ROBOTNG LABS

THE NEXT GENERATION

ROBOTNG.CA

HEXLAB™ I

"CIRCUITS + CODE"

With Tolson Winters and Ben Beck

and Introducing: *RoboBuddy!*


Everyone Is Welcome Here!
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PART I: CIRCUITS

CIRCUITS

Gear:

- **HEXLINK™**
  - Microcontroller: WeMos D1 Mini on a Dual Base
  - Protoboard (Breadboard)
  - Jumper Wires
- **RoboBuddy™**
  - 1 Ultrasonic Distance Sensor
  - 3 Servomotors
- USB Cable

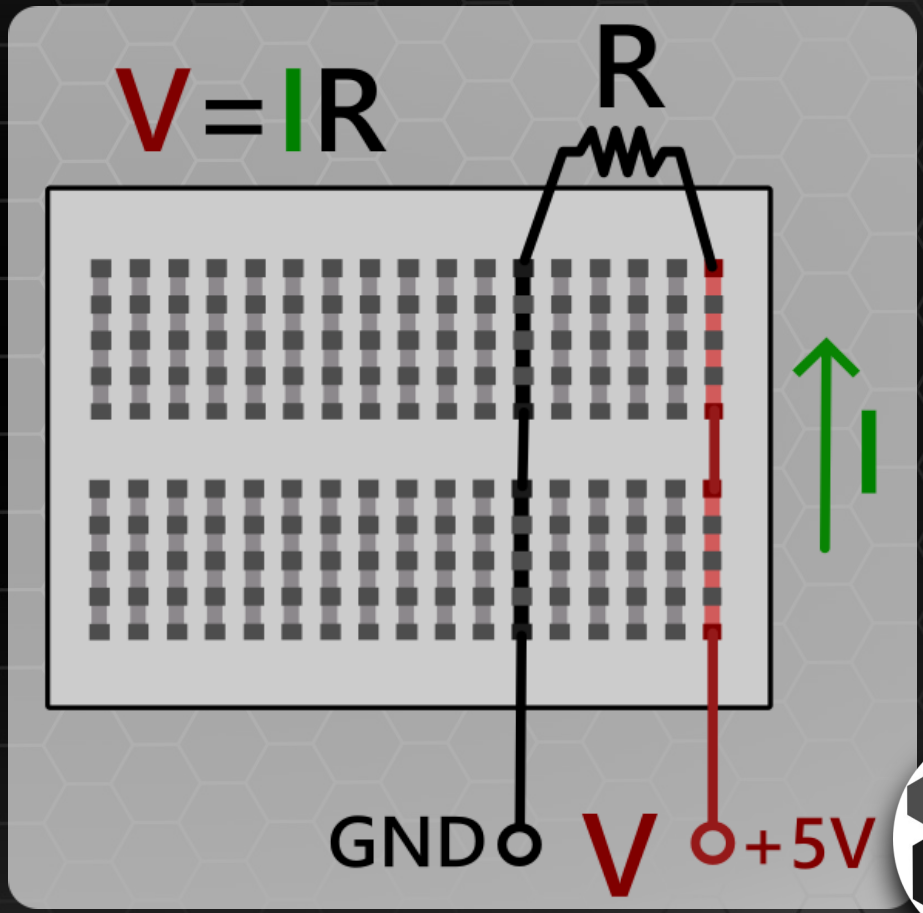
Concepts:

- Electric Potential (Voltage)
- Electronic Circuits
- Signal Pins (Digital/Analog)
- Wiring Schematics/Diagrams
- Prototyping
- *Short Circuits*

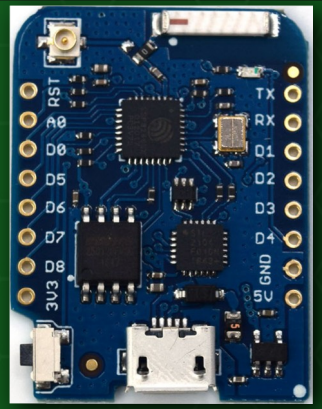
PROTOBOARD (BREADBOARD)

A Protoboard is Integrated into HEXLINK™!

- For Making Temporary Circuits
- "Rails" Link Pins as Shown
- Pins May Bend or Break
- Mind Your Fingers!
- Avoid "***Short Circuits***"



MICROCONTROLLERS: TINY COMPUTERS WITH *PINS*

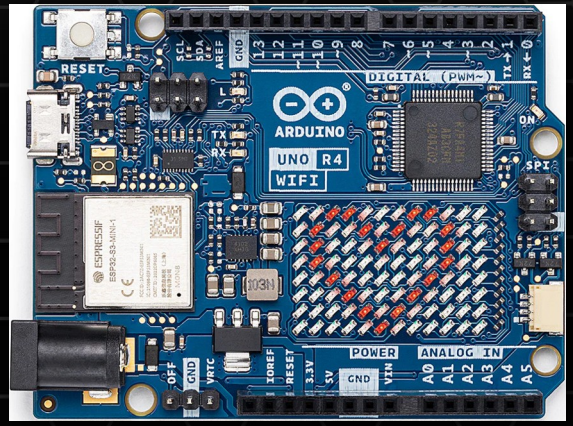


WeMos d1 mini

Very Compact

IoT (Internet of Things)

Some Soldering

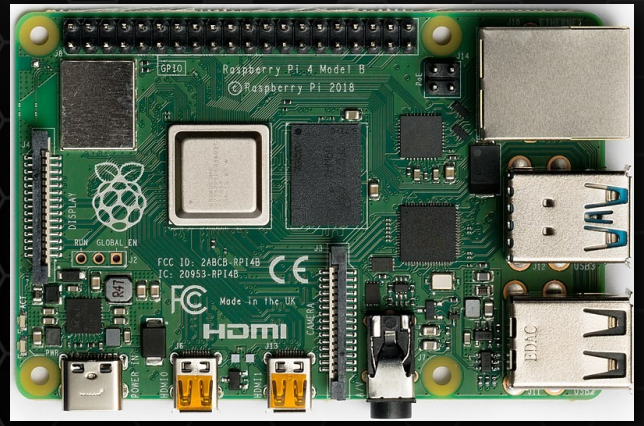


Arduino Uno

Larger

More Pins

No Soldering



Raspberry Pi

Fully-Featured PC

Even More Pins

No Soldering

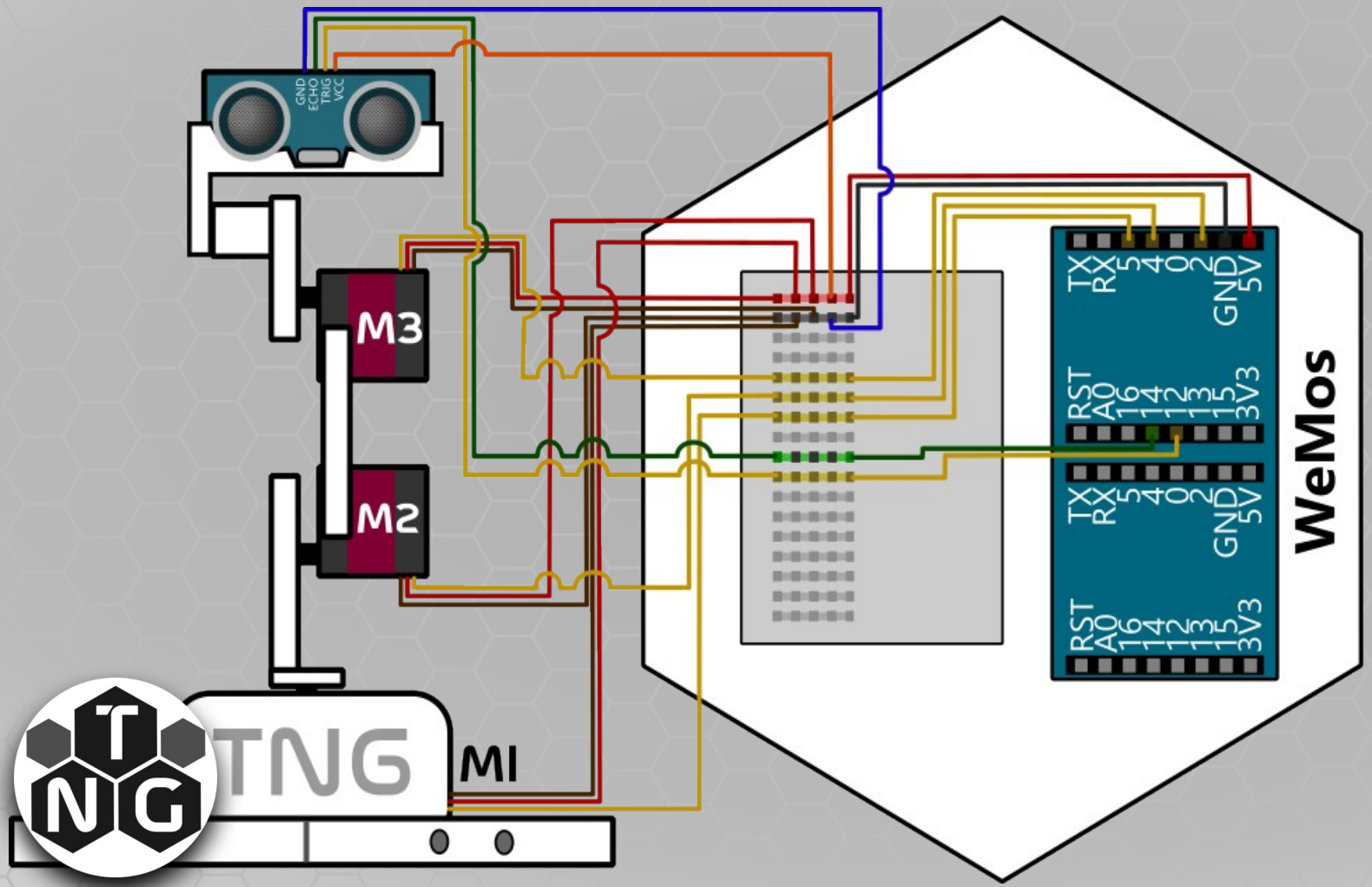
HEXLINK™: MODULAR PROTOTYPING

- ***WeMos D1 mini*** and ***protoboard*** mounted to 3d-printed hexagonal base
- Edge magnets connect to robotic component modules, mounting bases, activity kits, and more!
- Code in ***Python*** using ***uPyCraft*** IDE
- Connect to WeMos and operate robotics over local area network!
- No soldering required! (We do that)

DON'T PANIC

- All components are safe, and relatively inexpensive
- Core concepts are the same for all platforms (RaspPi, Arduino, WeMos)
- Pins operate a surprising variety of components in the same manner!

WIRING DIAGRAM: ROBOBUDDY™ + HEXLINK™



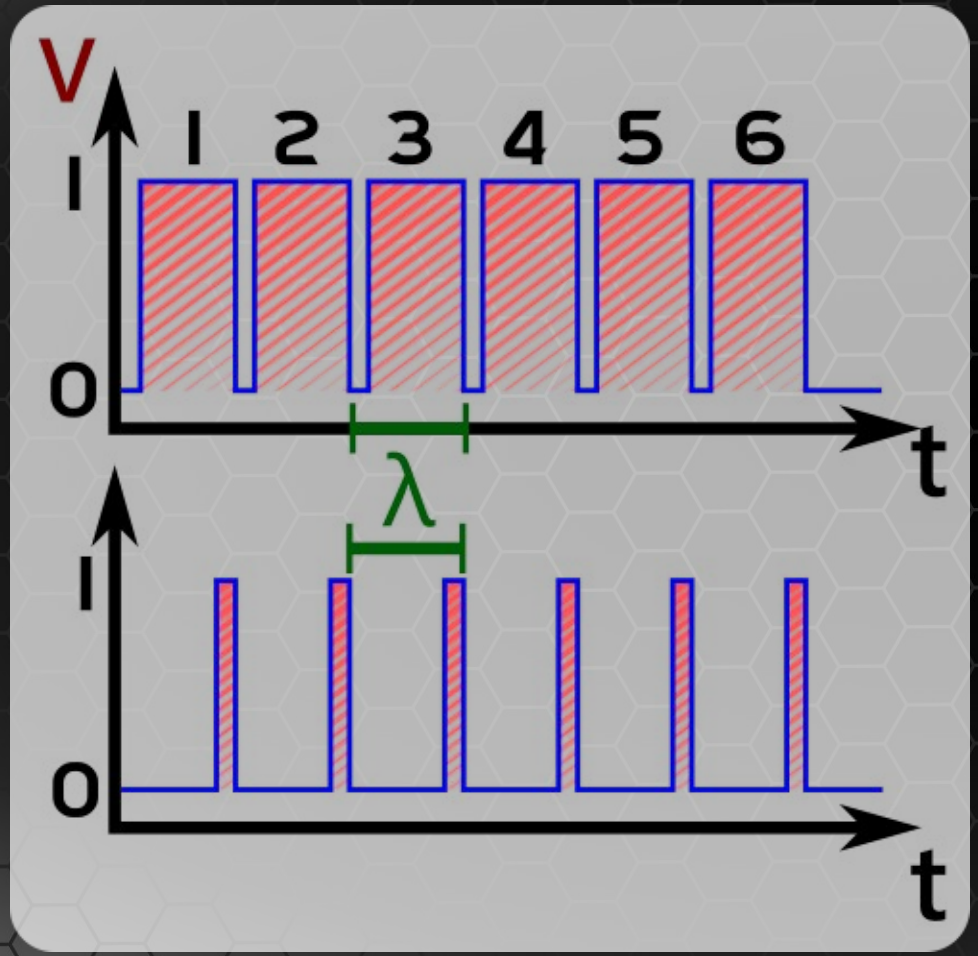
Sensor GND ► GND
Sensor Echo ► Pin 14
Sensor Trig ► Pin 12
Sensor VCC ► 5V

M1(red) ► 5V
M1(brown) ► GND
M1(orange) ► Pin 5

M2(red) ► 5V
M2(brown) ► GND
M2(orange) ► Pin 4

M3(red) ► 5V
M3(brown) ► GND
M3(orange) ► Pin 2

PULSE-WIDTH MODULATION (PWM)



- The Signal is ***binary*** (off or on)
- ***Wavelength*** (**λ**) and ***frequency*** (***f***) are unchanged
- The ***pulse width*** (time spent on) has changed!
- Known as ***duty cycles***
- Used to control servomotor positions, LED brightness, and more!


INTERMISSION
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PART 2: CODE

CODE

Gear:

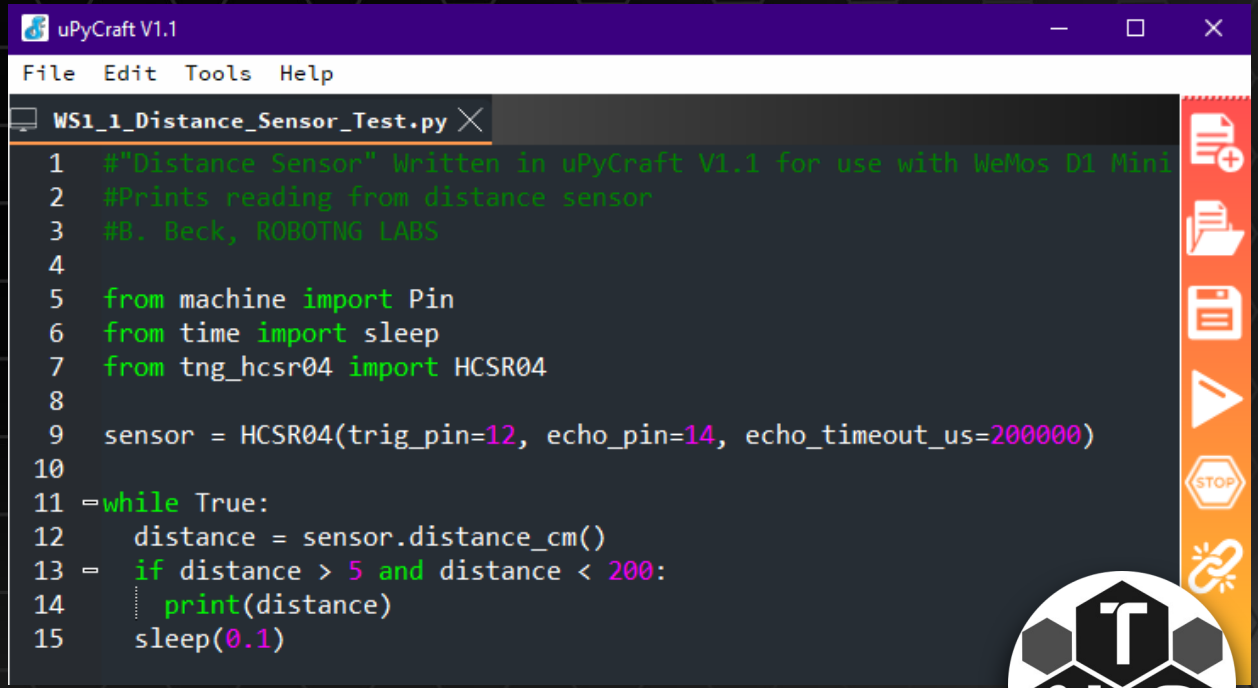
- Windows PC with USB
- Python
- uPyCraft IDE (Integrated Development Environment)
- RoboBuddy™ + HEXLINK™

Concepts:

- Loops (***For***, ***While***)
- Conditions (***If***, ***Elif***, ***Else***)
- Read and Write
- Functions(inputs)
- ***Sleep(****time (s)****)***
- "***Plugins***," "***Packages***," and "***Libraries***"

DON'T PANIC

- Python can be used for nearly any project
- Same concepts apply to all languages; ***syntax*** varies
- Steep learning curve; flattens quickly!
- Run ***small experiments***
- Work from examples and follow tutorials



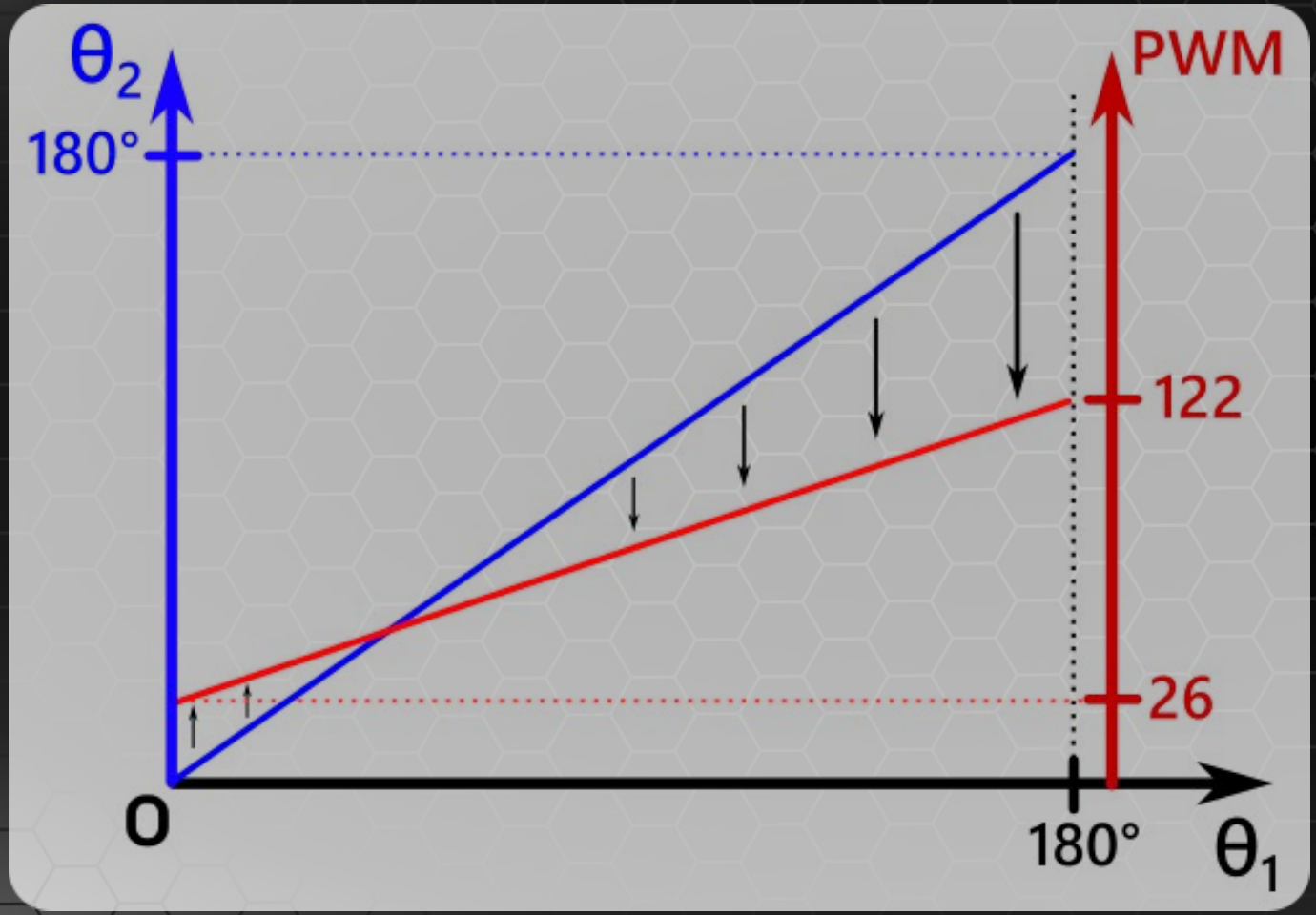
TIPS & TRICKS

- **Start simple:** operate a distance sensor, or a servomotor to start
- Work out what **error messages** are telling you, if possible
- Use "***Print(value)***" Function Strategically
- Use ***#comments*** to isolate or skip sections of code
- Read, understand and edit ***working code***

*WS1_2_Single_Motor_Test.py

```
4   #import functions from libraries
5   from machine import Pin,PWM
6   from time import sleep
7
8   #assign pin to servo and intitialize servomotor
9   Motor1 = PWM(Pin(5, mode=Pin.OUT))
10  Motor1.freq(50)
11
12  #start servo m1 at center position (in degrees)
13  m1 = 90
14  #convert degress to the corresponding PWM signal number
15  pos1 = int(0.54*m1 + 25.6)
16  #sets servo to position pos1
17  Motor1.duty(pos1)
18  sleep(3)
19
20  m1 = 0
21  pos1 = int(0.54*m1 + 25.6)
22  Motor1.duty(pos1)
23  sleep(3)
24
25  m1 = 180
26  pos1 = int(0.54*m1 + 25.6)
27  Motor1.duty(pos1)
28  sleep(3)
```

SERVOMOTOR VALUE CONVERSION



- We want to work in degrees (**0° to 180°**)
- The servomotor accepts values from **26 to 122**
- formula of the form: **y=mx+b** is used to convert degrees to **PWM** values

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HEXLAB™ I

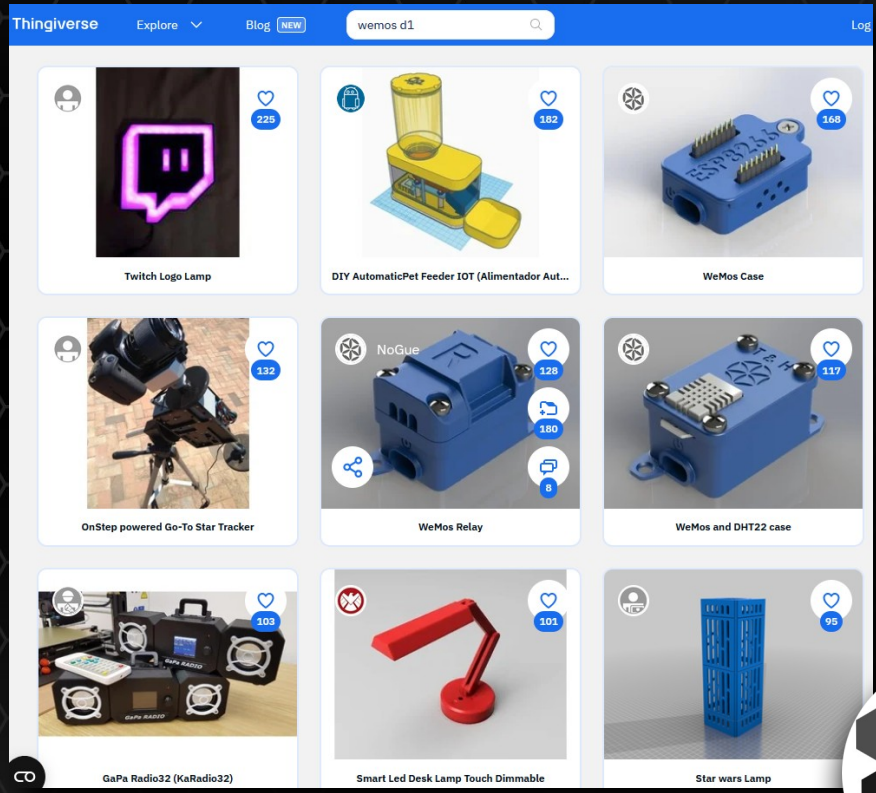
COMPLETED!

Thank you for joining us today!
We hope to see you again soon!

PART 3: EXTRA SLIDES

SKILLPOINTS: 3D PRINTING
MAKE (M)ANY THINGS

- Free downloadable 3D models (e.g. ***Thingiverse***)
- Filament Spools: Various, Colours and Materials



thingiverse.com (search: WeMos d1)

SKILLPOINTS: SOLDERING
PRACTICE MAKES PERFECT

$10 - $100 for a reliable ***soldering iron*** to start (local or online)

Fundamentals can be learned with a few hours

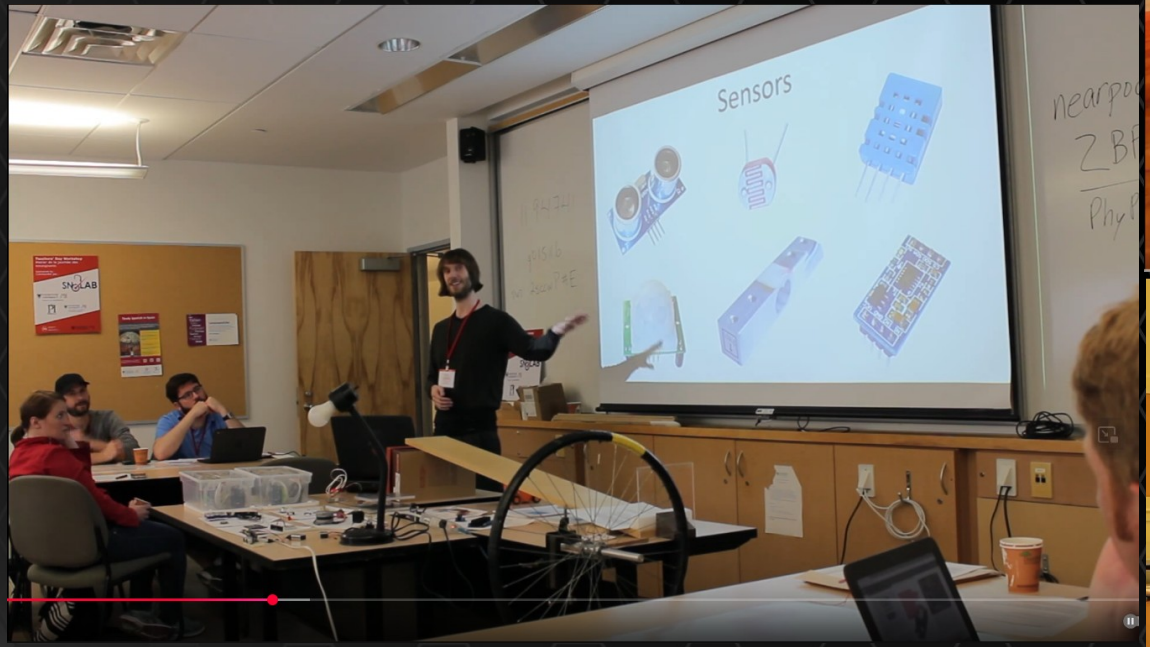
Sharp eyes, steady hands and patience are advantages

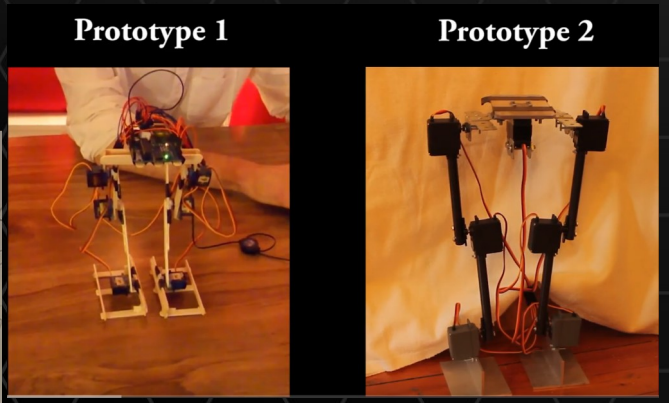
Safety and Quality of Life Factors:

- Ventilation, Good Lighting, Magnifying Lens, “Helping Hands” Soldering Mat, Temp control, Power switch, Stable Surface, Comfortable Chair

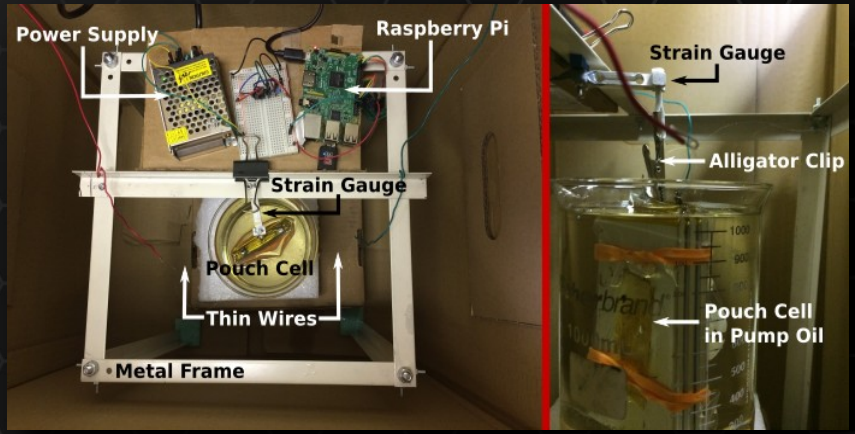
HOW WE GOT STARTED

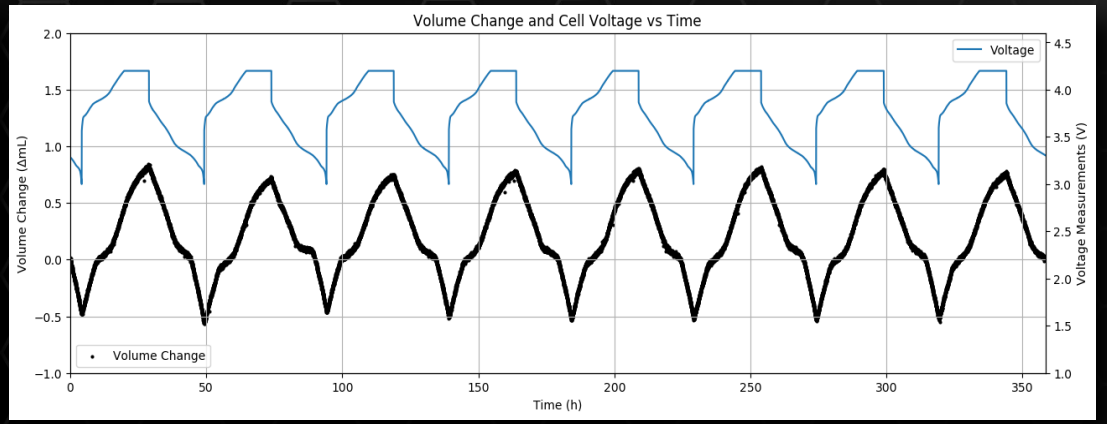
TOLSON'S FIRST ROBOTS

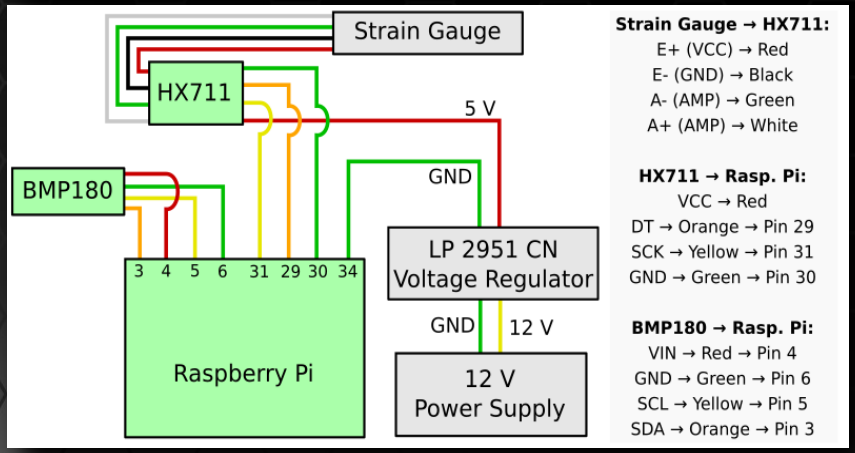




HOW WE GOT STARTED
BEN'S FIRST ROBOTS







Strain Gauge → HX711:
E+ (VCC) → Red
E- (GND) → Black
A- (AMP) → Green
A+ (AMP) → White

HX711 → Rasp. Pi:
VCC → Red
DT → Orange → Pin 29
SCK → Yellow → Pin 31
GND → Green → Pin 30

BMP180 → Rasp. Pi:
VIN → Red → Pin 4
GND → Green → Pin 6
SCL → Yellow → Pin 5
SDA → Orange → Pin 3