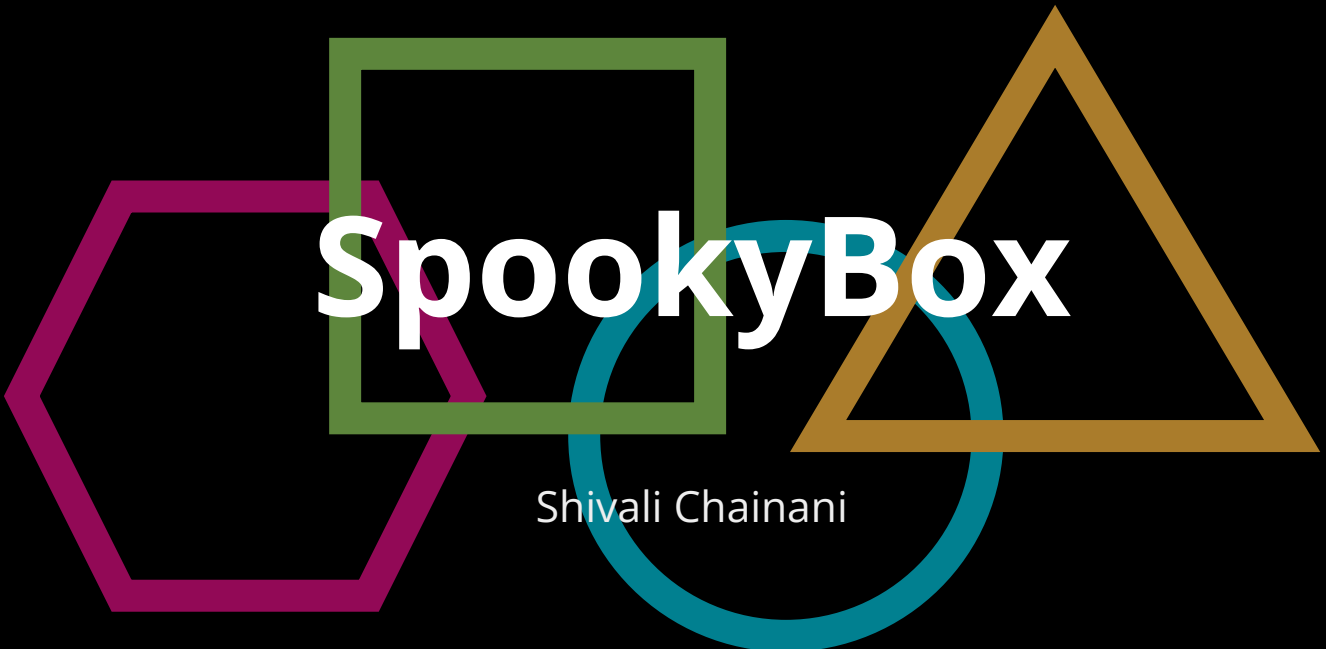




SpookyBox

Shivali Chainani

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Shivali Chainani

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- I run Cross Country
- I was captain on FRC Team 9015
- I'm working on my PPL
- I like to surf!

Origins of Spookybox



Origins of SpookyBox

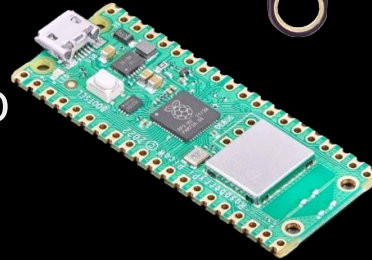
- We all enjoy CreepyPastas
 - A love for Halloween and scaring people
- A desire to protect people in the privacy of their homes
 - According to Simply Insurance, over 3,000 burglaries occur a day in the U.S. alone

Design choice

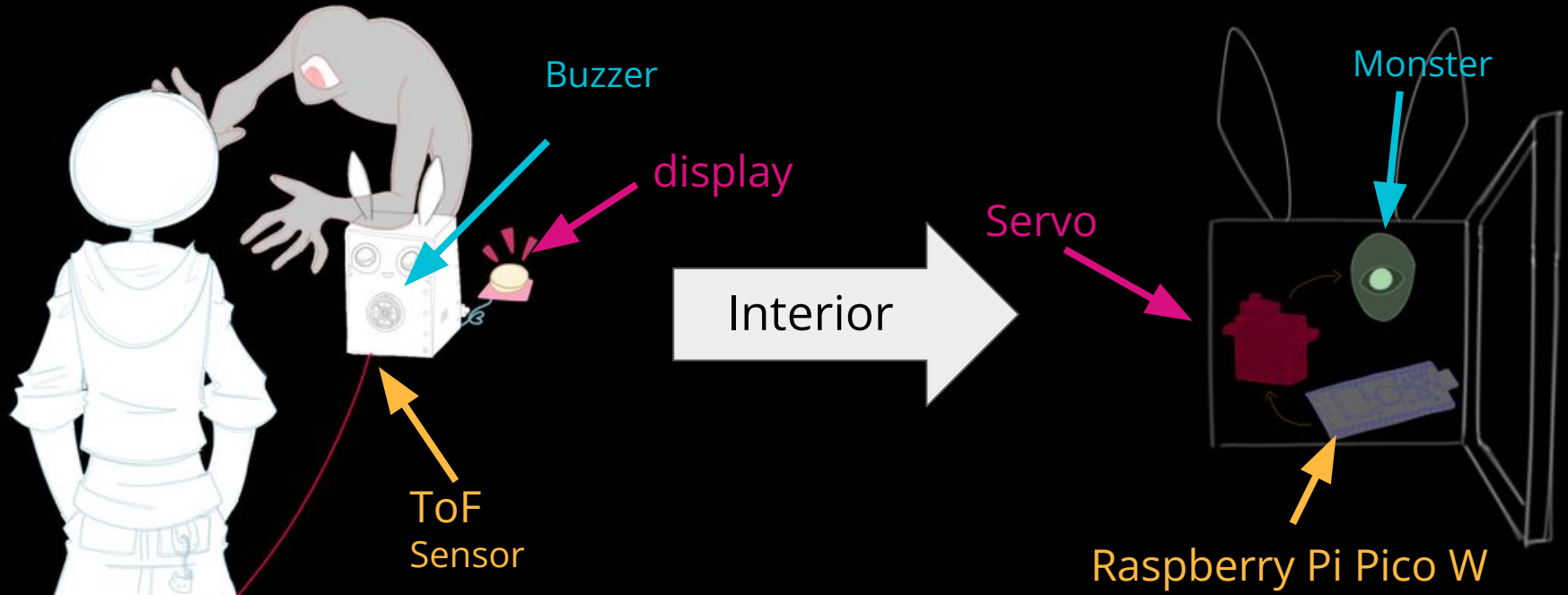
- Wanted to make sure the item is not noticeable
 - Security cameras are easy to spot
- Wanted to include multiple sensors and a motor
 - Including a wifi Module

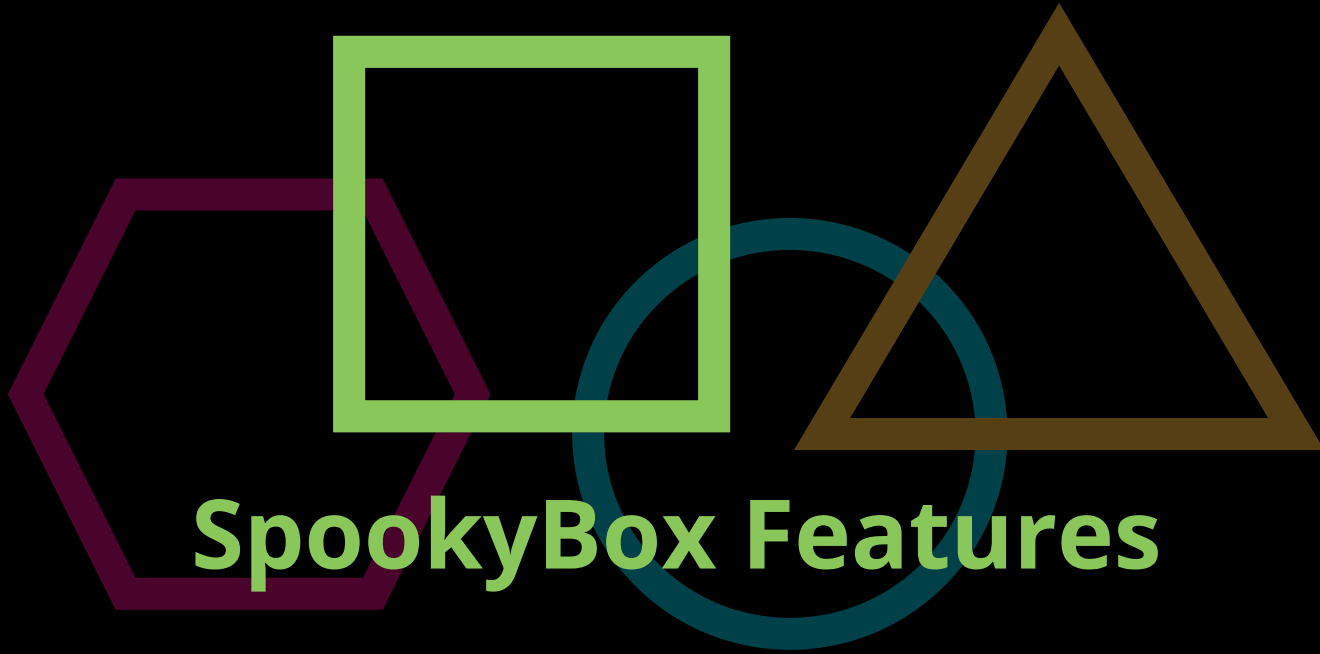
Dictionary

- Servo
- Time of Flight(ToF)
- Raspberry-Pi Pico
- Inertial measurement units



Concept

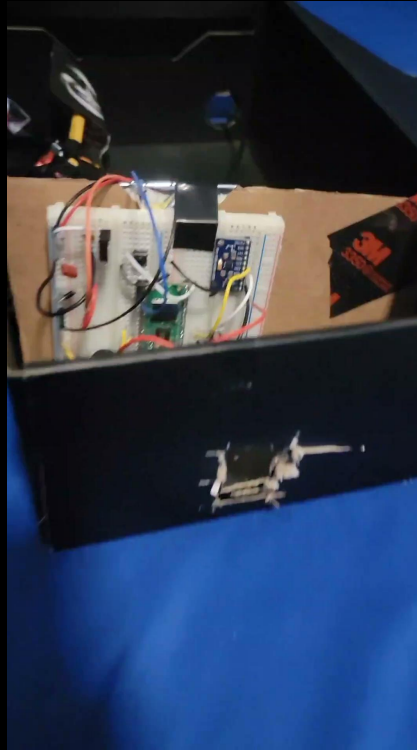




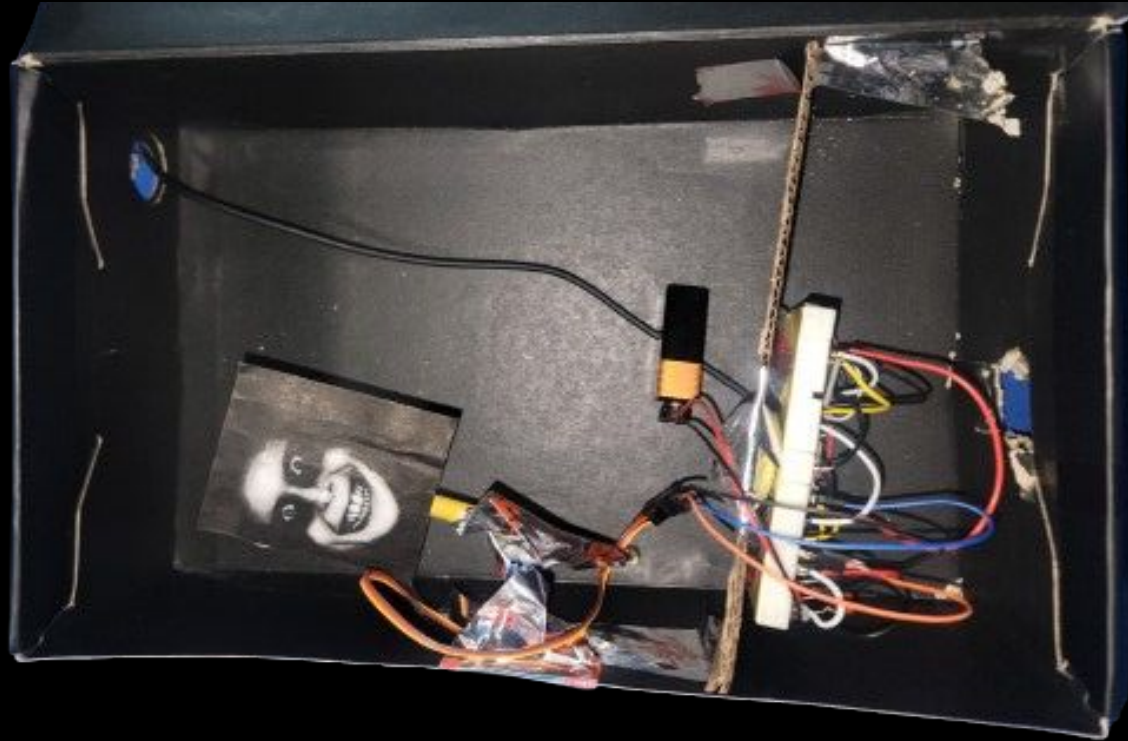
What exactly does SpookyBox do?

- Fully activates with the **press of a button**
- Actuates when someone or something is **between the distance of 150mm to 300mm of the Sensor (ToF)**
- During the activate, **a buzzer will sound** for added effect.
- A **visual display will launch** a message to the “intruder”
- A themed **object will pop out** of the box to “scare” the “intruder”
- The owner will **receive a notification** when the SpookyBox is activated
- The SpookyBox will **deactivate with the push of a button** OR when it is moved from its original location.

Video Demo



Example Interior



(Shoe box Model)

SpookyBox Models



Shoe Box
Garylee



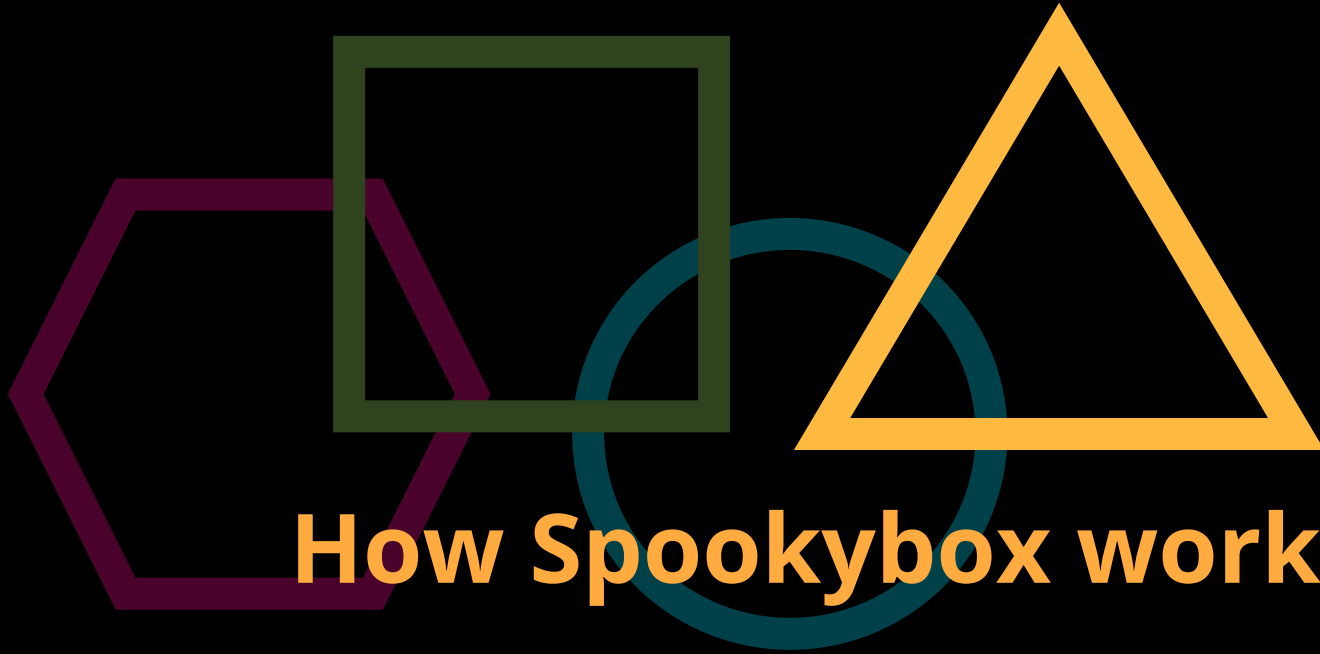
Camouflage Plant
Shivali



Milk Shake
Dominick

Advertisement



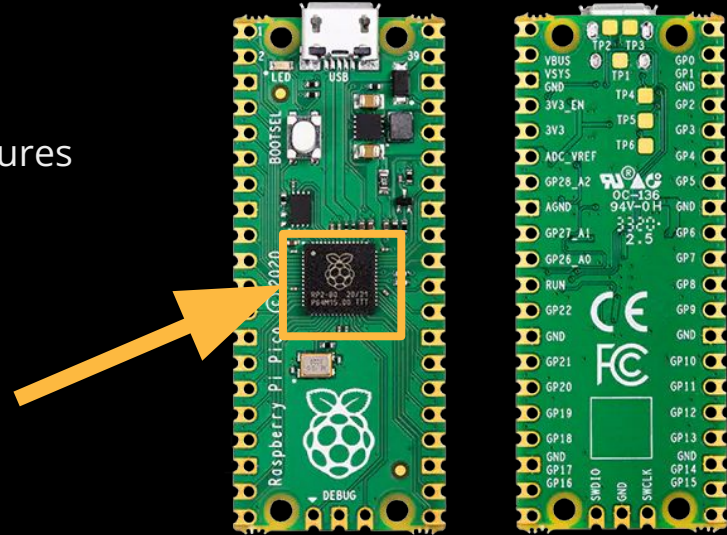


How Spookybox works

The Brain

- Raspberry Pi Pico W
 - Development Board
 - Microcontroller and additional features
- W stands for WiFi capability
- 3.3v comes from USB

MCU



Inertial Measurement Units (IMU)

- They measure internal movement
- MPU-9255
 - Used as an accelerometer
- Once detects acceleration sends a signal to Pico W by using I2C

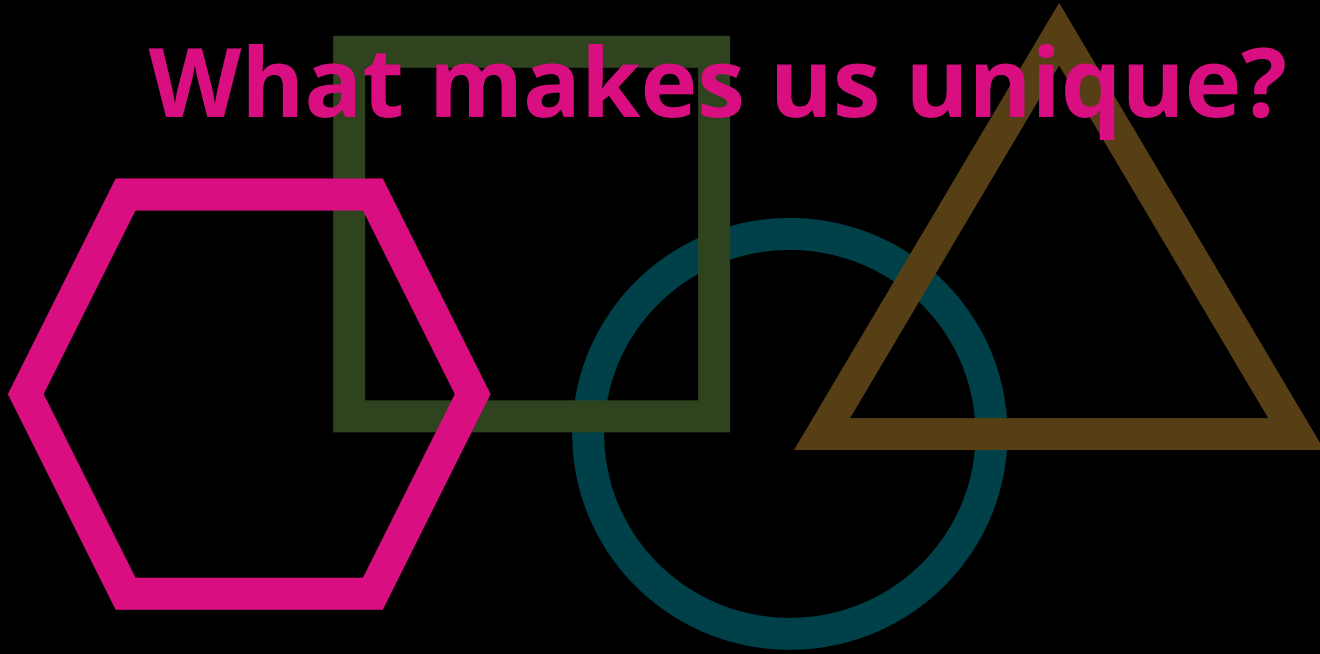


Display

- TFT LCD module that uses the GC9A01
 - LCD
- Regular display you see on a TV or Phone



What makes us unique?



Time of flight sensor

- Measures distance by using light
 - Emits light
 - Measures the time took for light to come back
 - Uses the speed of light to determine distance
- VL53L0X
 - infrared light
 - Range 1-3 meters



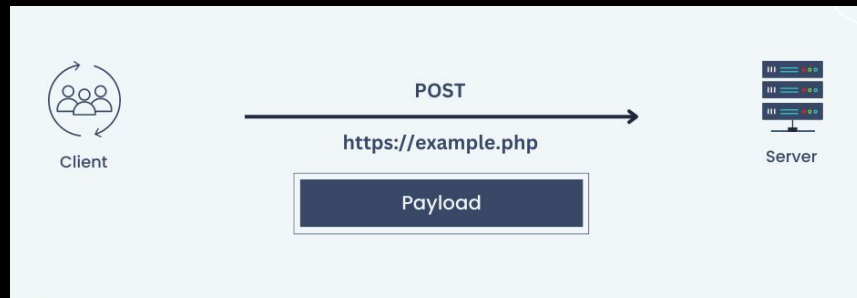
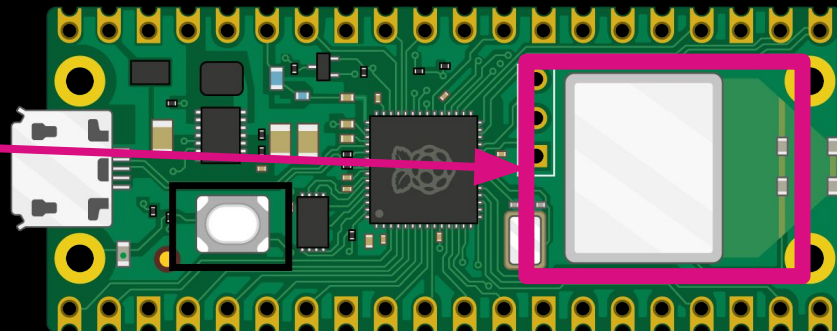
Servo

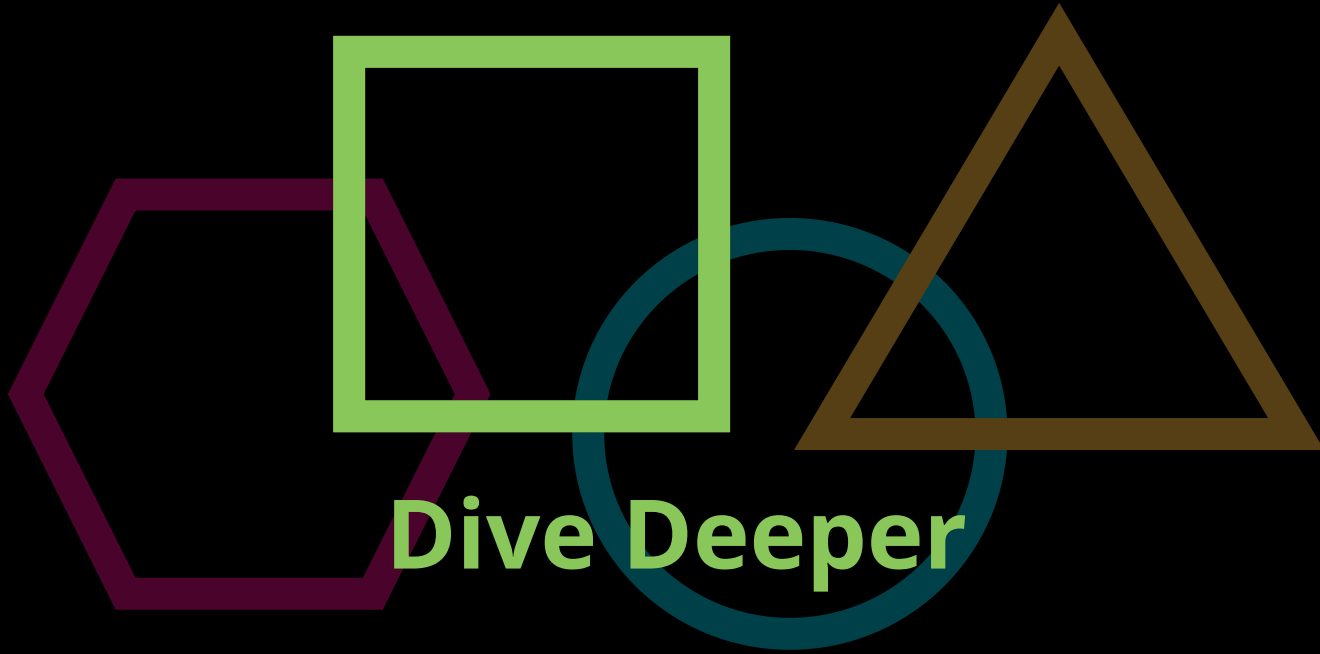
- Type of motor
 - Converts electrical to mechanical energy
- Used for precise movement
- Uses a PWM signal to move
- Sg90
 - Closed loop
 - 180- degrees
- Most annoying to wire
 - Used a voltage regulator



How we notify the owner?

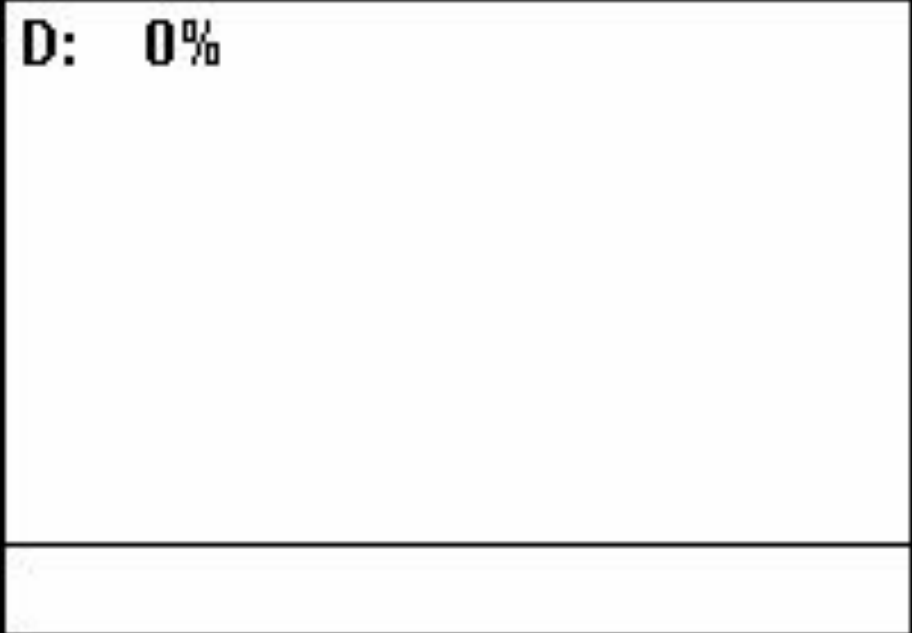
- WiFi
 - Wifi Module in the Pico W
- **H**ypertext **T**ransfer **P**rotocol request
 - HTTP post request
 - Discord Webhook URL
 - Current Time





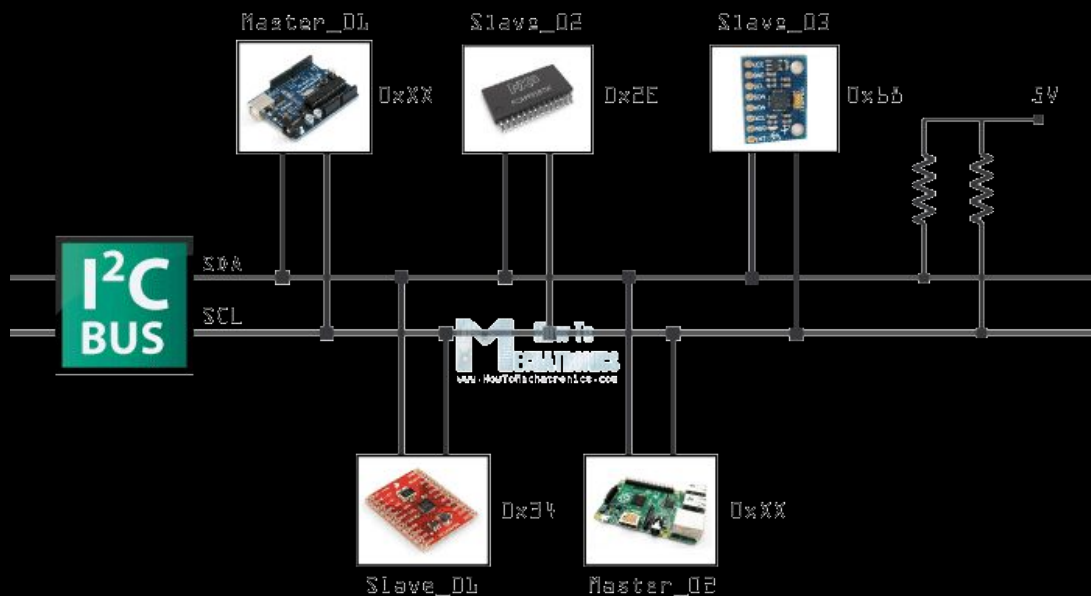
Pulse-width-modulation (PWM)

- Turns on or off
- Frequency
- Duty cycle
- Used in Servo and Buzzer



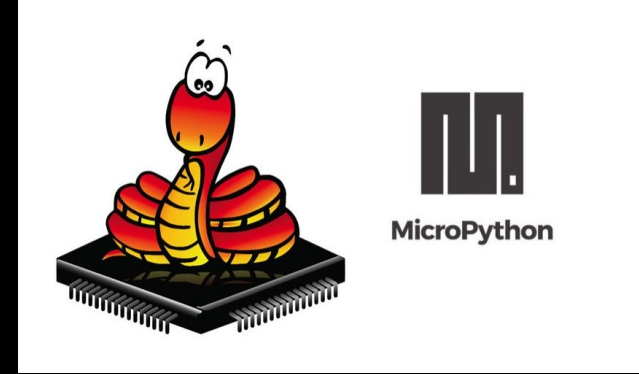
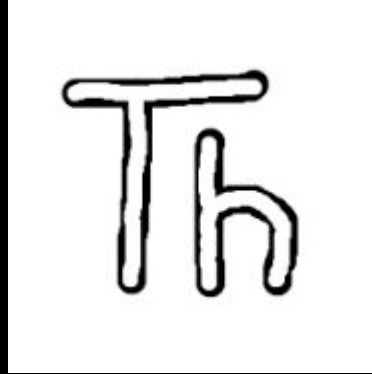
How do the chips communicate with the Pico?

- Inter-Integrated Circuit
 - I2C
 - Serial clock (SCL)
 - Serial Data (SDA)
 - A Lot of device at once
 - Device address



How did we connect to the Pico W?

- Thonny
- MicroPython





Hardships building and programming

- Servo
 - Getting the correct voltage was challenging
- Time of flight Sensor
 - At times, the sensor would misinterpret data and output the incorrect response

Hardships outside of code

- Parts arrived a bit late
- Power went out
- Laptop broke
- WiFi went out



Thank you

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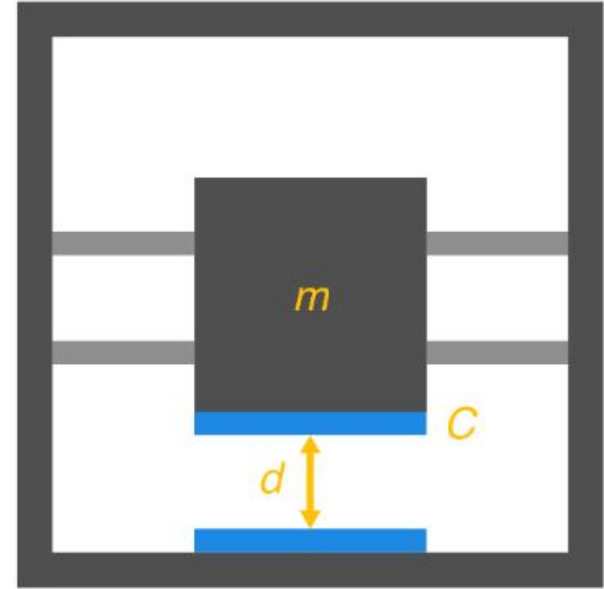
Link to our slides



Q&A

How the IMU works

- A frame
- A proof mass within the frame
- A spring that keeps the proof mass to the center of the frame
- $F = k \cdot \Delta T$
- Then use second law of motion $F = ma$
- micro-electromechanical systems
- <https://sum.mit.edu/course/iesj24/lab/2/c>



References

- [VL53L0x-nb driver\(ToF\)](#)
- [Using a servo motor with a Pi Pico board in MicroPython](#)
- [Interconnected Embedded Systems -MITES Semester 2024](#)
- [Duty cycle gif](#)