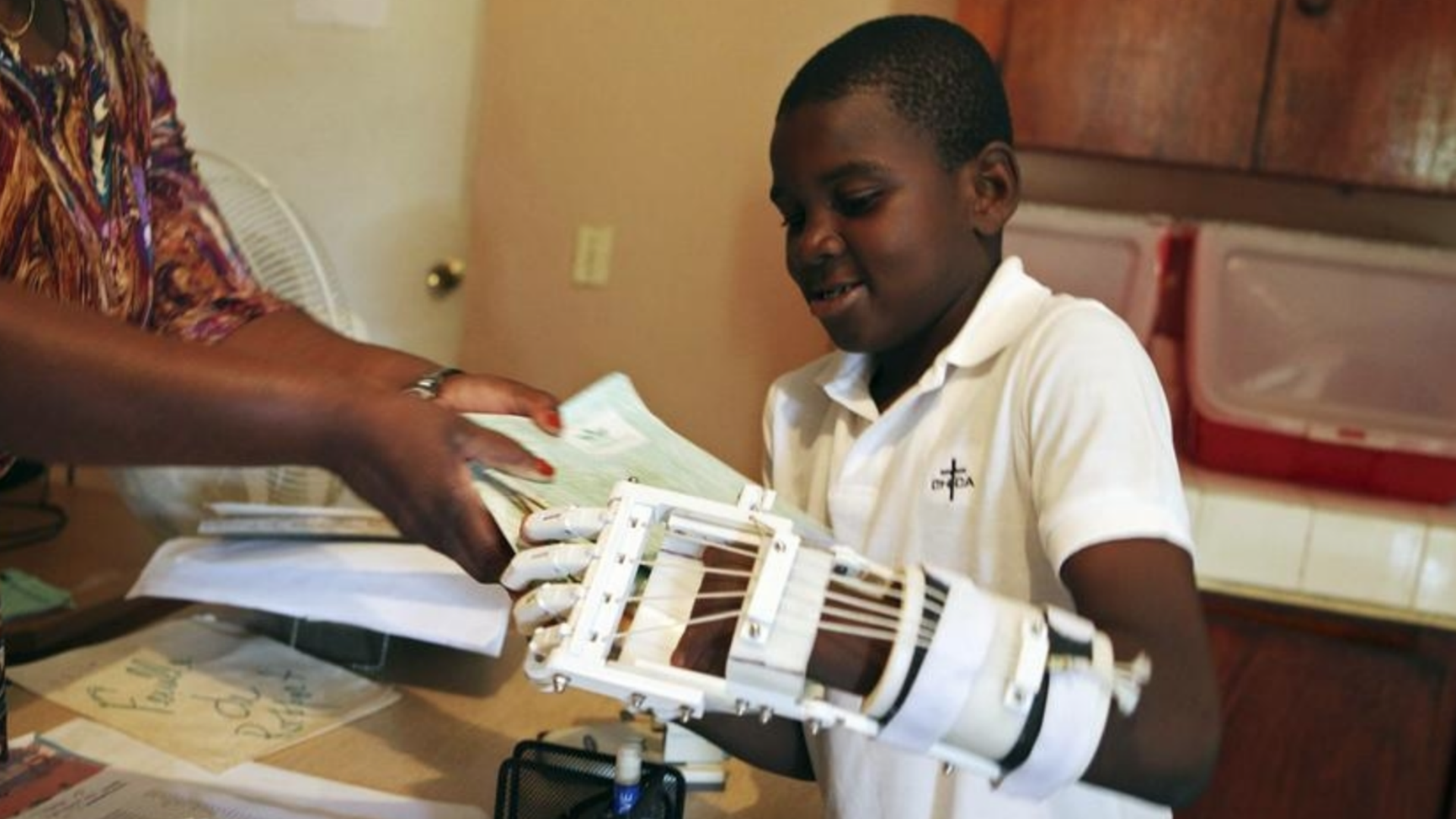


Robotic Hand

A robotic hand controlled by
electromyography and voice recognition

Chance Martin
Aaron Feldman
Shang-Li Wu
Sami Malek



“every \$1 dollar spent on rehabilitation saves the economy \$11 in various welfare and disability benefits. On the other hand, a person who does not receive a prosthetic within 2 years of amputation has a greater likelihood of social welfare, increased health concerns including obesity related diseases and conditions and is more likely to suffer depression. The US amputee population is approximately 1.9 million persons and growing, however science and medicine provide the technology to restoring a person's dignity, self-reliance, productivity and ability to contribute to society.”

<http://www.disabled-world.com>

OPEN SOURCE

... why we should use

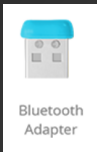
System wide view



USER

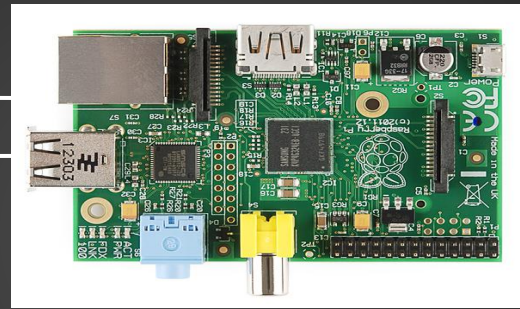
Voice commands

Bluetooth BLE



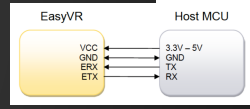
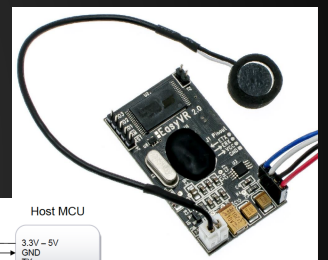
Bluetooth Adapter

2x USB ports

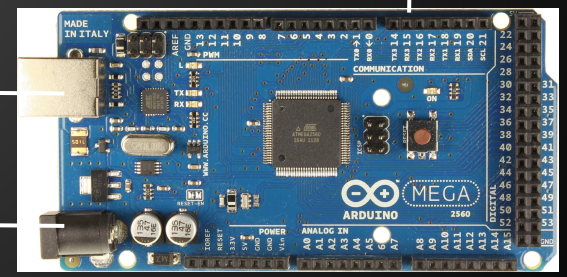


USB serial comm

5x PWM control signals
to servo motors



UART



What kind of Motors?

DC Motor?

Stepper Motor?

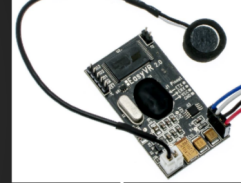
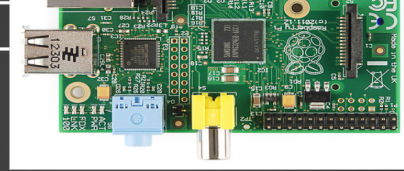
Servo Motor?

Arduino mega board

- ATmega2560 microcontroller
- 5V operating voltage
- 15 digital I/O provide PWM output (+)
 - perfect for controlling our servo motors
 - 40 mA DC current per I/O pin (won't drive servos) (-)
- 16 MHz clock speed (-)
- 256 KB flash memory (-)
- Easy hardware integration with VR module (+)

Note: No OS

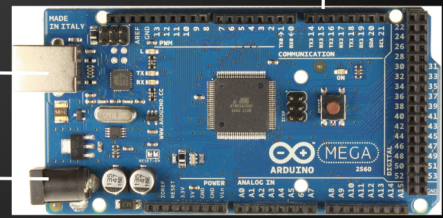
Arduino side (C)



UART

USB serial comm

5x PWM control signals



- Servo library
 - mediate PWM comm with servo motors
- EasyVR library (MIT license)
 - provide API for communication with VR module

```
void one(){ //fist
    myservo1.write(100);
    delay(100);
    myservo2.write(150);
    myservo3.write(150);
    myservo4.write(150);
    delay(100);
    myservo5.write(150);
    delay(100);
    myservo1.write(150);
}
```

```
void recognizeCommand (int8_t group)
    Starts recognition of a custom command. Results are available after hasFinished() returns true.
```

```
bool hasFinished ()
    Polls the status of on-going recognition, training or asynchronous playback tasks.
```

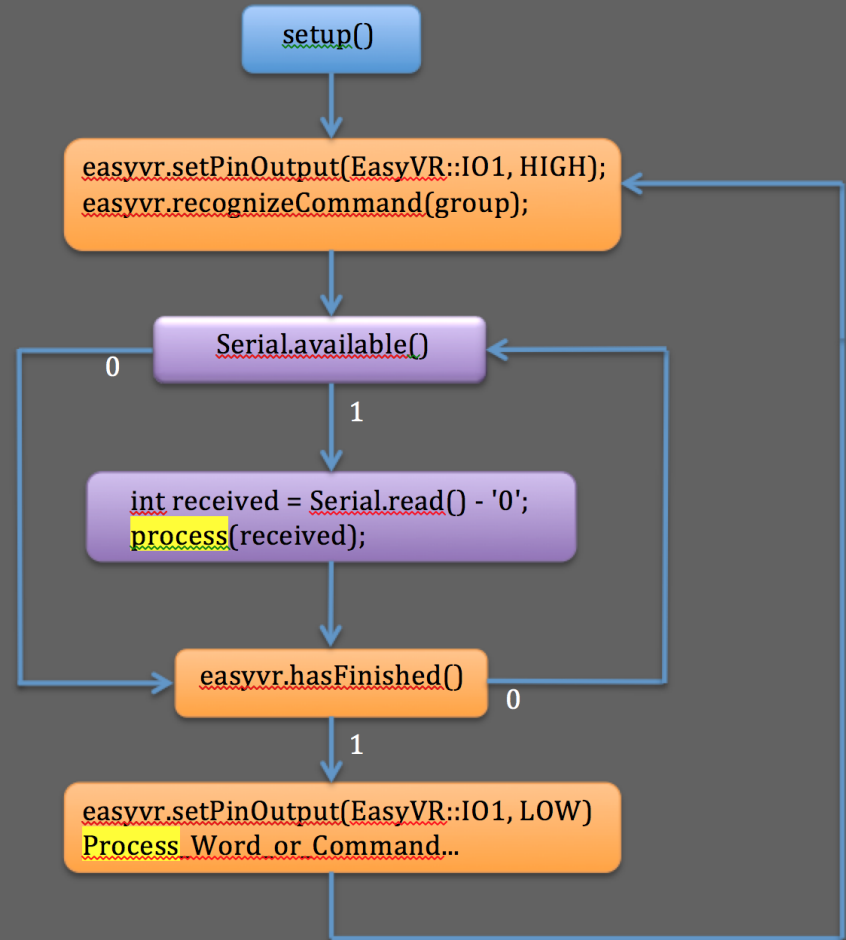
- Serial library
 - receive raspberry pi USB serial messages

```
if (Serial.available()) {
    int received = Serial.read() - '0';
    process(received);
}
```

Arduino Side

```
easyvr.setPinOutput(EasyVR::IO1, HIGH); // LED on (listening)
Serial.print("Say a command in Group ");
Serial.println(group);
easyvr.recognizeCommand(group);
do
{
  if (Serial.available()) {
    int received = Serial.read() - '0';
    process(received);
  }
}
while (!easyvr.hasFinished());
easyvr.setPinOutput(EasyVR::IO1, LOW); // LED off

idx = easyvr.getWord();
```



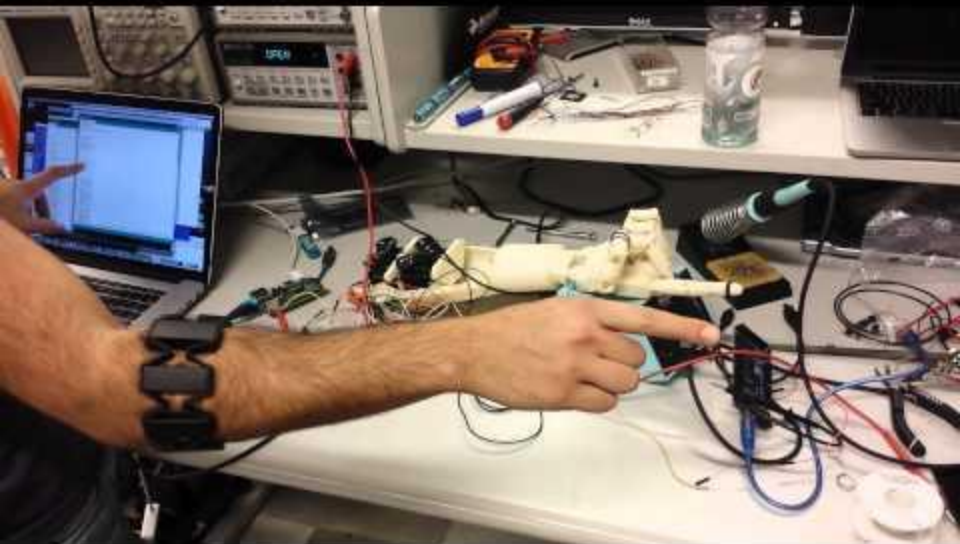
Raspberry Pi board

- 512 MB RAM
- 2 USB ports
- 700 MHz processor (+)
- **hosts Linux OS**
 - **easily interfaced with dongles**
 - good for running
 - BLE stack
 - Python libraries (machine learning)

Raspberry Pi side (Python)

- Bluetooth (BLE) stack library
 - under MIT license
- Myo-specific protocol (hacked old version)
 - raw data streaming VS processed result
 - under MIT license
- sklearn library for training and classification
 - nearest neighbor classifier
 - 25 neighbors, 15 samples

Video Demo



Video links

http://www.youtube.com/watch?v=hO9Z_722qHo&feature=youtu.be

<https://www.youtube.com/watch?v=O4oDQ8jbVLA&feature=youtu.be>

Thank You