it.its goal is to move the robotic arm through the movement of the foot based on a sensing system

THE ANDREW & ERNA VITERBI FACULTY OF ELECTRICAL ENGINEERING

CRML

Control Robotics and Machine Learning Laboratory

TECHNION Israel Institute of Technology

Controlling a robotic arm using sensors on foot

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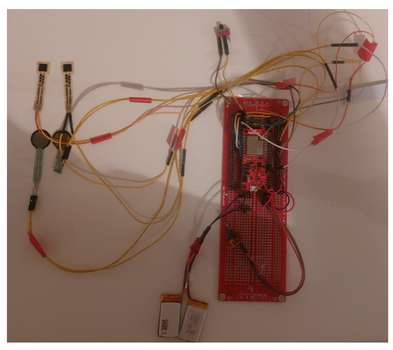
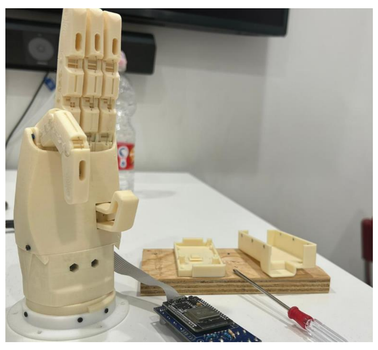
Introduction

- The purpose of our project was to create a light and affordable solution to people who lost their arms in association with the charity Haifa3d
- Our system uses force sensors connected to a controller to read inputs from the user





Goals

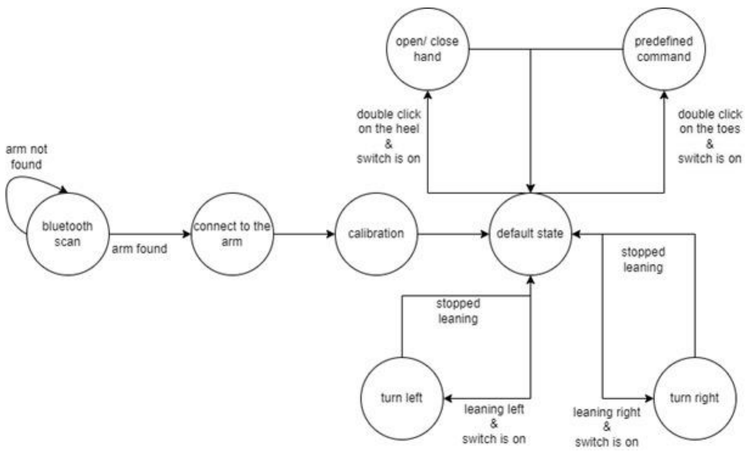
- Affordability
- Simple to use
- Reliable
- Adjustable for different users

Challenges

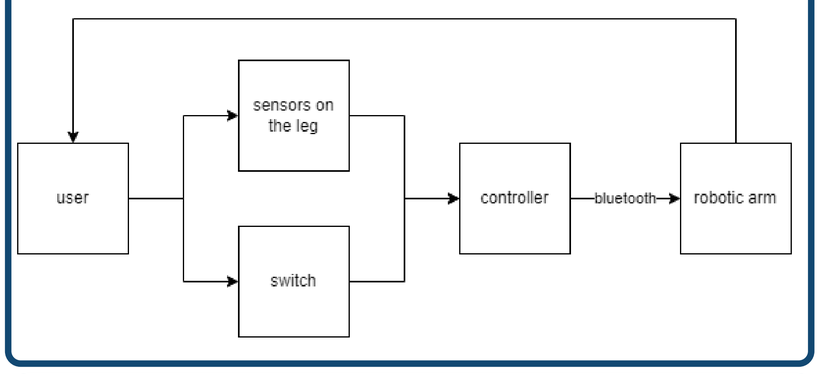
- Identifying orders correctly
- Making the system adjustable for different users
- Connecting the system to the arm via Bluetooth

State machine

- The systems state machine is as follows:



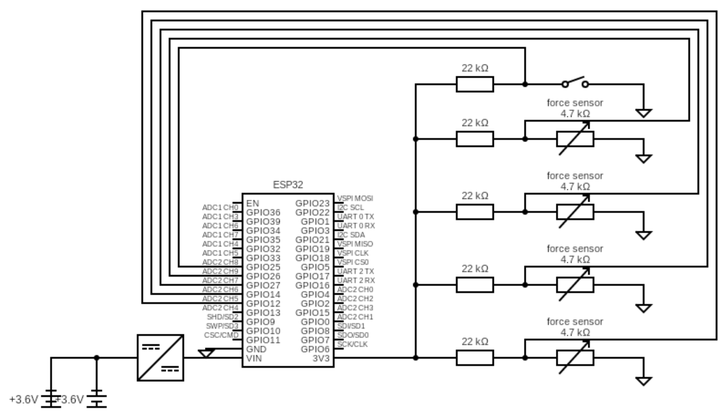
The systems Block Scheme



Physical design

The components of the system:

- Esp-wroom32 microcontroller
- 4 force sensors: FSR402 Force Sensitive Resistor 0.5 inch
- 5 resistors with a resistance of $22k\ \Omega$
- Three leg switch
- 2 batteries 3.7[V] 350[mA]
- 3.3[V] Voltage regulator



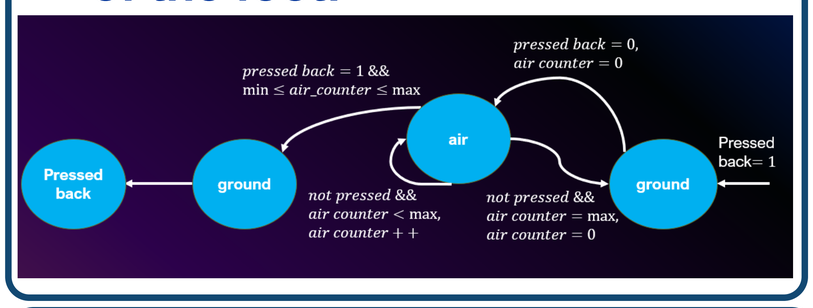
Calibration

- To make the system adjustable, each user must calibrate the system at initial use
- The following screen is shown to the user via a phone connected to the system
- The length of the calibration is 30 seconds

```
16:56:05.772 Forming a connection to 24:62:ab:f9:72:9e
16:56:05.778  - Created client
16:56:05.842  - Connected to server
16:56:07.643  - Found our Execute service
16:56:07.643  - Found our Execute characteristic
16:56:07.648  - Found our Trigger service
16:56:07.648  - Found our Trigger characteristic
16:56:07.654 We are now connected to the BLE Server.
16:56:07.654 started calibration stand normally
16:56:07.658  lean forward
16:56:14.654  Now lean backwards
16:56:19.654  Now lean right
16:56:24.654  Now lean left
16:56:29.654  Ended calibration
```

Tap detection algorithm

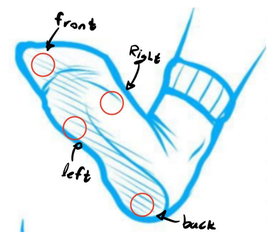
- In order to prevent misinputs we created an algorithm
- The user must double tap to send a command
- The algorithm measures a single tap on the front or back of the foot:



Users manual

1. Sensor placement

- The user must place the sensors as follows:

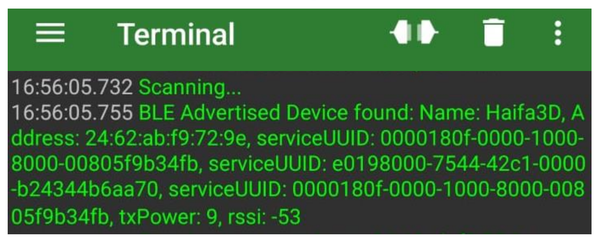


2. Turning on the device

- The user must turn on the controller and connect it to the phones serial usb terminal app via usb

3. Connecting to the arm

- The user must turn the arm and the device will connect automatically



4. Calibration

- The user must follow the instructions given by the phone

5. Usage

- The user can disconnect the phone from the device and control the arm
- Leaning will cause the arm to turn
- Double tapping at the heel will cause the arm to open and close