ASSIGNMENT 1:
The Boo Bear

Gerald Alvarez
Maedeh Sharifi

Elio Bidinost and Sabine Rosenberg
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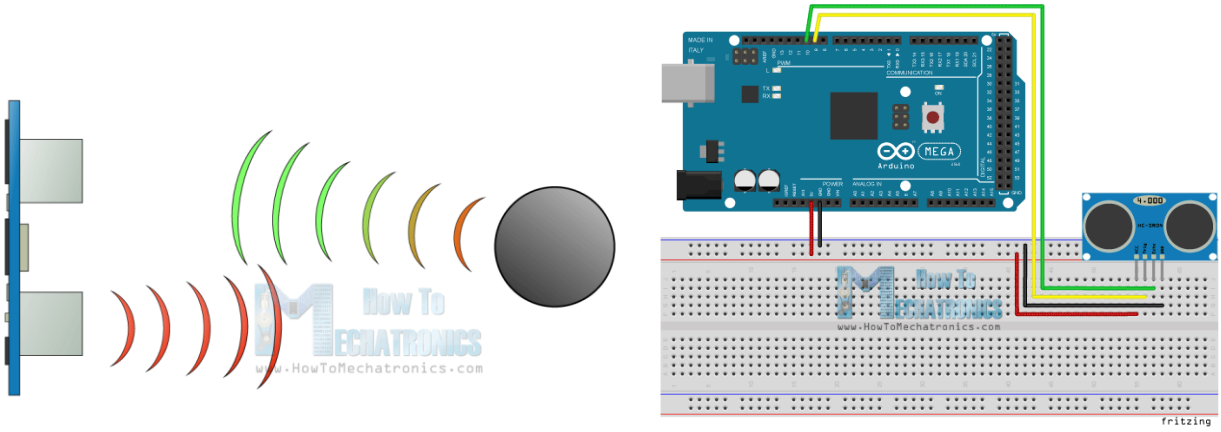
Research concerning 3 sensors:

1) HC-SR05 Ultrasonic Ranging Module - 5 Pin [CK-1034]

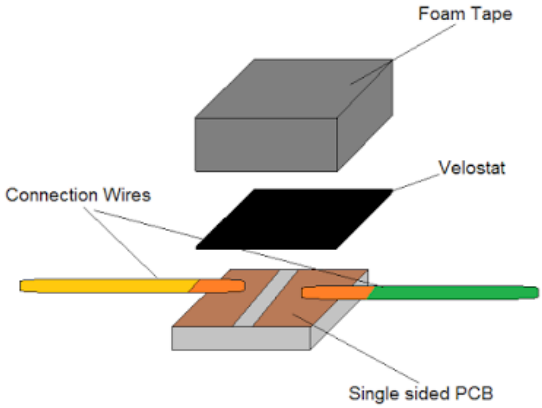
This digital sensor detects the range of any object within 5 meters. The sonar fires a pulse of frequency (echo) and then receives it back. It calculates the time passed between the trigger pulse and the receiving pulse. With this information it can calculate the distance between the sensor and the object.

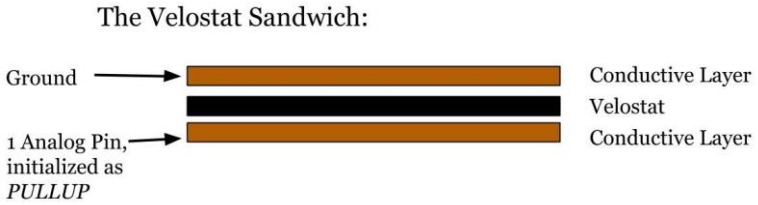


Source: http://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/
https://www.spikenzielabs.com/Catalog/index.php?main_page=product_info&cPath=122&products_id=940

2) Pressure sensitive conductive sheet (velostat)

The sensor is pressure-sensitive: squeezing it will reduce the resistance. Thus, the current flows better when you press on the sensor. An advantage of the sensor is that is can be flexible.

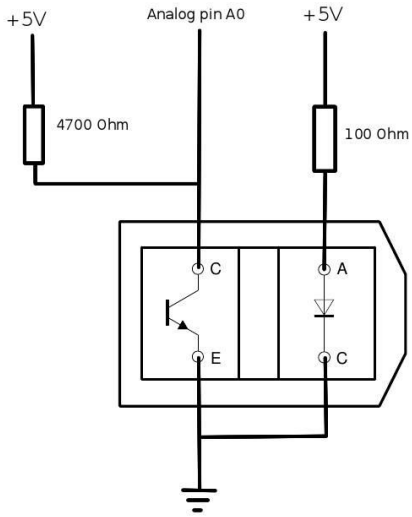




Source: https://sites.google.com/a/mtholyoke.edu/cs-243-spring-15-barkh22g/project-1-touchable-canvas/velostat-explorations

3) TCRT5000 Reflective IR Optical Sensor with Transistor Output [CK-7043]

The TCRT5000 is a two part IR proximity sensing module. One side emits IR light, and the other side receives the reflected light. It works best at close range.



Source:
https://www.spikenzielabs.com/Catalog/index.php?main_page=product_info&cPath=122&products_id=967

The Boo Bear

The Boo Bear is an interactive teddy bear designed as a children's toy. The concept is that the boo bear requires massaging in order to be pleased. Thus, a challenge and reward system compels the user to touch the bear on his paws and chest in order for him to generate sounds according to the degree of pressure. There is a specific range of pressure in which the bear becomes pleased. If the pressure of the touch is too high or too low, the bear will produce unpleasant sounds in the high or low frequencies. If the user manages to please the bear, he will sing back a song with the recorded notes. If the user fails to please the bear, he will scream in a high frequency as a sign of his dissatisfaction. The teddy bear includes two sensors: an Ultrasonic Ranging Module and a pressure sensor (velostat) in order to detect user input and generate sounds. There are 4 modes of activity for the bear:

First, is the waiting Mode. In this period, the bear waits for the user to interact with him. The bear detects movement within 2 meters and will play a tone in a periodic interval of time to attract the user's attention. When the user is within 50 cm and but doesn't touch the bear; he will do nothing. The bear will go to the next mode and be interactive when the user physically touches him.
Next is the Interact Mode. In this mode, the user will be able to interact with the object by touching (pressing) its paws and chest. The goal is to satisfy the bear so he can go to the next mode. The level of satisfaction is calculated by incrementing the counter variable in the code. In the object's context, the user needs to massage the bear in its sensitive areas, which are the paws and chest. If the bear is pleased during the massage; it will play a normal pitch of tone. If the user presses too hard or too low; it will play high or low notes. If the user failed to satisfy the bear it will go to rest mode and skip the playback mode entirely. In addition, every second, a frequency is stored in the playback array. The parameters for each note is the frequency determined by the degree of pressure and the pitch determined by the range between the user and the object .

Next is the Playback Mode. In this mode the user will be able to hear the musical properties of the bear. A generated music will be played after successfully massaging the bear. Each note's duration will be given randomly by the pre-set.

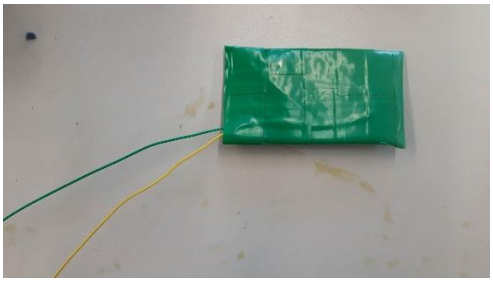
Finally is the Rest mode. If the user successfully passes the interact mode, the bear will play low hums for a certain time. If failed the user failed in the interact mode, the bear will scream for a certain period of time.

Overall, the goal of this project is for the user to live an interactive experience with the Boo Bear. Through his motion sensor, the bear is able to detect the presence and distance of the user and through the 3 pressure sensors put in his 2 paws and chest, the bear can respond to user input by generating sound. Therefore, the teddy bear is humanised by having needs and responding to the actions of the user.

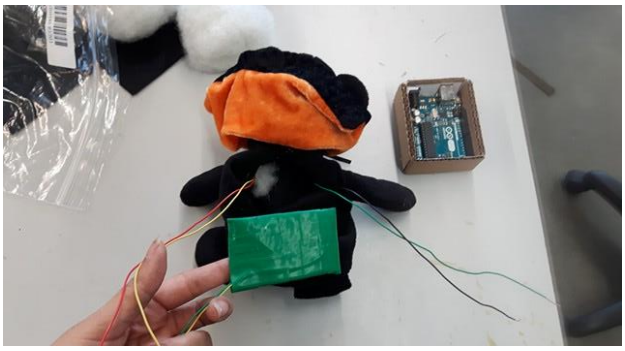
Video of the bear in action: https://vimeo.com/240432011

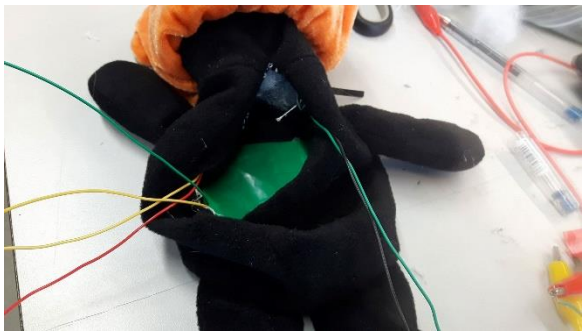
Creation Process

Velostat pressure sensor covered in electric tape

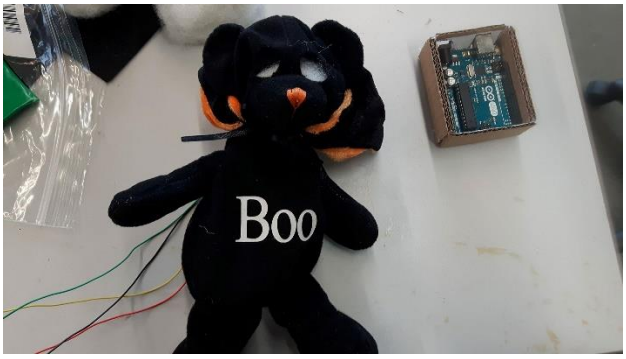


3 pressure sensors are put inside the Boo Bear (in its paws and chest)

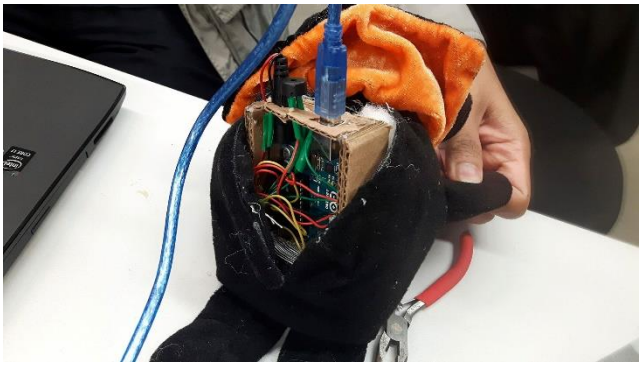




The eyes are cut out in order to insert the movement sensor instead.

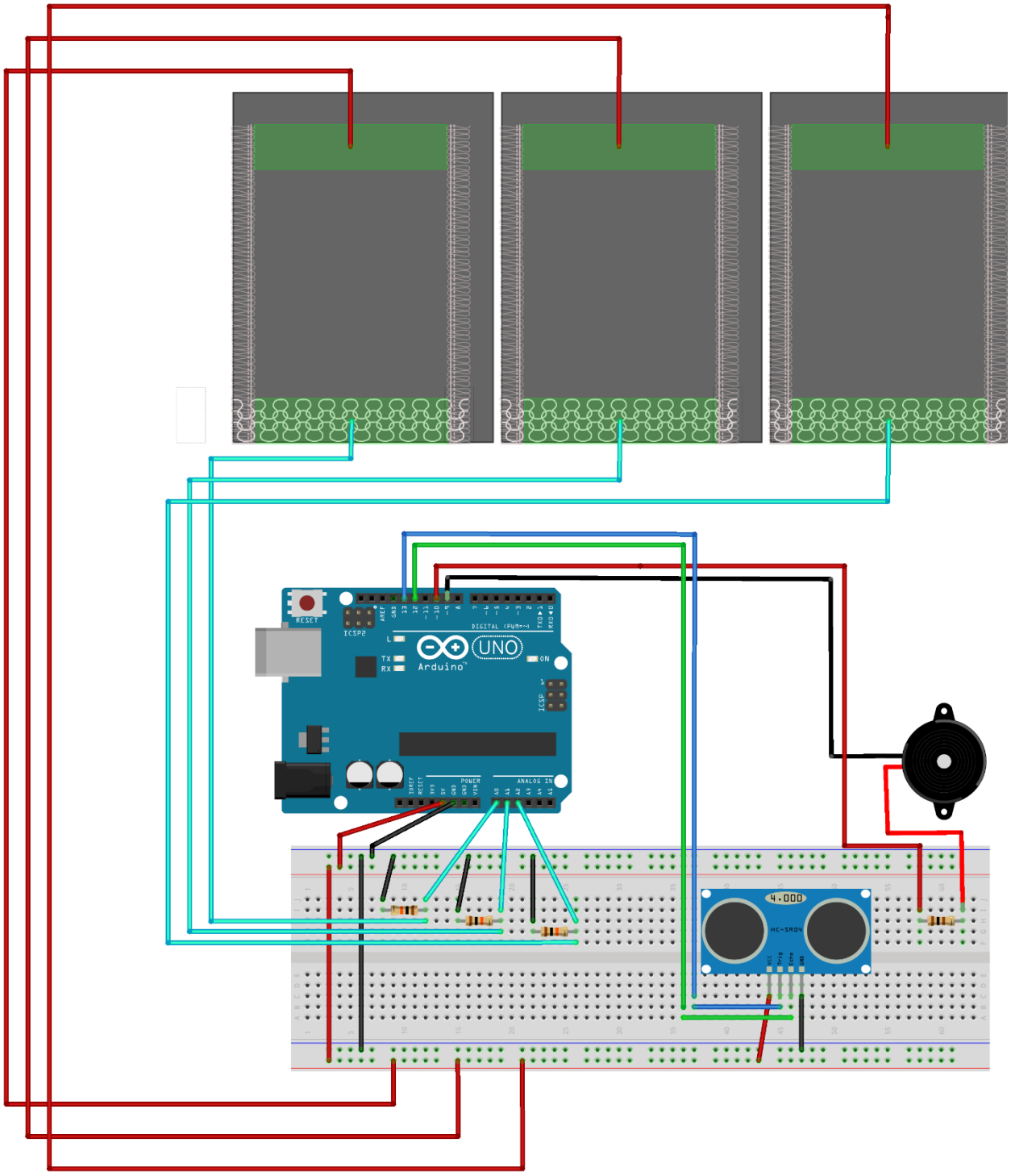


The Arduino and the circuit are put inside the bear's belly



The Boo Bear as seen from the front. The motion sensor is his eyes.

Schematic



Schematic Explanation

HC-SR05 Ultrasonic Ranging Module:
For this range sensor we used the traditional method of setting the pins instead of the OUT pin for input and output for trigger and echo. The Vcc pin is powered and connected into Arduino 5 volt pin and GND pin is connect to the Arduino GND pin. The Trig pin is connected to the Arduino number 13 pin for triggering the pulse. And lastly, the Echo pin is connected to the Arduino number 12 pin for receiving echo.

Buzzer:
For the audible output, we used the toneAC library to control the volume of the buzzer. Therefore, the buzzer's pin needed to be connected to Arduino number 10 pin and number 9 pin with a pulldown resistor of 100 ohm.

Pressure-Sensitive Conductive Sheet (Velostat):
We used three pressure sensors for Boo Bear in which they are placed in the both arms and in the belly. The sensors are set up using pulldown resistor of 10k ohm to draw out the flow of the current into the Arduino analog input pins in which the 3 sensors are connected into A0, A1, and A2. The sensors are powered with Arduino 5 volt pin and the pulldown resistors are connected to the GND pin.

Teammate Evaluation

Gerald Alvarez:
The concept of using the range sensor was originally thought by my teammate (Maedeh). We then expanded the idea after seeing the Boo Bear at Dollarama Store. At the beginning, the concept was to create a simple musical object in which the range sensor will translate the range into frequency. However, the idea was too simple and we both decided to integrate a pressure sensor in which to the user could press to activate a certain frequency alongside the range distance. My teammate expanded this idea by providing the pressure sensors a range of frequencies and providing a formula equation for an offset for the frequency. From there we designed the behavior of the bear. More into the tangible aspect of the project, my teammate planned the dissection of the object, placement of the sensors, and putting all the circuit inside and closing the bear. Lastly, my teammate did the film editing and the finalization and correction of the documentation.

Maedeh Sharifi:
Gerald researched heavily on the technical aspects of the two sensors we chose: the range module and pressure sensor. We decided on the set of behaviors of the bears together and he wrote most of the code describing the Teddy Bear's sequence of actions. Gerald brought up the concept of massaging the bear in order to please him and as a result pass onto the next mode of action. He expanded on that idea by implementing a pleasure meter which acts as a counter calculating whether the user wins or fails the massage challenge. He added a behavior where the bear screams if the user fails the challenge. Gerald soldered the circuit parts together and created a box to place the micro controller inside in order to later put it inside the bear.