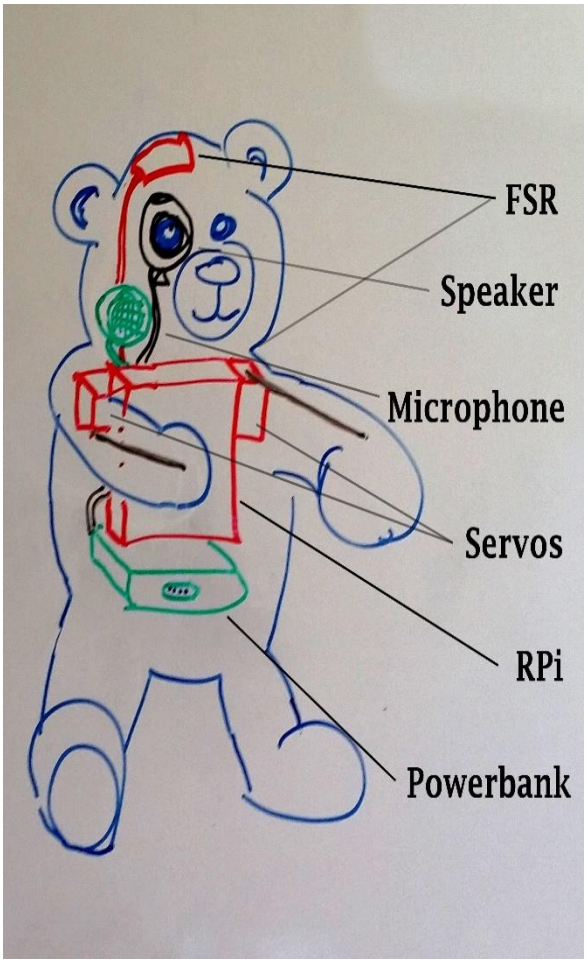
BARRETT BEAR: SERVICE MANUAL



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Akash Menon
Gustaf Franksson
Nora ALnaami
Oscar Hammarqvist
Oskar Dahl
Temin Lee

INNEHÅLL

1. ABSTRACT

The Barett Bear is an autonomous robot that is used for day-to-day companionship. The functionalities vary and can be added and removed by the user's taste but in this prototype the functionalities can be described as hugging, petting and talking.

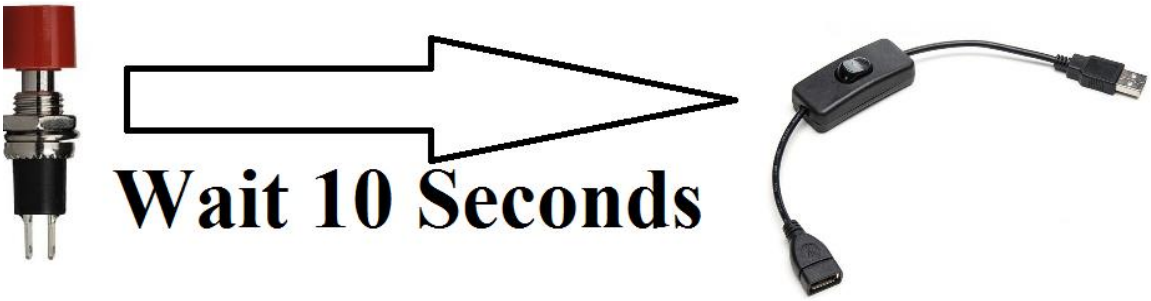
2. USER MANUAL

2.1 TURNING ON

To turn on the Barett Bear the user should turn on the black Switch which is located inside the back of the robot has to be toggled to On.

2.2 TURNING OFF

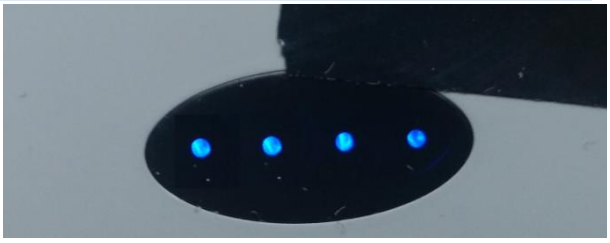
To Safely turn off the Barett Bear, the Red-Button on the back of the robot has to be pressed followed by a 10 seconds waiting time before toggling the black Switch to Off.



Pressing the red button is the correct way to shut down the robot, where all data and files are safely stored to the memory. By pressing the black power switch directly may cause the microSD card to get corrupted.

2.3 CHARGING BATTERIES

In order to charge the bear, a micro-USB cable needs to be connected to the battery (Powerbank) on the back of the bear. Once all 4 leds on the Powerbank is lit up, the Battery is fully charged.



2.4 PET

Gently pet (or apply pressure to) the robot on its head to make it activate the speakers outputting pre-defined sound. The robot is programmed to react to a solid pressure impact, therefore a too fast impact or nudge will not trigger the Pet sequence.

2.5 HUG

When embraced, by gently applying pressure to the Barret Bear, the robot will move its arms inwards, making a hug gesture.

2.6 VOICE RECOGNITION

For the Voice recognition, Barett Bear recognizes the words listed in its dictionary. The words have a different priority so when several words are recognized, the highest prioritized command will be executed before the lower priority command.

For example, if you say “Hello, it is a good morning” to the robot, it will respond with an answer: Good morning. Since ‘Morning’ has a higher priority than ‘Hello’.

2.6.1 VOICE COMMANDS

Silence - When either of the commands "Silence", “” Shutup” or “Quite” is spoken to the robot, it should immediately mute itself untill either of the phrases “Barett” or “Bear” is included in a sentence. Silence has priority number 99 and Barett has number 100.

Long conversation - When multiple defined phrases are recognized, Long conversation initiates and after the client stops speaking the bear will play a sound to encourage the client to proceed talking. Example of defined phrases:

Example of sound: “aha that is interesting”, “Go on”

Morning - When, the key phrase; "Morning" is spoken to the robot it should reply back by saying Good Morning, or some other appropriate phrase. Morning has priority number two.

Goodnight - When “Goodnight” is spoken to the robot pet, it should reply good night or some other appropriate phrase. Goodnight has priority number two.

Hello - When the keyphrase "Hello" is spoken to the robot, it should answer back by saying Hello or some other appropriate phrase. Hello has priority number three.

Joke - When mentioning the word “Joke”, the robot will recognize the word and tell you a randomly selected joke from its library. Joke has priority number three.

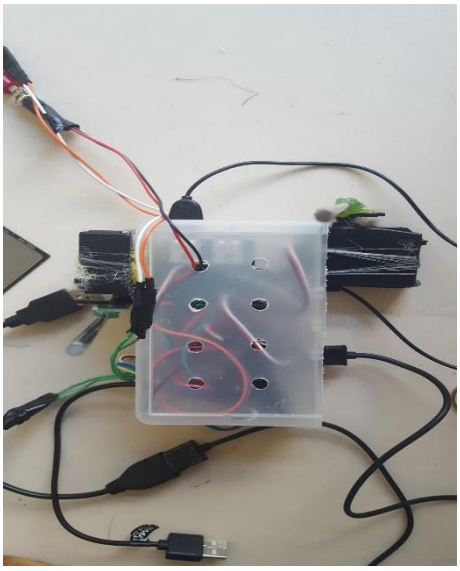
Hungry – The robot will react accordingly when” Food” or” Hungry” is spoken to it. Hungry has priority number three.

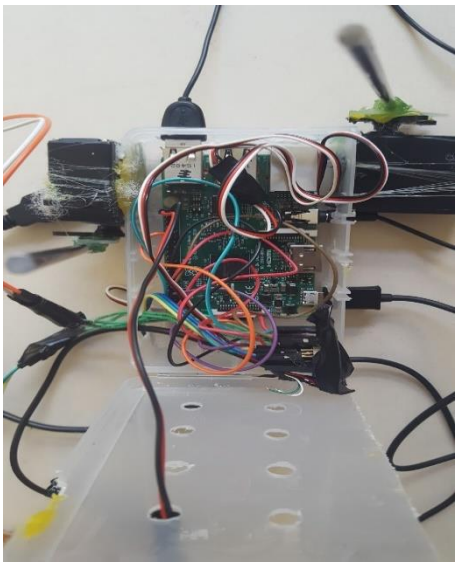
3. MATERIALS AND COMPONENTS

3.1 COMPONENTS

3.1.1 CASE

To hold all the hardware components fixed inside the embodiment and simultaneously protect them from physical impacts, the microcontroller and the circuit board were placed inside a custom made rigid plastic case. To this case the various components were connected by cables and some even glued firmly on to the case.





3.1.2 CIRCUIT BOARD

The circuit board works as a terminal between the components and the microprocessor where majority of the cables interconnects to this junction. The cables, pins, capacitor and resistors have been soldered to the board.

3.1.2 ARM

Two Parallax servos fastened to steel bars serves as the skeleton of the robot arm. One GPIO input pin is used for both servos on the RPi. As for the physical design, one servo is turned upside down and fastened to the hard plastic case to make the servos move inverted to the same destination on the same signal; like a hugging gesture. The hug is programmed to move in a rather smooth and slow hug inwards and move back in a faster pace.

3.1.2.1 PARALLAX STANDARD SERVO #90

The servo works as a junction between the fixed case, which indicates as the body, and the permanently fixed metal bar, which indicates the arm. The Barett Bear's arms, that are controlled by the servos, hold any position between 0° and 180° and has 38-oz in torque at 6 VDC. The power each servo requires is 4-6 VDC.

3.1.3 BROWN TEDDY WITH ROSETTE

A moderate sized, 35cm in height, brown cuddly Teddy bear stuffed with cotton with a golden rosette around its neck is used as the embodiment of the Barett Bear.

3.1.4 MICROCONTROLLER: RASPBERRY PI 3 MODEL B

A 64-bit processor with 1GB RAM-memory, the Raspberry Pi 3 model B, was used as the CPU for the robot. The microcontroller, together with the wired circuit board is protected in a plastic case to protect them from physical impact and other external contact.

3.1.5 MINI SPEAKER KITSOUND

A compact speaker powered by an external built-in rechargeable battery connected via the 3.5mm port on the RPI is used for sound output. The speaker itself is connected to one of the Raspberry Pi's USB ports for continuous electrical supplement.

3.1.6 SAMSUNG EVO MICROSDHC 32GB

For storage of all the data and the software, we use a microSD card which has a capacity of 32GB and uses UHS-I interface. Its transfer speed is 48MB/s with UHS-I interface.

3.1.7 SQUARE FORCE-SENSITIVE RESISTOR (FSR) - INTERLINK 406

Two square force sensitive resistors that vary its resistance depending on the pressure applied. The harder the force, the lower the resistance. FSR's voltage is from 0.1-5 V and current depends on the area. The area for the square FSR is 1.75x1.75 which is 3.0625 mA.

3.1.8 ENERPLEX JUMPR PRIME POWER BANK 10400 MAH

For the power supply the Barett Bear uses a power bank with an electric charge of 10400mAh. The two ports, that can charge small USB-enabled devices, has a power output of 2.1A where both the Raspberry Pi's and the Parallax Standard Servo's power cords are connected to.

4. SOFTWARE

The Barett bear is controlled through a program, written in high level programming language; python. The program is in the auto-start options for the operating system together with a small, separate program which enables the usage of the "safe shutdown button".

For the Voice Recognition Software, Jasper was chosen as the Barett Bear's platform. The STT (Speech-to-text) used is called Pocketsphinx**,** which is an offline package and serves well with embedded systems which are supposed to run without constant internet connection. In order to make the Barett bear more personal, a library consisting of multiple signed 16-bit wav-audio files were recorded and imported to the unit.

5. HOW TO DISASSEMBLE

STEP 1. - TURNING OFF THE BARRETT BEAR

Unzip the Bear, beware of the polyester cotton getting stuck in the zipper.

STEP 1.2.

Just under the zipper lies a FSR and just under it, should the Red and black push button, that are taped together, be. Push the Red Button firmly, to safely shutdown the computer unit.

STEP 1.3.

After waiting 10 seconds turn the power-supply switch Off.

STEP 2. – DISASSEMBLING THE POWER BANK

Carefully reach up your hand from the back of the bear and grab the USB cables connected to the power bank in the bottom of the bear. (You might have a limited vision since the bear is stuffed with a lot of polyester cotton. Either dig for the power bank or remove some of the cotton to find it.)

If you have located the power bank, gently pull the two connected cables, one belonging to the servo and the other to the power supply from the RPi, from the power bank. When the power bank is fully detached, pull it out of the bear.

STEP 3. DISSASSEMBLING THE CHASSIS

Now carefully pull out the chassis, the plastic case, containing the RPi with the attached servos from the bear. The chassis is quite big and with all the wires it might take some twists and tweaks to get it out from the bear.

***Warning**, there are still loose cables with FSR:s, a speaker and a microphone inside so be careful not to damage them or pull them off by force from the chassis.*

STEP 3.1. REMOVING THE SPEAKER

Turn off the spherical speaker by switching the button to Off. The blue light on the speaker should die when the speaker is turned off.

Carefully grab the plastic case (in which the Raspberry Pi 3 B is located) with one hand. With the other hand grab the USB-cable, which charges and supplies the speaker with power, that connects the speaker and the plastic case and pull it out from the USB-port. If there is too much trouble removing the cable, simply open the plastic case and directly but yet carefully grab the Raspberry Pi 3 B and try pulling the cable out again. Do the same thing with the 3.5mm audio connection cable from the speaker.

STEP 3.2. REMOVING THE MICROPHONE

The microphone, which is a webcam, is located in the head of the embodiment. If it has not been removed from the bear while removing the chassis, pull it out of the bear. Unplug the USB connection from the RPi.

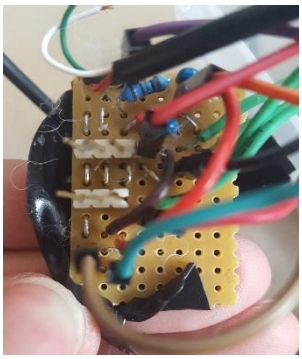
STEP 3.3. REMOVING THE FSR

There are two square and flat FSR: s in the bear. One, as you might have seen just under the zipper when you opened the bear, the second is just under the surface of the back head of the bear. Pull both of the FSR:s out, if they are not already outside of the bear, which are connected to the RPi inside the chassis. The connection area for the FSR:s and the cable was fastened with glue and electrical tape. It is easily removed by removing the tape and glue with your bare hands.

STEP 3.4 REMOVING THE ELECTRIC CIRCUIT BOARD

The electric circuit board is connected to the RPi:s GPIO pins. The different components, resistors and capacitors etc. are permanently soldered onto the circuit board and cannot be removed unless breaking the component.

Now, open the chassis and pull out the cables from the Raspberry Pi's GPIO pins by pulling either the cables directly or the plastic end-parts. If the plastic end-parts of the cables gets stuck at the GPIO-pins, simply pull them out directly with either your hands or a pincer.



STEP 3.5 REMOVE THE RPI

Now there should only be the power supply cable, with a USB button adapter attached to the RPi. Remove the last remaining cable from the RPi and take out the microcontroller from the case.

STEP 3.6 REMOVE THE MOTOR-SERVOS

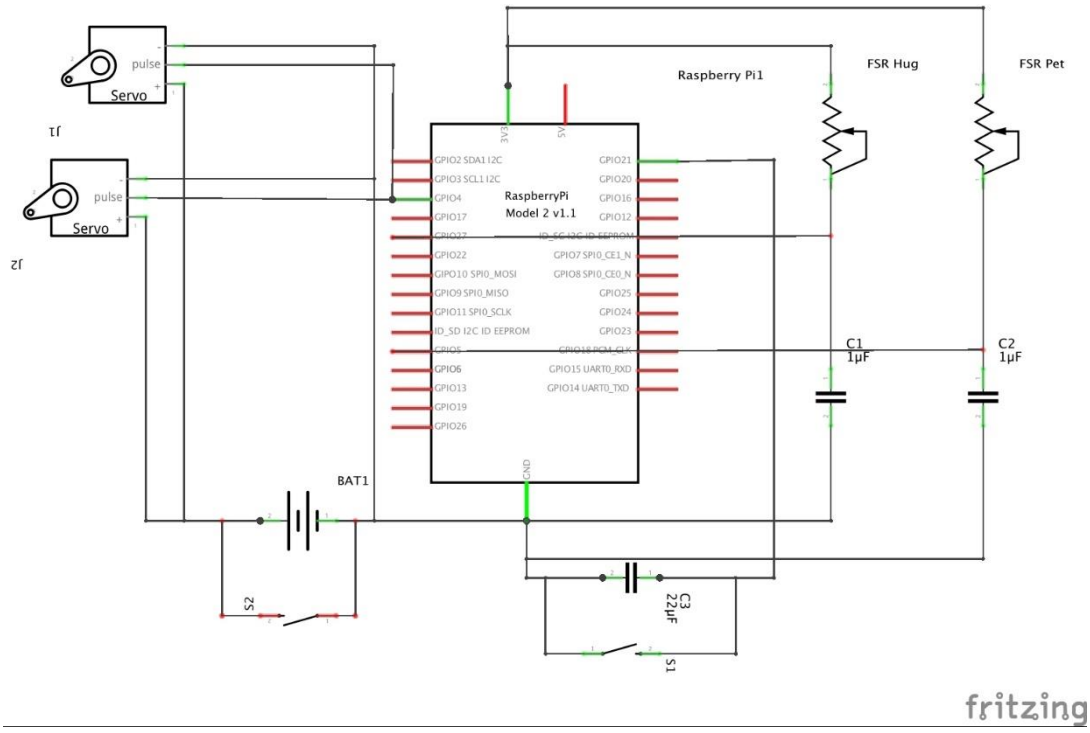
***Warning**, the motor-servos are firmly and permanently fastened with fishing lines and glue. When once removed it will be unable to reattached.*

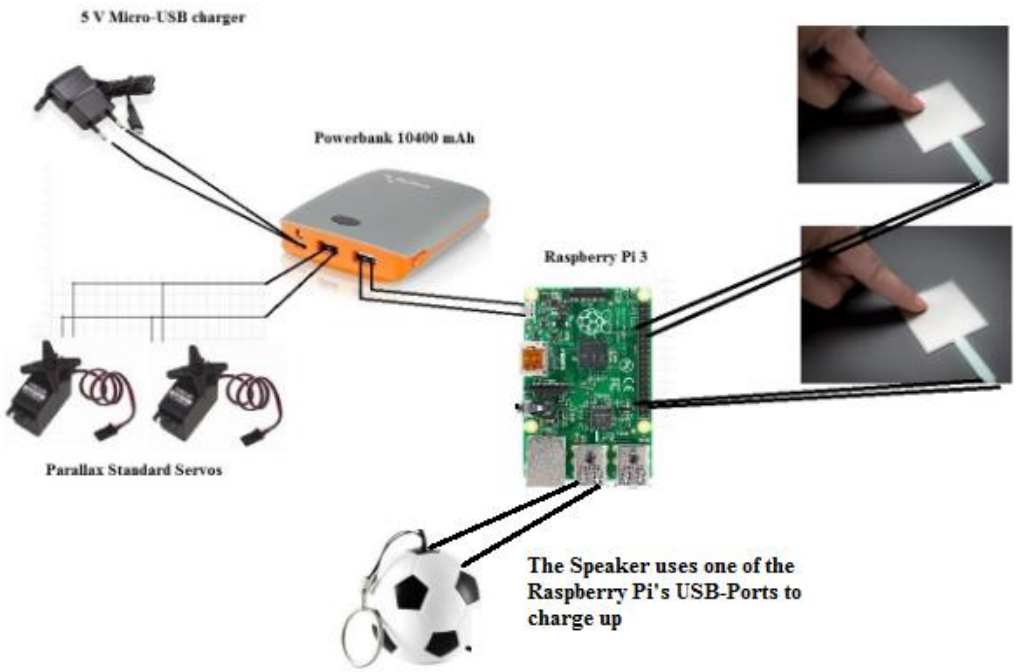
Use a scissor to remove the fishing lines that keeps the motor-servos in place. With force pull off the motor-servos off the chassis.

The Bear is now successfully Disassembled!

6.APPENDIX

6.1 ELECTRIC CIRCUIT DIAGRAM




5 V Micro-USB charger
Powerbank 10400 mAh
Raspberry Pi 3
Parallax Standard Servos
The Speaker uses one of the Raspberry Pi's USB-Ports to charge up