduino IDE Software.

RGB Lighting

The LED feature would be displayed on the Pikachu doll’s cheeks and tail in two different colors: yellow and red.

Pushing the Right Button:

For a happy reaction: the RBG LED from the cheeks and tail will slowly blink yellow at the same time.

Pushing the Left Button:

For an angry reaction: the pattern of the RBG will be a fast red-red-yellow blink. The cheeks will blink red twice, then following a yellow blink from the tail.

Initiating the Tilt Sensor by moving the Pikachu doll:

For a bothered reaction: the pattern of the RBG will be a fast red-red-yellow blink. The cheeks will blink red twice, then following a yellow blink from the tail.

Using the Remote Control:

Three buttons will be used to emit different patterns of RGB LED on the on the Pikachu.

Button 1: A moving lightning effect across the Pikachu’s tail as if it is covered in lightning.

Button 2: A lightning effect around the Pikachu's cheeks as if it is charging up energy.

Button 3: A rainbow lightning effect around the Pikachu's tail.

Servo Motor Movement

Our vision for servo motor placement will be the ears and the tail of the Pikachu doll. From an outside perspective, the ears will wriggle from side to side, with a movement angle of less than 90°. In addition, a servo motor will also be placed in the base of the doll's tail, allowing for tail movement in a horizontal fashion.

Pushing the Right Button:

For a happy reaction: the ears will shake together in a normal speed.

Pushing the Left Button:

For an angry reaction: the ears and tail will shake together in an aggressive manner.

Initiating the Tilt Sensor by moving the Pikachu doll:

For a bothered reaction: the ears will shake together in an aggressive manner.

Speaker System

The Pikachu doll should evoke a sound to its users that exhibits an emotional feeling. The speaker system will utilize an amplifier

Pushing the Right Button:

For a happy reaction: a voice over with "pika-pika" sound

Pushing the Left Button:

For an angry reaction: a voice over with "pika-pika-chu" sound

Initiating the Tilt Sensor by moving the Pikachu doll:

For a bothered reaction: a voice over of a frustrated Pikachu

Coding Theory

Due to the multiple functions that we would like the plush to have, 2 Arduinos will be used. One Arduino will handle the tilt sensor, buttons, motors, speaker and some RGB LED's while the second Arduino will have the code for the IR Remote and its receiver along with many RGB LED's. The specific pins and sensors that will be used are pictured in the diagram below:

# Pin	Arduino 1	Arduino 2
2	IR Remote	RGB Tail 3 red
3	Right Button	RGB Tail 3 green
4	Left Button	RGB Tail 3 blue
5		RGB Tail 4 red
6	RGB Tail 1 red	RGB Tail 4 green
7	RGB Tail 1 green	RGB Tail 4 blue
8	RGB Tail 1 blue	Chip Select (SD Card)
9	Servo Right Ear	Amplifier/Speaker Signal
10	Servo Left Ear	
11		Master Out Slave In (SD Card)
12		Master In Slave Out (SD Card)
13		Serial Clock (SD Card)
A0	RGB Tail 2 red	RGB Cheeks red
A1	RGB Tail 2 green	RGB Cheeks green
A2	RGB Tail 2 blue	RGB Cheeks blue
A3		Servo Tail
A4	------ Arduino Connection	------
A5	------ Arduino Connection	------

Since there are multiple layers to a single "reaction" in the plush to different stimuli, the code is structured to be able to respond to multiple stimuli, for example if 2 buttons are pushed at the same time, the plush will execute both reactions tied to each button in sequence. This is done by running a "check" which records the inputs that occur. Then, another function will call a reaction based on the recorded inputs. For example, if the tilt sensor was triggered,

then it will call and execute the tilt function. A simplification of the structure is shown below:

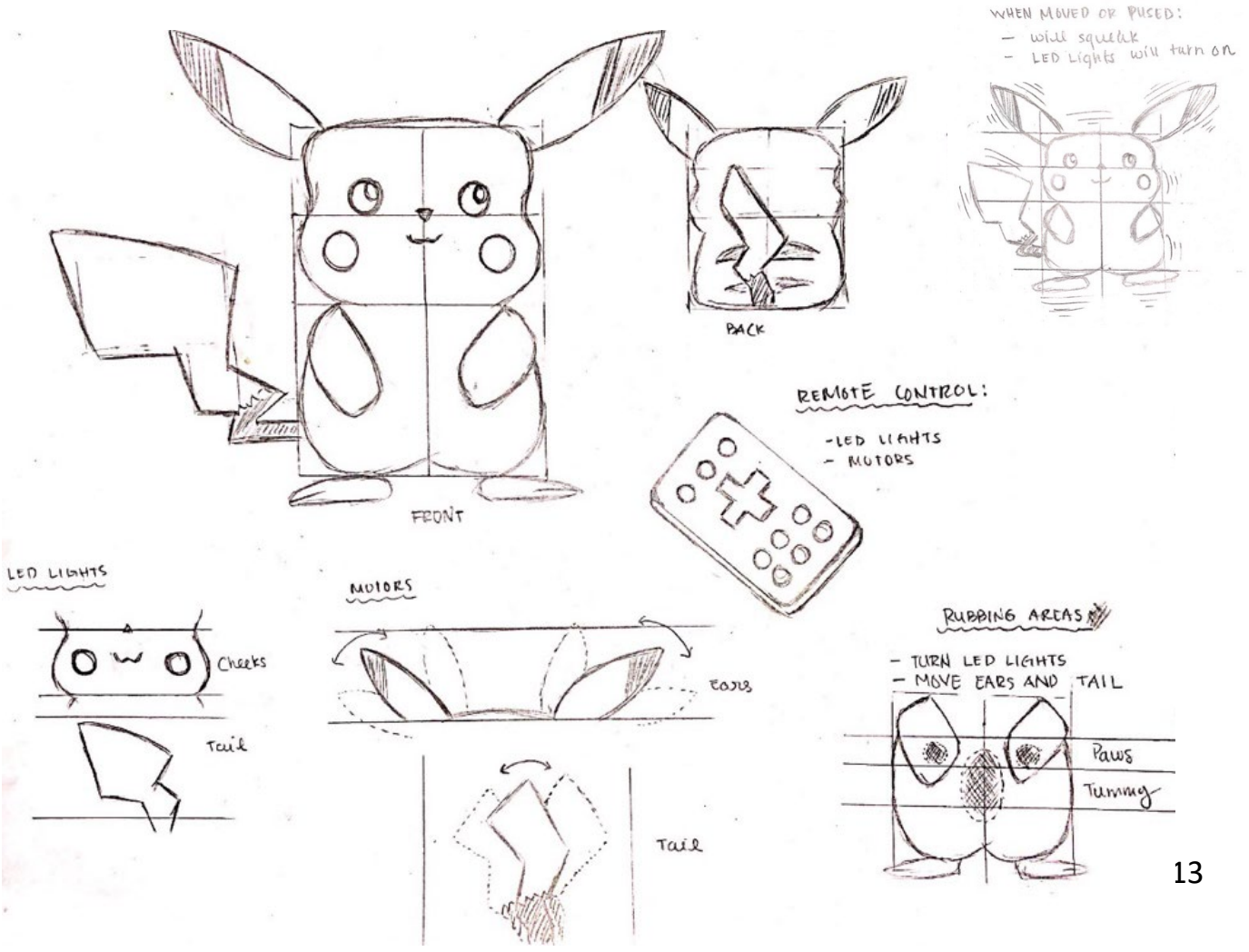
```
void pikaInput() {
  if(digitalRead(r_button) == HIGH) { //happy Pikachu behavior
    happy_Pika();
  }
  else if(digitalRead(l_button) == HIGH) { //angry Pikachu behavior
    angry_Pika();
  }
  else if(irrecv.decode(&results)) {
    int value = results.value;
    Serial.println(value);
    switch(value) { //redo of Pikachu stretch/set up behavior
      case 12495: //button 1
      pikastretch();
      break;
    }
    switch(value) { //happy Pikachu behavior
      case 6375: //button 2
      happy_Pika();
      break;
    }
    switch(value) { //annoyed Pikachu behavior
      case 31365: //button 3
      annoyed_Pika();
      break;
    }
    switch(value) { //angry Pikachu behavior
      case 25979: //button 4
      angry_Pika();
      break;
    }
}
```

The second Arduino, that will handle the remote controls, will have a similar, but more simple structure since it is only checking the remote's signals. Unlike the first Arduino, the second Arduino will have many RGB LED's that will take up most of the pin space on the board. An example of this code is below:

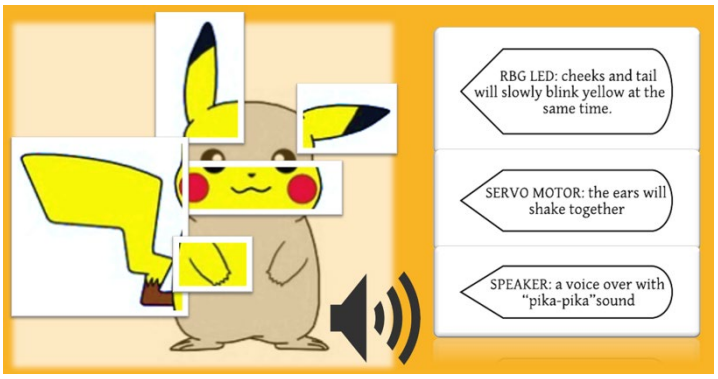
```
#include <Wire.h> //transmit between two Arduinos, this Arduino is the slave
#include <Servo.h> //enables Servo library
#include "SD.h" //library to read SD card
#include "TMRpcm.h" //library to play audio
#include "SPI.h" //SPI library for SD card
#define tail3_RED 2 //tail RGB #3 red
#define tail3_GREEN 3 //tail RGB #3 green
#define tail3_BLUE 4 //tail RGB #4 blue
Servo servo_tail; //sets up servo motor in tail3
#define tail4_RED 5 //tail RGB #4 red
#define tail4_GREEN 6 //tail RGB #4 green
#define tail4_BLUE 7 //tail RGB #4 blue
#define SD_ChipSelectPin 8 //Chip select is pin number 4
#define cheeks_RED 14 //cheek RGB red
#define cheeks_GREEN 15 //cheek RGB green
#define cheeks_BLUE 16 //check RGB blue
int x = 0;
TMRpcm music; //Library object is named "music"

void setup() {
  Wire.begin(17);
  pinMode(tail3_RED,OUTPUT);
  pinMode(tail3_GREEN,OUTPUT);
  pinMode(tail3_BLUE,OUTPUT);
  servo_tail.attach(A3);
  pinMode(tail4_RED,OUTPUT);
  pinMode(tail4_GREEN,OUTPUT);
  pinMode(tail4_BLUE,OUTPUT);
  pinMode(cheeks_RED,OUTPUT);
  pinMode(cheeks_GREEN,OUTPUT);
  pinMode(cheeks_BLUE,OUTPUT);
  Serial.begin(9600);
  music.speakerPin = 9; //arduino out on pin 9
  if (!SD.begin(SD_ChipSelectPin)) { //failsafe for SD card check
    Serial.println("SD fail");
    return;
  }
  music.setVolume(5); //0 to 5. Sets volume level
  music.quality(1);

}
```

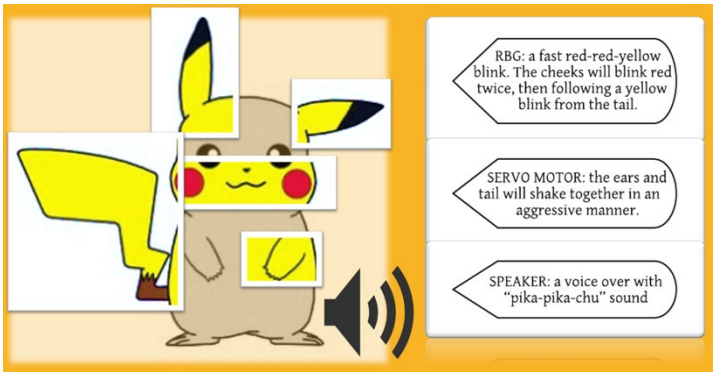
Product Design

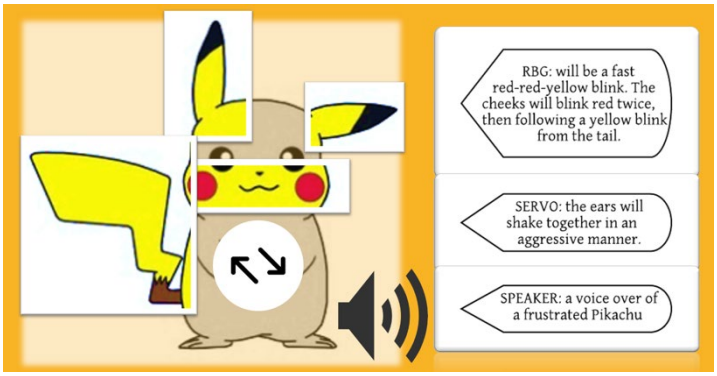
The photos below show the initial product design of Pika Power. At first, we envisioned Pika Power to be able to glow in the dark, move its ears and tail, and have a simple sound system. As the project progressed, two changes were made. First, push buttons replaced the temp sensors as an input. Second, in order to create a more human-like interaction with Pikachu, four different human emotions were added: happy, angry, bothered, and annoyed. The main purpose of this emotional aspect to Pika Power is to further help adolescences cope with the pandemic's lockdowns.

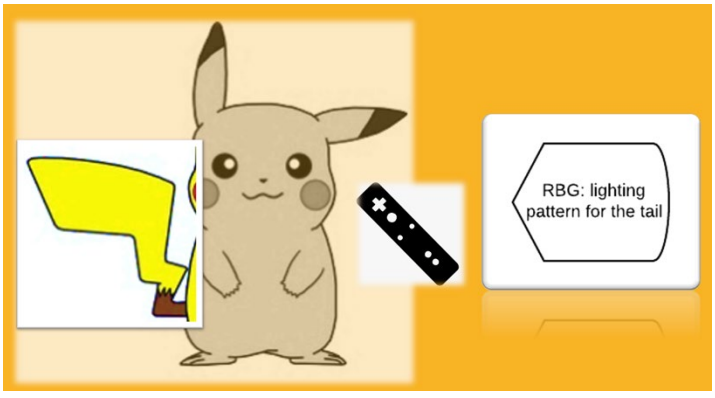


The photos below detail the finalized inputs and outputs of Pika Power. In total, there are four inputs: two push buttons, tilt sensor and remote control. These inputs will have three different outputs: LED lights, servo motor, and sound system. Witnessing these outputs work together, an emotion will be conveyed. For example, by pushing the right button, it will have an LED light pattern, movement pattern, and a voice over of Pikachu to convey a happy emotion. While, the left button will convey an angry emotion and tilt sensor conveys a bothered or annoyed expression. Despite no emotion is assigned to the remote control, this input still plays a role for a more realistic Pikachu. In Pokémon, Pikachu uses its tail to send Thunderbolt to its enemies. Coding its tail to have a lighting pattern that mimics the Thunderbolt attack, will make Pika Power more attractive and effective to its purpose.



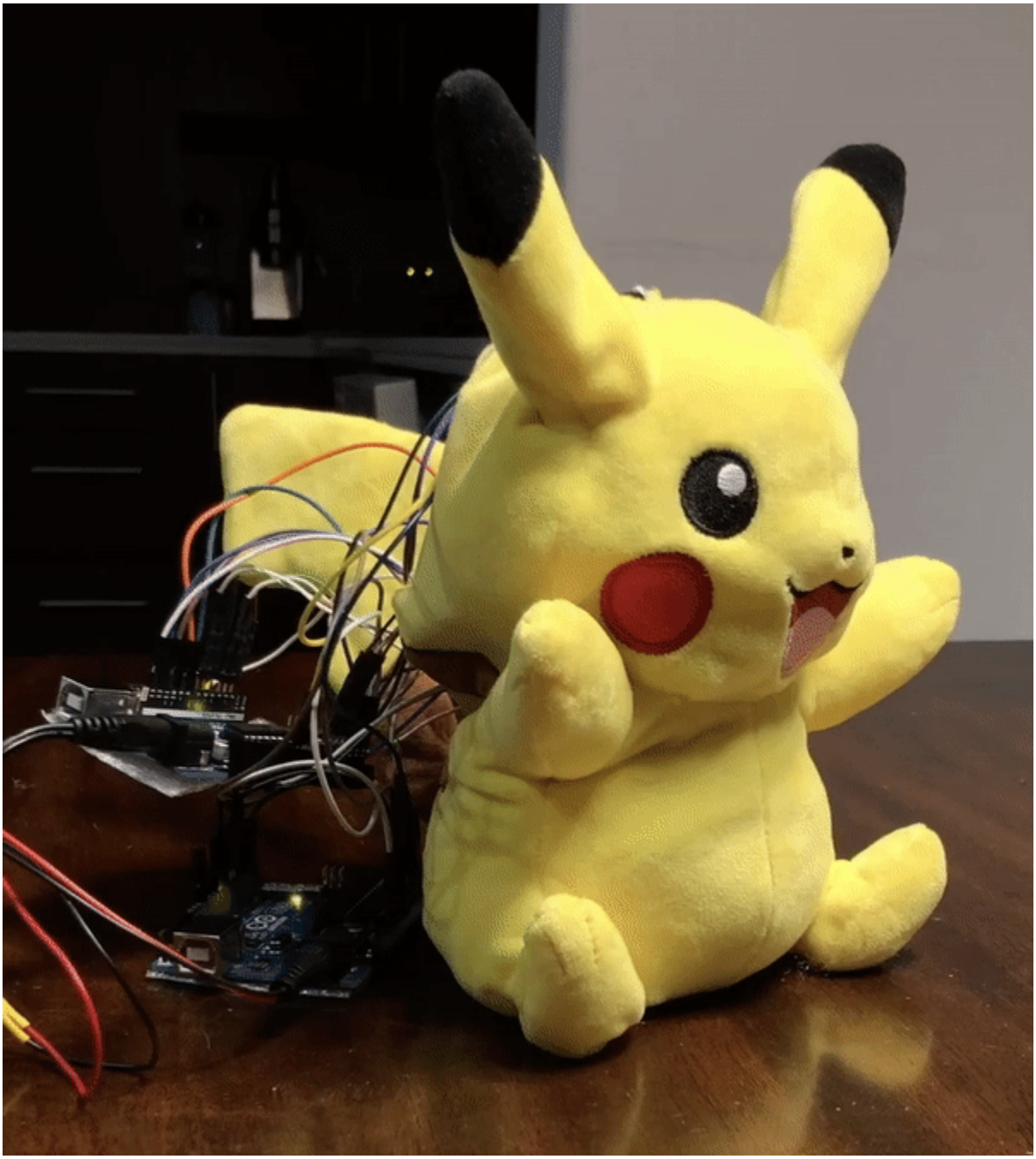




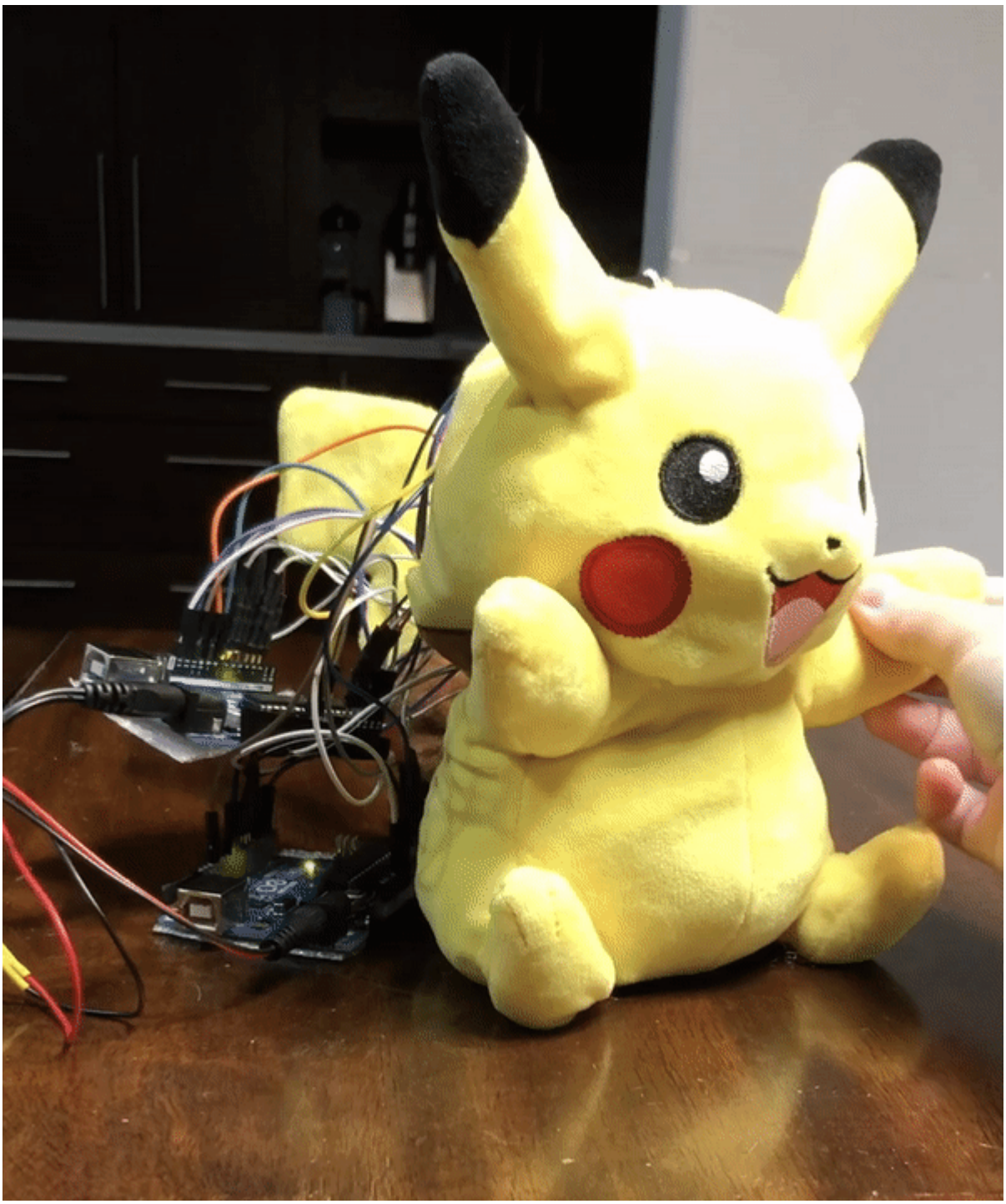


Results

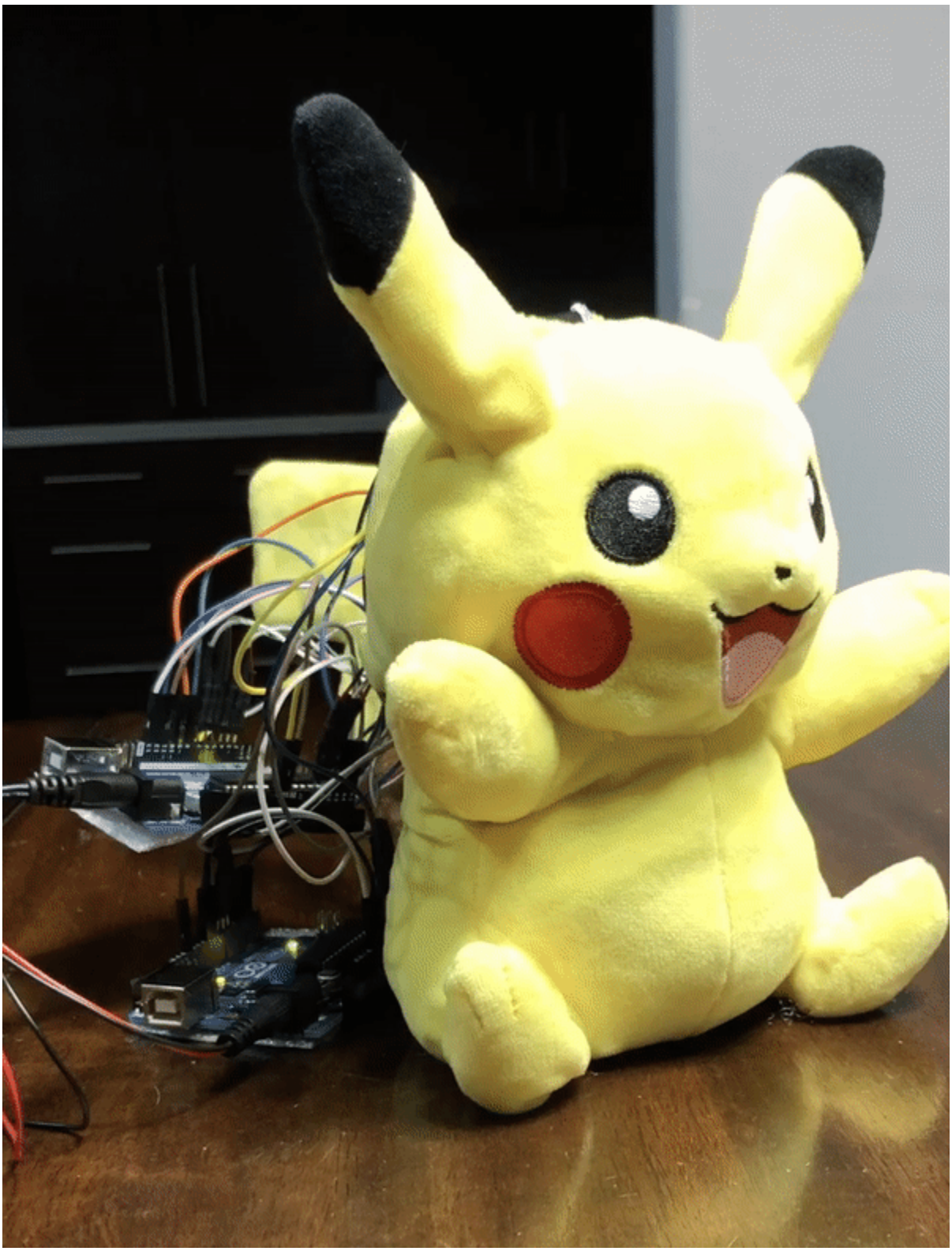
Start Up Function:



Left Button Function:



Right Button Function:



Completing the product design required the usage of multiple Arduino libraries, which included “Wire.h”, “IRremote.h”, “Servo.h”, “SD.h”, “TMPpcm.h”, and “SPI.h”. Each specific library provided a separate and required function. The respective code for the Master and Slave can be found here and here.

Wire.h Library

This library facilitated communication between the two Arduinos used for the product design, aptly named the Master and the Slave. By using the SDA (data line) and SCL (clock line) pins on the respective Arduino boards, the two are able to communicate using I^2C, Inter-Integrated Circuit.

IRremote.H Library

This library provided the ability to send and receive infrared signals on an Arduino board. Physically, this library required the usage of a mobile, infrared remote and an infrared receiver, located inside the Pikachu doll.

Servo.h Library

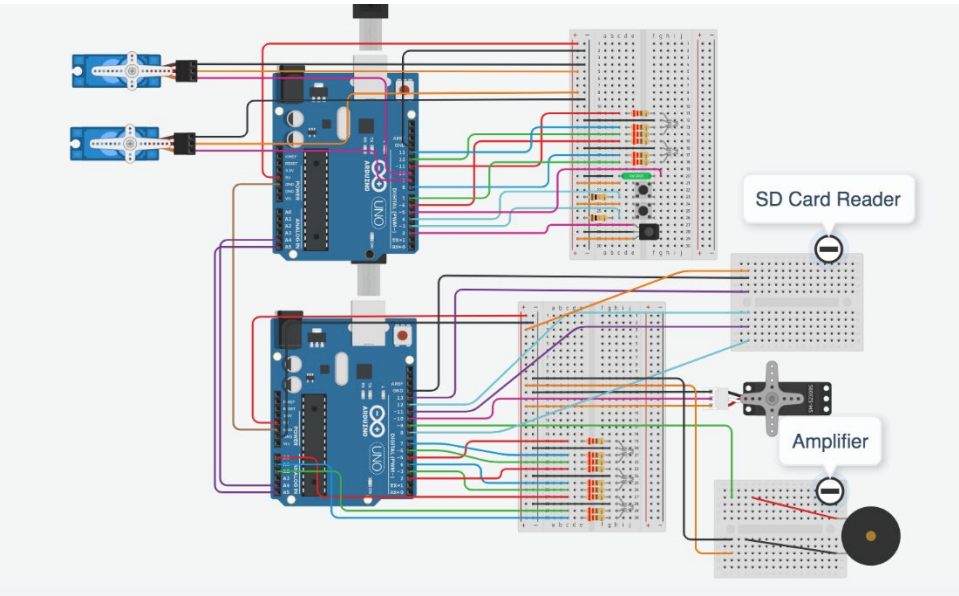
The Servo library served as a control function for the mini-behavior and customization of both ears and the tail on the Pikachu doll. The code for this section uses for loops to control the speed and angular direction of the servo motors for each respective area.

SD.h, TMPpcm.h, and SPI.h Libraries

The above libraries provided a method of adding a voice to the Pikachu doll. SD.h provided a method for communication between the memory card (an SD card) and the slave Arduino. The SPI.h library provided a source for pulling the sound file from the SD card, and the TMPpcm.h library decoded the wav file and provided the function for playing that file through the 8 ohm speaker system.

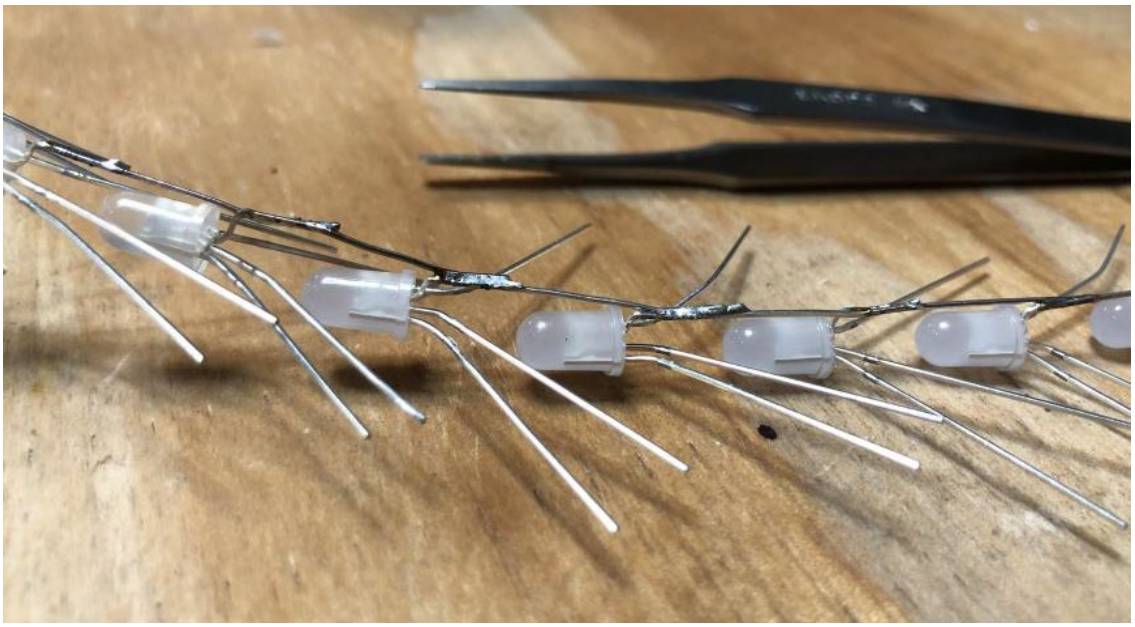
Building Process

Once all the code was complete, it was obvious that the breadboard would not fit inside the Pikachu alongside the metal structure. So that it would fit, we decided to solder the wires together to make the connections that the breadboard would. These would also be easier to put inside the Pikachu doll as they can be maneuvered around the metal base that will be put in.
The basic wiring plan looked similar to the diagram below:

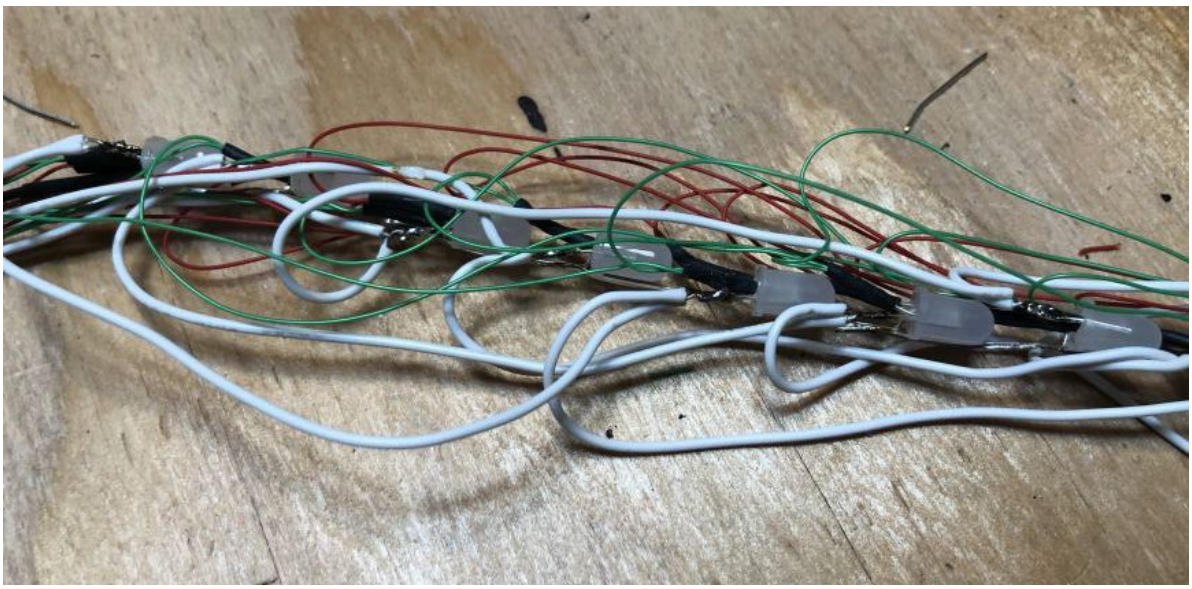


Tail LED's

The toughest to connect were the tail LED's as they were grouped in 4 groups of 3 LED's, 12 in total. Each group was soldered together by connecting each of their ground pins in a line, in an order of Group 1, Group 2, Group 3, Group 4, Group 1... until there was a chain of 12.

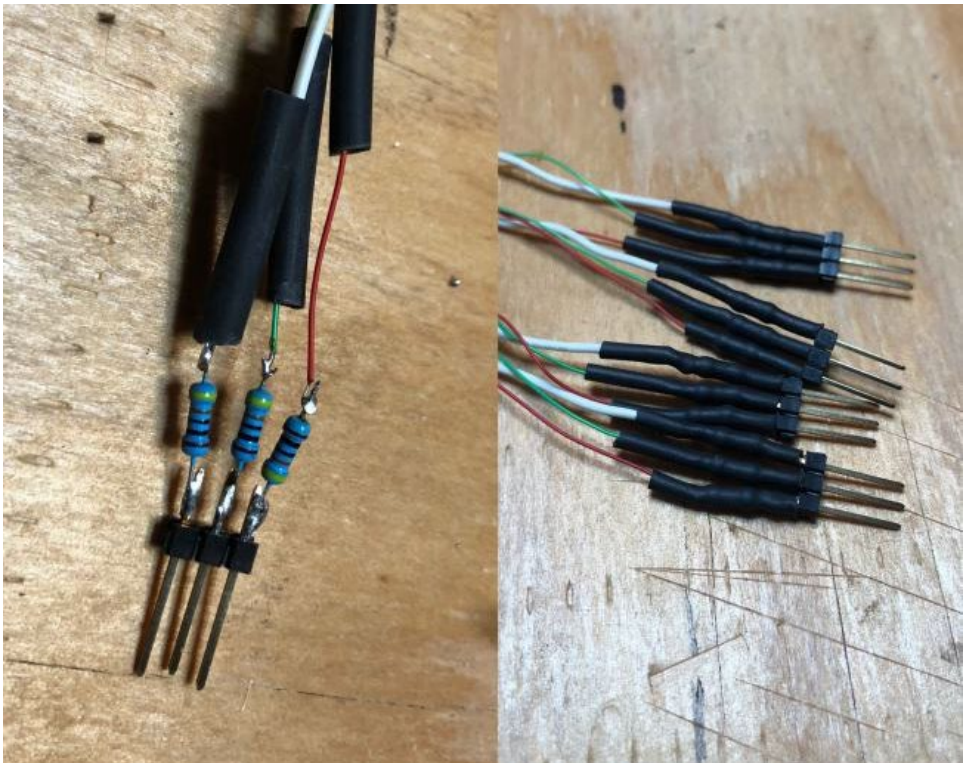


Then each type of pin was connected between each group like so: (The example shows the connection of the red pins only between the Group 1 Tail LED's. The same is done for each of the other pins for Group 1, and in between all the individual color pins for all the other groups: (red for the red pins, green for the green pins, and white for the blue pins)

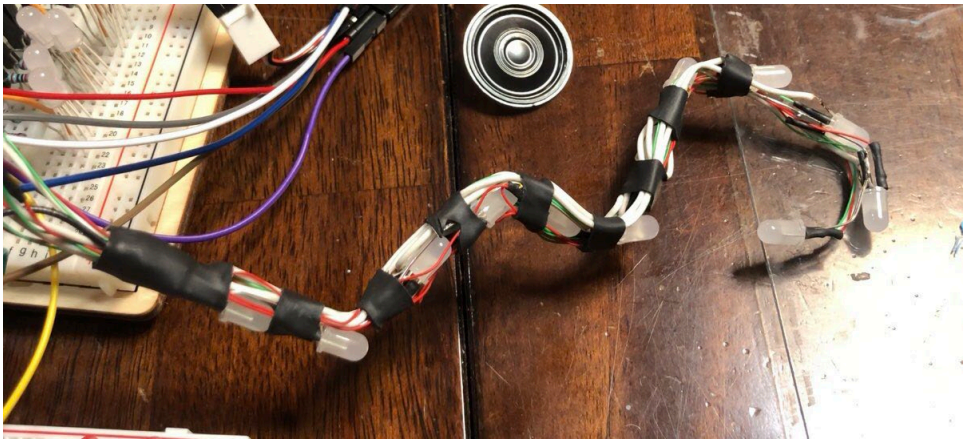


At the end of the tail, each group of LED's had their wires twisted together to form cables and were marked off. The collective ground pin of all the LED's was attached to a longer wire as well so that the LED's can be connected back

to the Arduinos outside the tail. Each of the pin cables also had a 430 ohm resistor attached and then soldered to a pin head so that it can connect back to the Arduino.



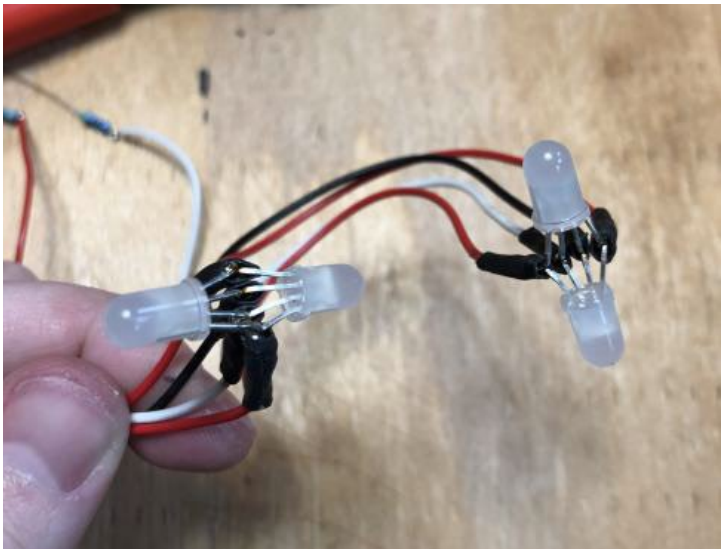
The total end result of the Tail LED's after being bent into the shape of the tail:



Cheek LED's

The Cheek LED's needed to be made flush to the backside of the Plushie's cheeks, so they were soldered at a 180 degree angle to each other

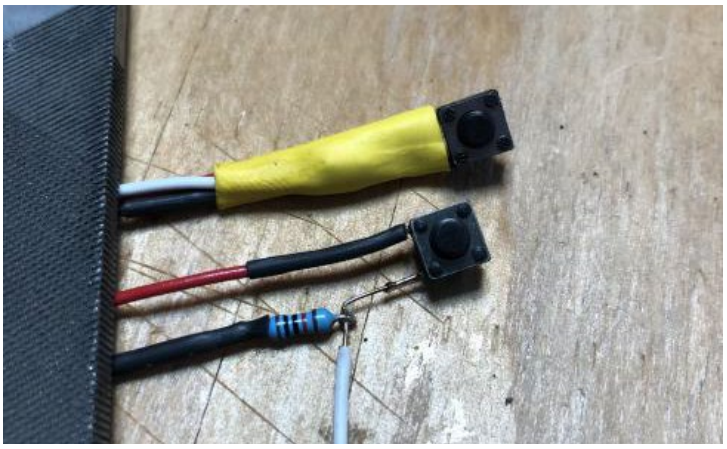
connecting each of their Ground, Red, Green and Blue pins together. Each cheek held a group of 2 LED's. The ends of each cheek's LED was soldered with resistors in the same way the Tail LED's were done:



These were then sewn into the back of the Pikachu's cheeks so that they would stay in their proper place:

Buttons

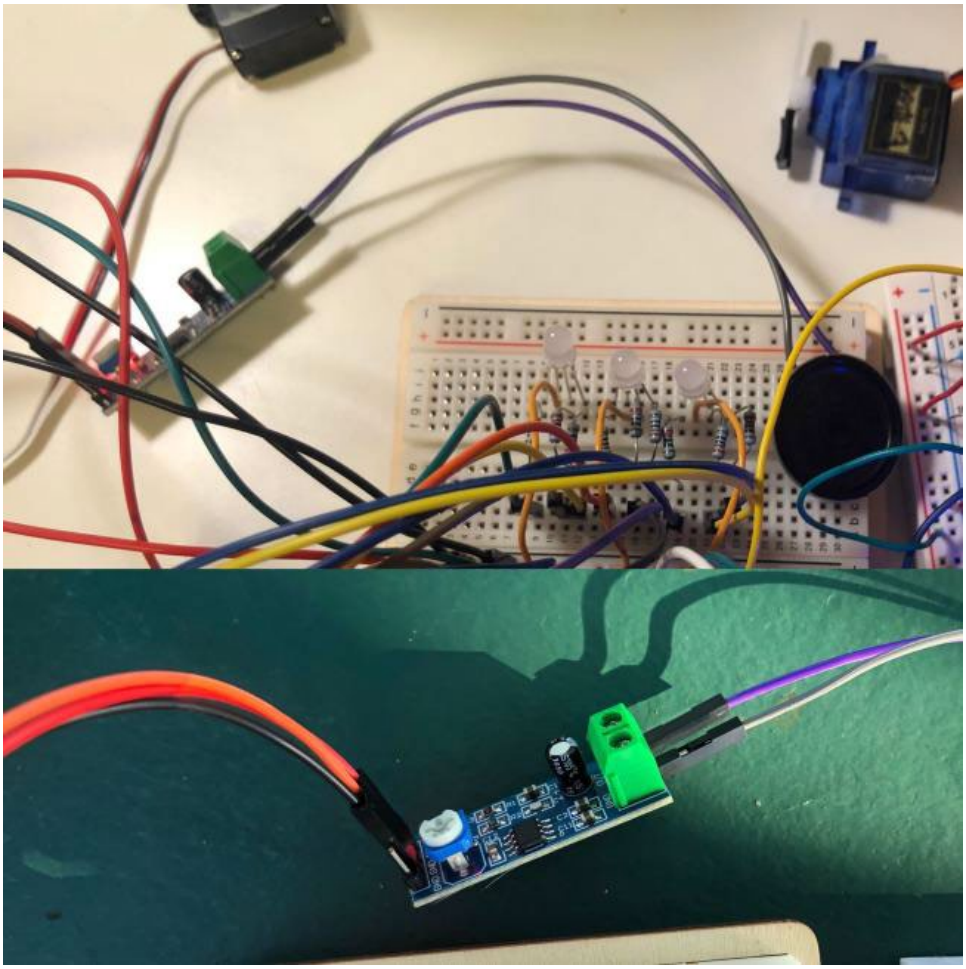
Each of the buttons also needed to have wires and a resistor soldered on as they were stuffed into the end of the Pikachu's paws. A wire that will connect to the power from the arduino and a wire that will connect to an input pin was soldered onto the two pins of a button. Then a 10k ohm resistor and ground wire were soldered to an exposed area of the input wire. This was then all covered in thermo-shrink as to prevent any possible short circuiting. The ends of the wires were soldered to male pins like the LED's. (Top Button: completely covered to prevent the stuffing from catching on the components, Bottom Button: The wiring of the power wire (red), input wire (white), 10k ohm resistor, and ground wire (black))



The buttons were also then gently sewn to the paws of the Pikachu to prevent them from shifting around inside.

Speaker and Amplifier

The Speaker and Amplifier did not need soldering as it was stable already, but connected to each other like so:

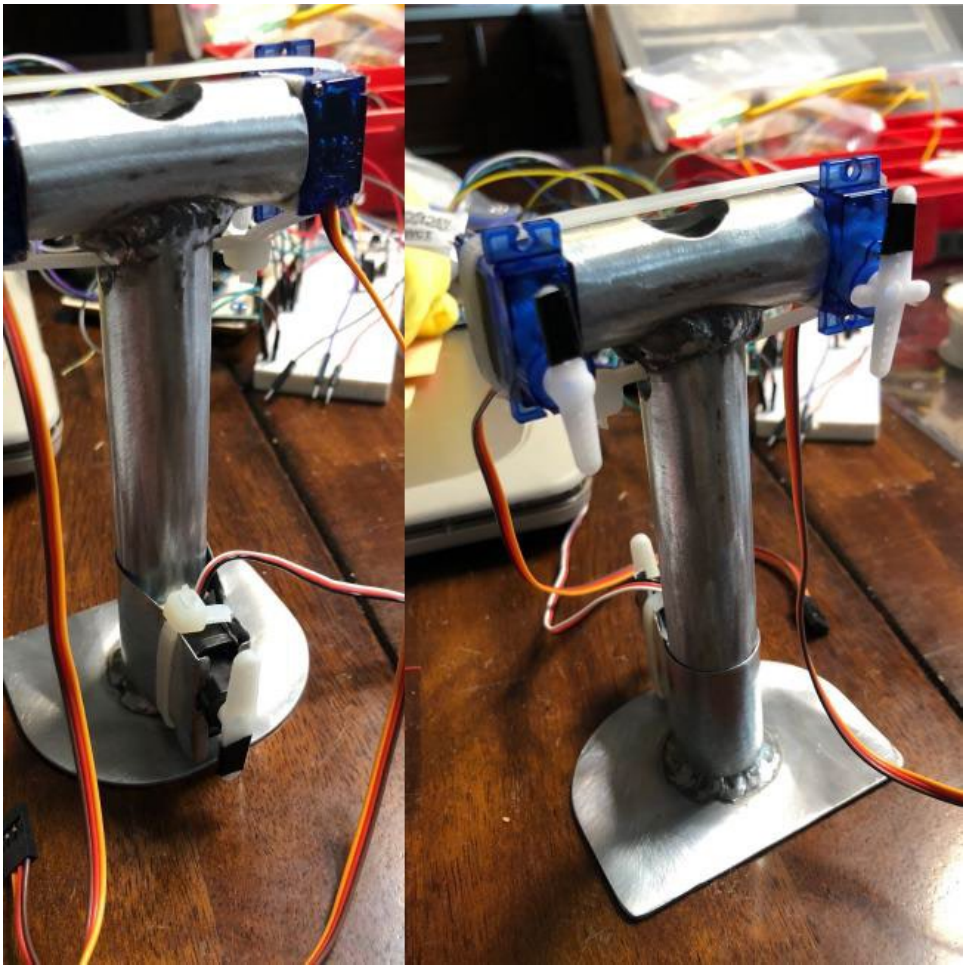


The purple and gray wires from the Speaker were its ground and power. The red wire from the amplifier connected to the power, the black wire to the ground and the orange wire connected to Pin #9 on the Slave Arduino to receive the music input.

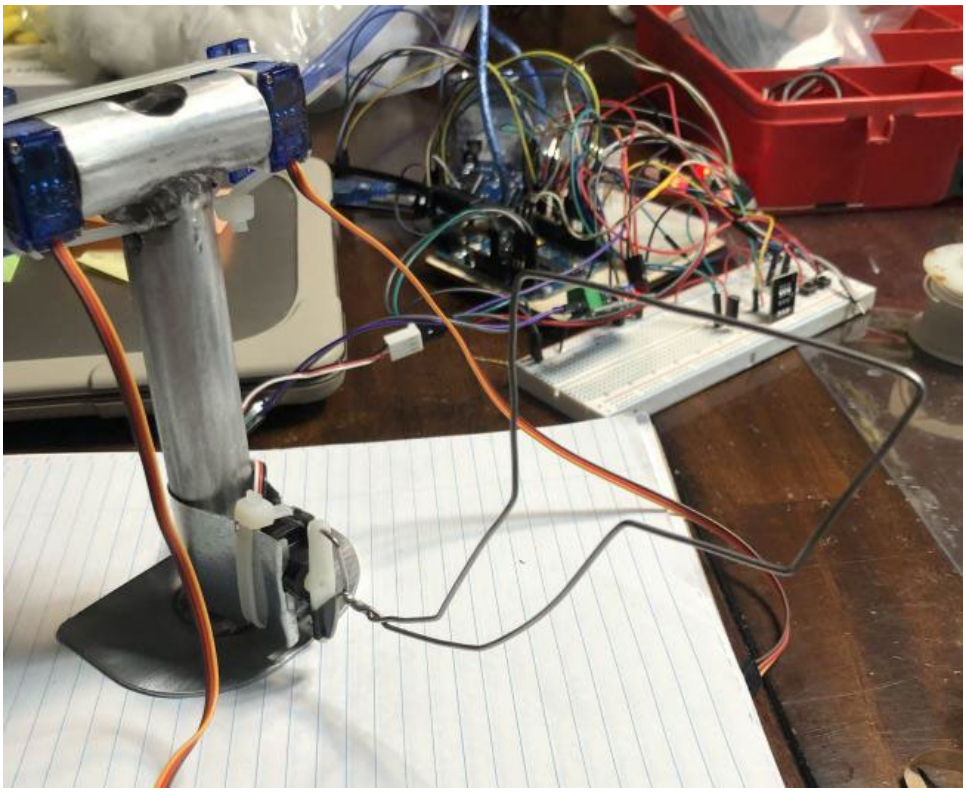
Motors

Before being placed into the plushie, the motors needed to be attached to the metal base that will be placed inside so that they are stable and unmoving from their position to allow for the movement of the tail and ears. To prevent the motors from completely shaking out of place, they each were attached securely to the base using 2 methods. The tail was attached by wrapping a metal band around the tube and the sides of the motor which was then zip-tied to hold the motor securely in place. The ear motors were attached using a large zip-tie that held them against the sides of the

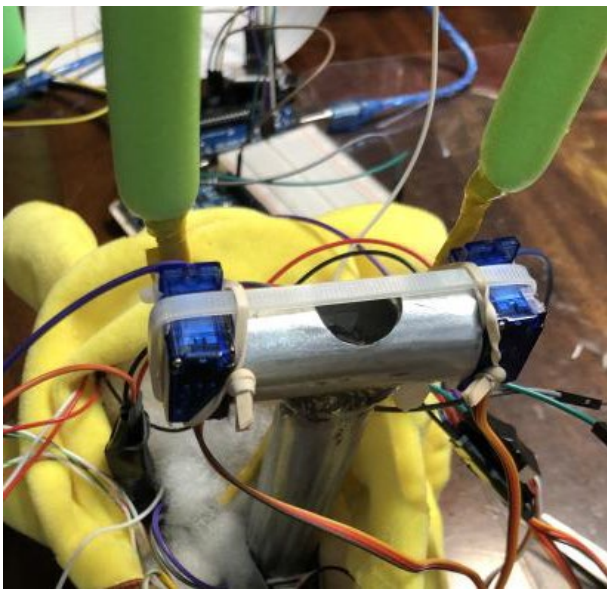
horizontal tubing of the base. To prevent the zip-tie from slipping, it was run through a hole drilled horizontally though the spine of the metal base. (Tail motor pictured to the left, Ears pictured to the right):



Attached to the tail motor's rotor is the tail's wire structure which will move the tail during a reaction. This was formed out of a tough steel wire and bent into the shape of the Plushie's tail so that it may be inserted later:



To move the ears of the Pikachu, foam pieces that are reinforced with a wire, were attached to each of the ear servo motors' rotors:



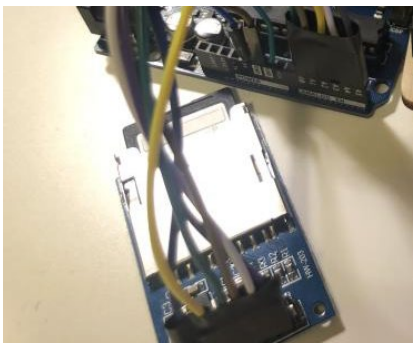
IR Remote Sensor

The IR remote sensor was not soldered into the Pikachu either and instead kept attached the Arduino wires that came in the kit. The gray wire connected

to the ground, the red wire connected to the power, and the purple wire connected to Pin #2 on the Master Arduino.

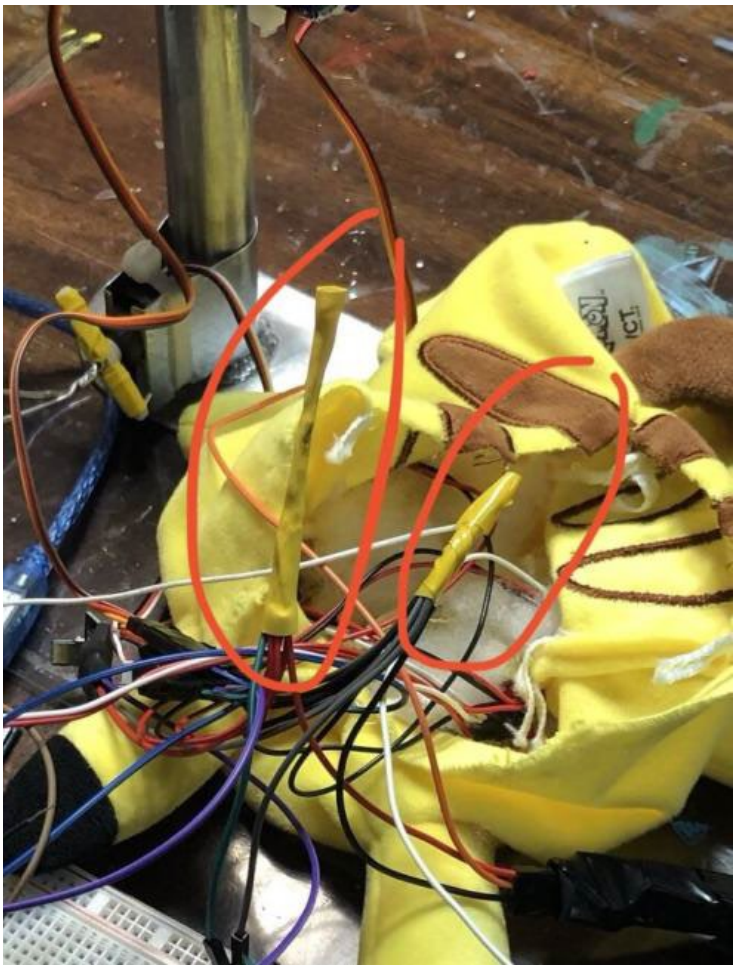
SD Card Reader and SD Card

For the SD Card reader, it was connected to the Arduino using 6 pins: A Chip Select Pin (#8) to communicate with the Arduino, a Serial Clock Pin (#13) to sync the time between the Arduino and the SD Card Reader, And two pins on #12and #11 to move information between the Arduino and the SD Card. The SD Card held short, 8-bit .WAV files that were read by the SD Card Reader and sent through the Slave Arduino to the Speaker to play the specified sound in the code.



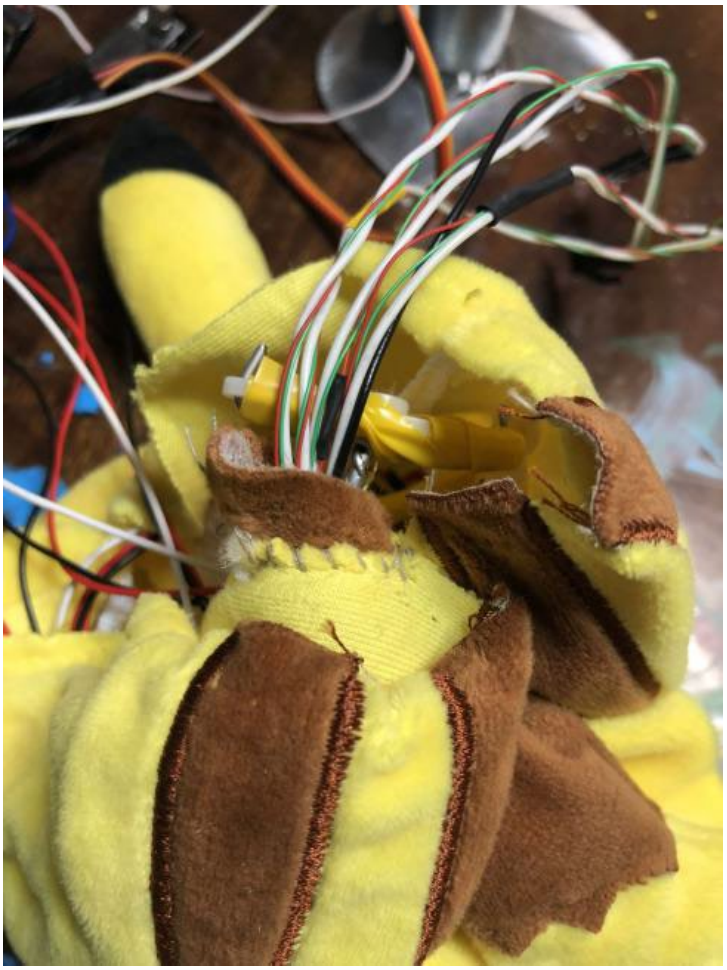
Ground and Power Wires

Each of the many components also had a ground and power wire coming from it that needed to be connected back to the Arduinos. Due to the absence of a breadboard, each individual wire cannot be attached to the Arduinos, so instead, all the power and all the ground wires were connected to each other to form 2 master wires that connected just to the power and the ground of the Master Arduino. To make it stable and provide a good connection, the power wires and the ground wires were also soldered together. (The ends are circled in red below)



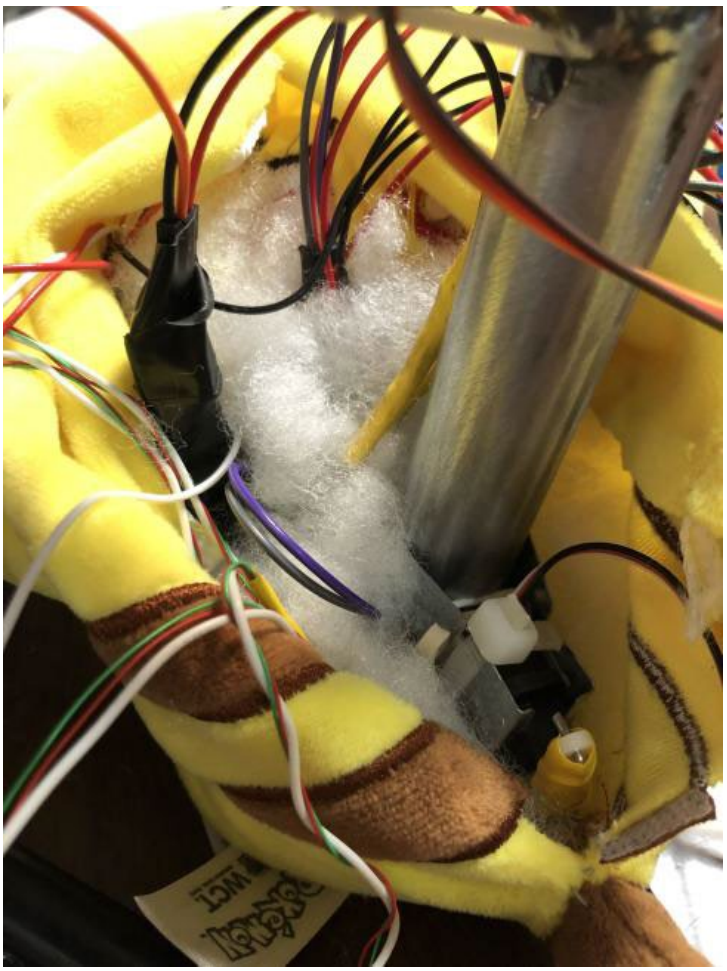
Putting Everything Together

After everything was soldered and attached, the final construction began. Firstly, the tail was reattached to the Pikachu after inserting the tail frame that will attach to the tail rotor and the tail LED's:



Then, the Metal Base was placed gently inside the Pikachu. Stuffing was slowly added as the Speaker and IR remote sensor were placed into the belly. The stuffing was added quite fully to prevent the floating pieces, such as the

IR remote sensor and speaker, and the wires from moving around too much inside the plushie.



The ear rotors were then placed inside the ears and the stuffing was added to the inside of the face and more around the base

Finally, the stuffing was almost fully covering the inside of the Pikachu. The Arduinos turned out to be too large to fit inside the Pikachu plushie, so they were left outside, and the rest of the wires were fed out the back of the Pikachu and connected to their respective pin placements on each of the Arduinos.

Final Build

The Final Build was connected to 2 9V Batteries.Build of the Pikachu was connected to 2 9V Batteries.

Conclusion

Though time constraints prevented the completion of the product design, the knowledge and experience gained by this experience are invaluable. Our group project was able to conclude that the product design provided a much needed friendly and interactive social experience during a time period where social interaction is extremely limited due to the effects of COVID-19.

Adding an interactive feature to the product design allowed the Pikachu doll to truly connect with its user and provided a human factor that could potentially be applied on a mass scale to others worldwide.

Citations

21, Mustafa February, and Paul May 30. “Venn Diagram with 4 Circles for PowerPoint.” *The Free PowerPoint Template Library*, 9 Dec. 2018, www.presentationgo.com/presentation/venn-diagram-with-4-circles-for-powerpoint/.

Anuwat. “PNG Images.” *Pngtree*, pngtree.com/free-png?source_id=63&chnl=ggas&srid=752076878&gpid=38126922183&asid=423754849671&ntwk=g&tgkw=kwd-442258019674&mchk=freepng&mcht=b&pylc=9032176&dvic=c&gclid=Cj0KCQjw6575BRCQARIsAMp-ksPQypAkWXngFK6_d_YDwtyjZQFnJfgl0smjBnymeV8EPfedLYpxHF8aAnOEEALw_wcB.

Cantarella, A., et al. “Using Dolls for Therapeutic Purposes: A Study on Nursing Home Residents with Severe Dementia.” *Wiley Online Library*, John Wiley & Sons, Ltd, 19 Apr. 2018, onlinelibrary.wiley.com/doi/abs/10.1002/gps.4872.

Carrington, Victoria. “'I'm in a Bad Mood. Let's Go Shopping': Interactive Dolls, Consumer Culture and a 'Glocalized' Model of Literacy - Victoria Carrington, 2003.” *SAGE Journals*, journals.sagepub.com/doi/abs/10.1177/14687984030031004.

“COVID-19 Lockdown Having an Impact on Adolescent Mental Health.” *HCPLive*, www.mdmag.com/medical-news/covid-19-lockdown-adolescent-mental-health.

“A Roadmap to Better Mental Health During COVID-19.” *Neuroscience from Technology Networks*, www.technologynetworks.com/neuroscience/news/a-roadmap-to-better-mental-health-during-covid-19-333487.

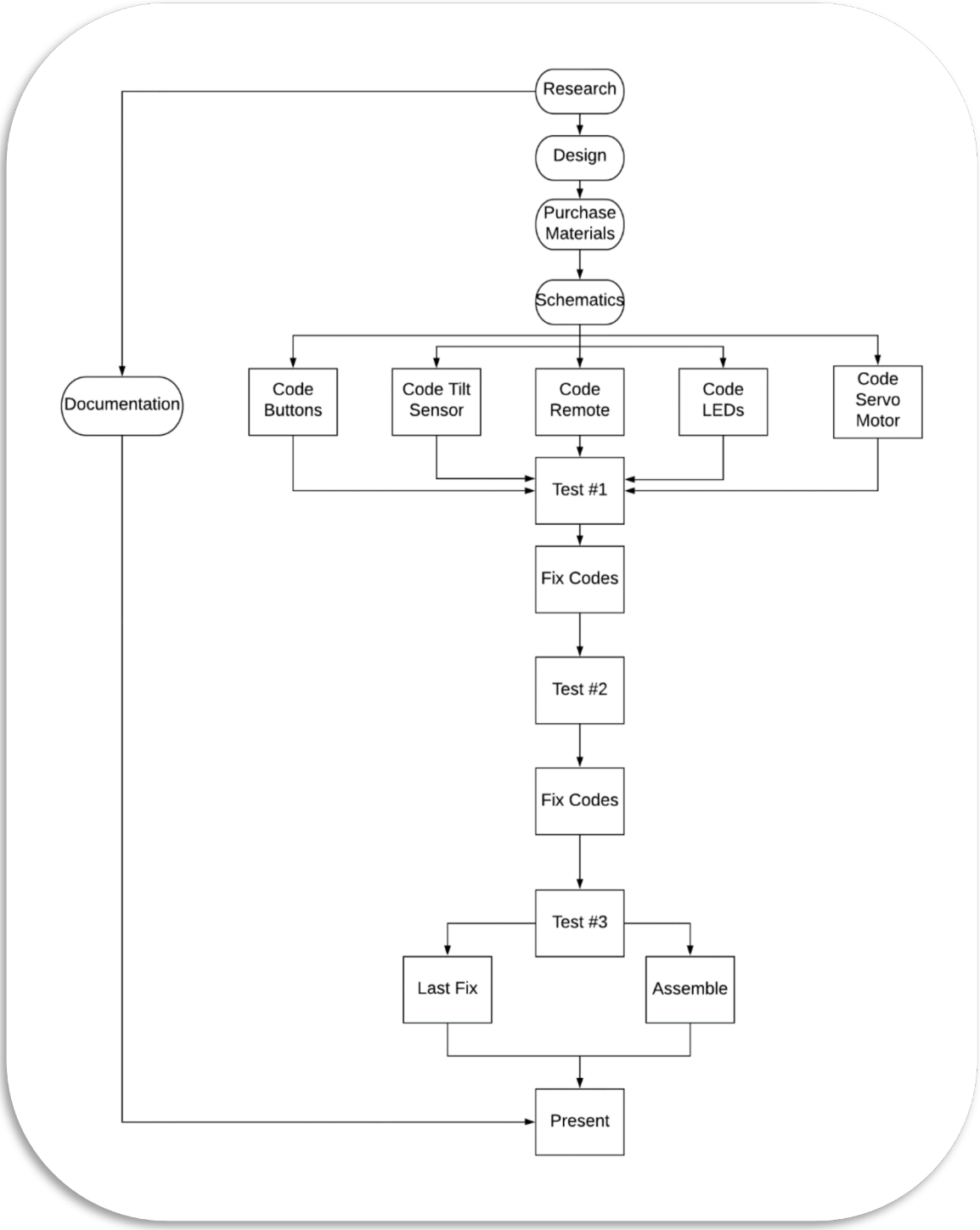
"Speaker with Arduino and Micro SD." *Arduino Project Hub*, create.arduino.cc/projecthub/HUNMAN/speaker-with-arduino-and-micro-sd-f238b8.

Tseng, Kevin C, et al. "Design, Development, and Clinical Validation of Therapeutic Toys for Autistic Children." *Journal of Physical Therapy Science*, The Society of Physical Therapy Science, July 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC4968488/.

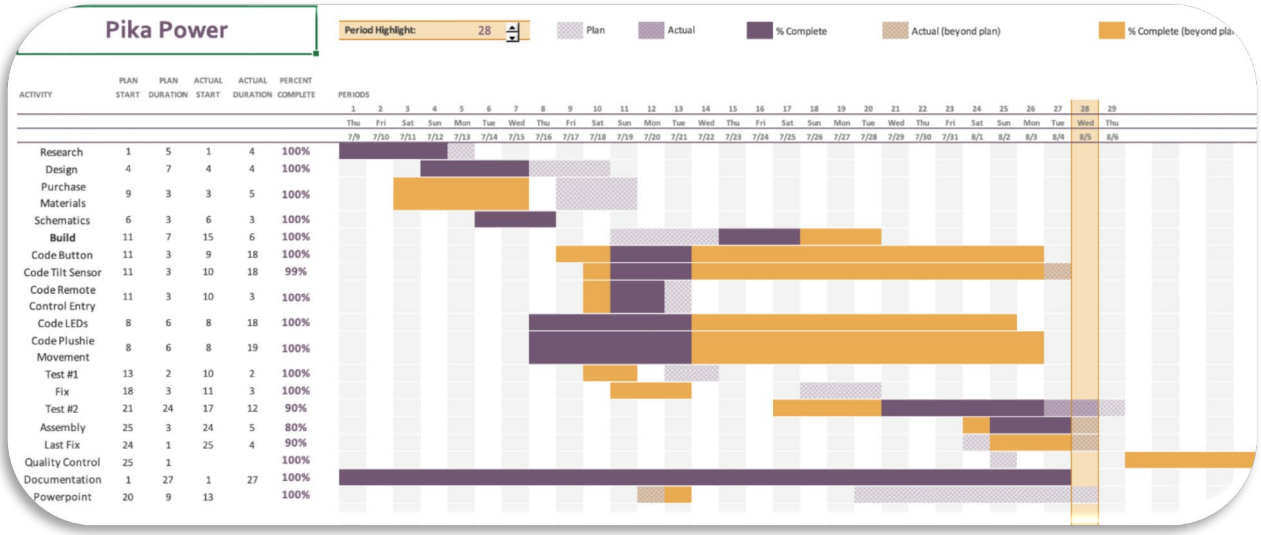
" Adolescent Development." *Adolescent Development*, www.amchp.org/programsandtopics/AdolescentHealth/projects/Pages/AdolescentDevelopment.aspx.

Appendix

Pert Chart



Gantt Chart



Purchasing Chart

Materials	Ordered By	Order Status	Delivery Stat	Links	Quantity	Price per cor	Total Price
Super Starter Kit UNO R3 Project (Arduino Uno Kit)	Zaera, Daria	Purchased	Delivered	Arduino Kit	2	$40.41	$80.82
Most Complete Arduino Uno Kit	Tee	Purchased	Delivered	Arduino Kit Complete	1	$57.90	$57.90
Pikachu Plushie	Daria	Purchased	Delivered	Pikachu Plushie	1	$9.99	$9.99
LM386N-3 Semiconductors (5-pack)	Daria	Purchased	Delivered	Audio Amplifier	1	$8.50	$8.50
8ohm 0.5watt Mini Metal Speaker (4)	Daria	Purchased	Delivered	Speaker	1	$1.95	$1.95
Virtuabotix SD Card Reader/Writer	Zaera	Purcahsed	Delivered	SD Card Reader	1	$5.29	$5.29
16GB SD Card	Zaera	Purcahsed	Delivered	SD Card	1	$4.99	$4.99
Popsicle Stick Pack	Zaera	Purchased	Delivered	Popsicle Sticks	1	$7.64	$7.64
LED's (100 Pack w/ Resistors)	Daria	Purchased	Delivered	LED Lights	1	$9.00	$9.00
Galvanized Steel 15"x1.5"	Tee	Purchased	Delivered	Home Depot	1	$8.31	$8.31
Galvanized Steel Plate	Tee	Purchased	Delivered	Home Depot	1	$9.65	$9.65
Total							$204.04
Tools							
Solder Kit	Daria	Pre-Owned	N/A	-	1	$0.00	$0.00
Glue Sticks		Pre-Owned	N/A	-	3	$0.00	$0.00
Tape		Pre-Owned	N/A	-	3	$0.00	$0.00
Pro-Spot Welder	Tee	Pre-Owned	N/A		1	$0.00	$0.00
							$0.00
Total							$0.00
Total Cost							$204.04