

Collision Avoidance Quadcopter

Aidan Melen

Introduction

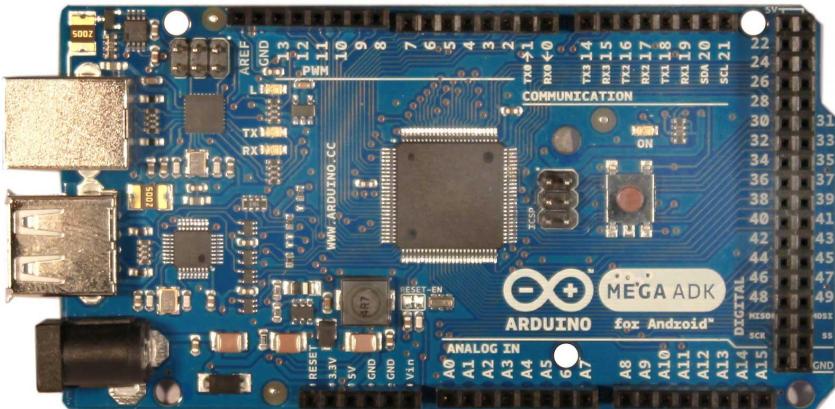
The purpose of this project is to reduce the responsibilities a RC pilot will have in regards to crash avoidance.

How will this be accomplished?

- The flight controller will control the craft in flight.
- An array of onboard sensors will provide object detection.
- The Arduino microcontroller will execute the collision avoidance algorithm.

Technologies

Arduino Mega ADK → Avoidance System

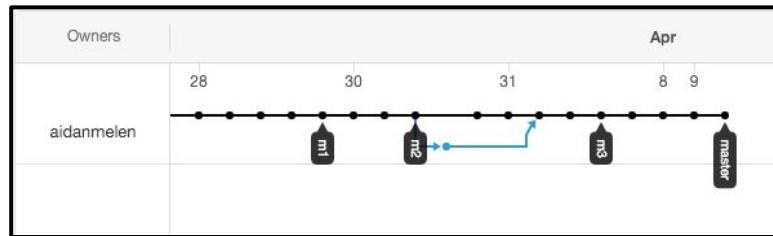


Naza M v2 → Flight Controller



Programming Environment and Version Control

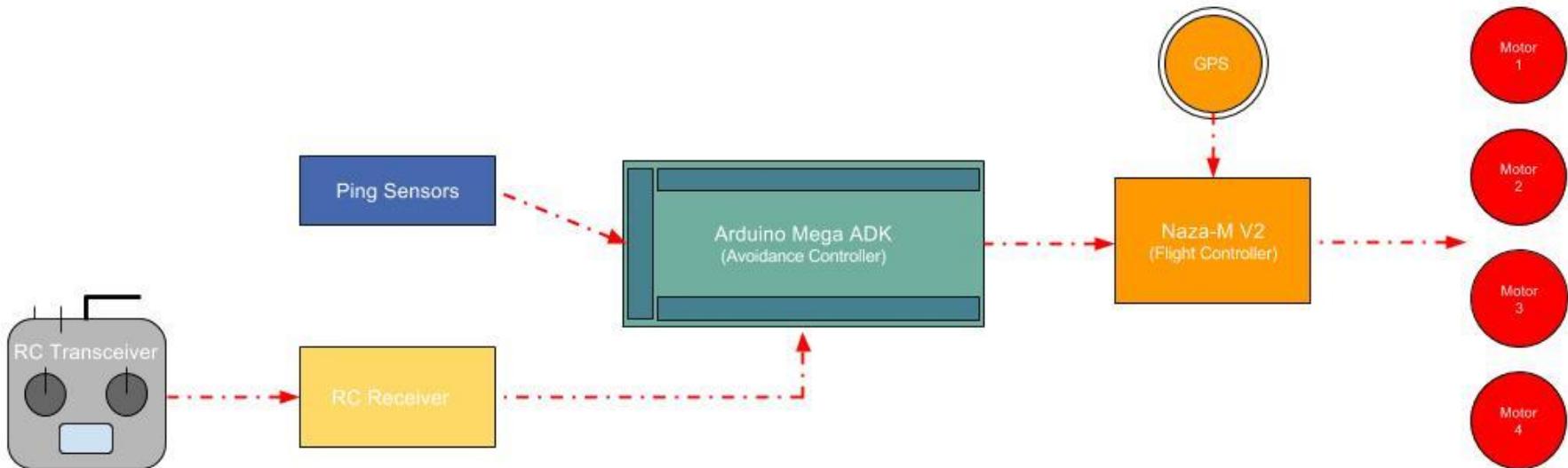
- I used the Arduino IDE.
- I versioned the collision avoidance software with Git.
- The project is hosted on GitHub.com.



3 Programming Subtasks

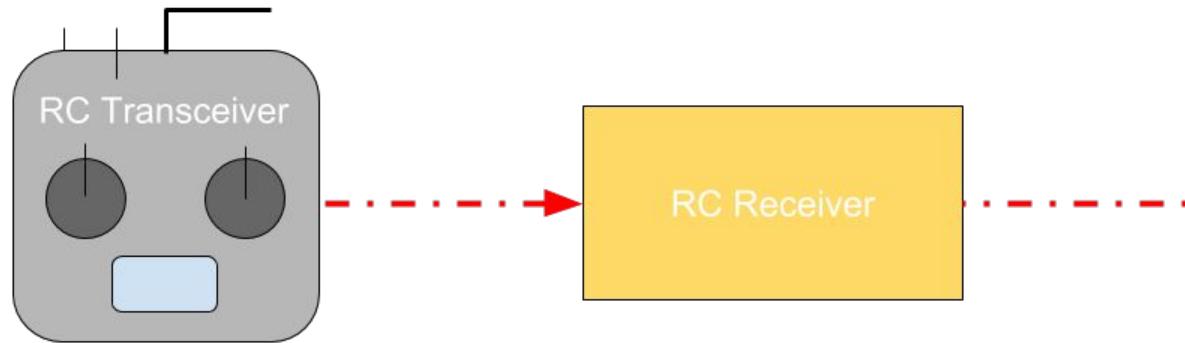
1. Read the analog signals coming from the RC receiver and forward them to the flight controller.
2. Get the distance measurements from all four ultrasonic distance sensors.
3. Get the closest measurement and check if it is within the target range.
If it is — instruct the flight controller to perform an avoidance maneuver.

Project Abstraction



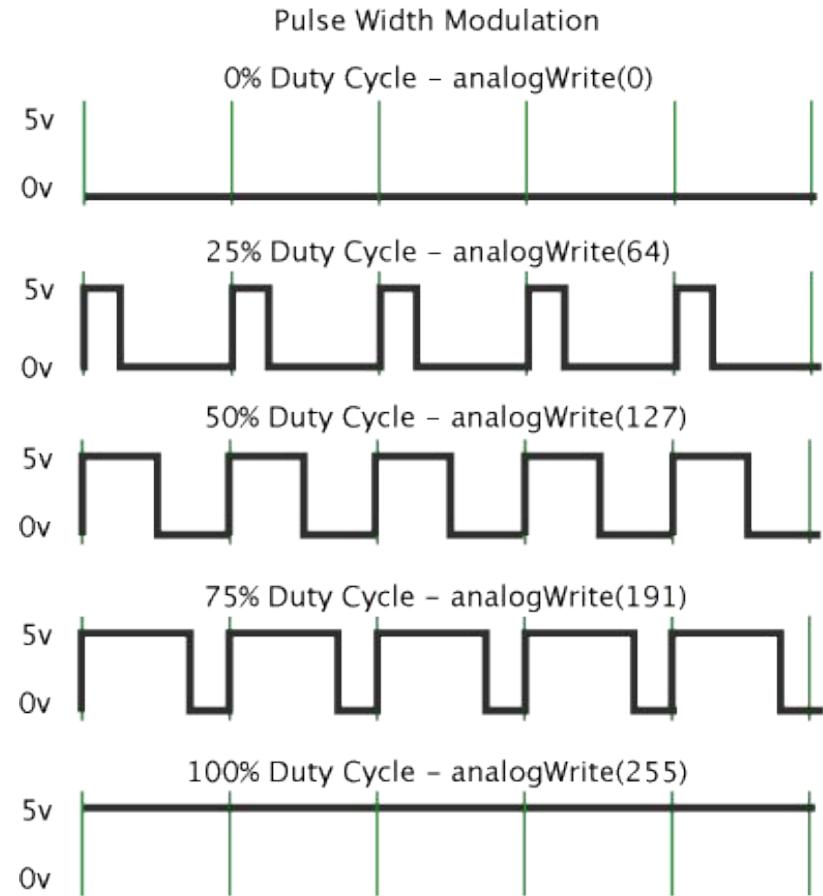
What is Pulse Width Modulation or PWM?

It is a technique used to decode pulsing analog signals into digital bytes of information.



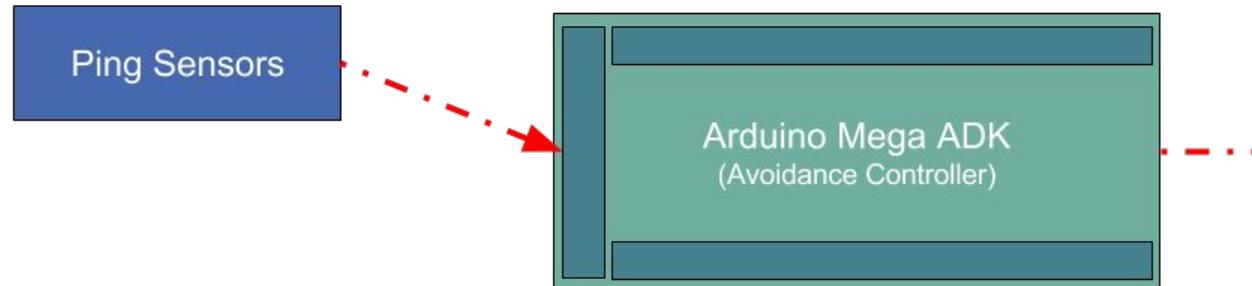
How Does It Work?

- Analog values range from (0-255).
- The green line represents a cpu clock cycle.
- The black line represents the duration of a pulse.



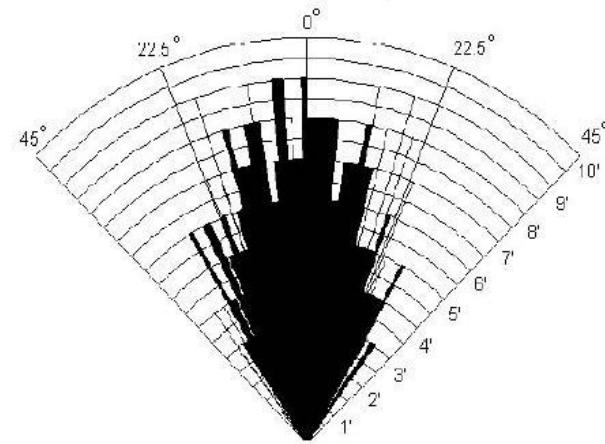
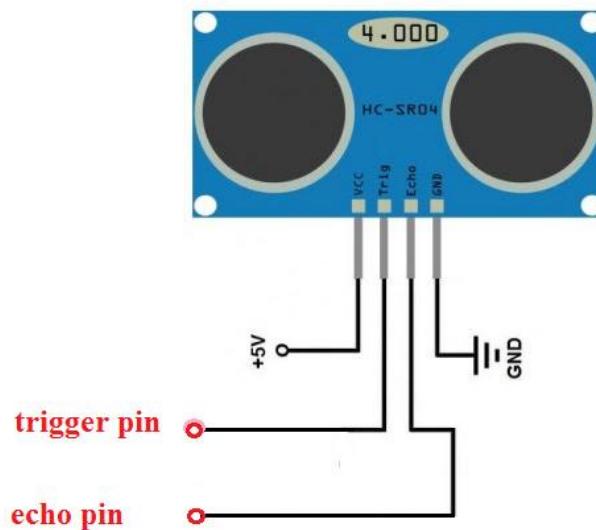
What is a HC-SR04 Ultrasonic Sensors?

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object just like bats or dolphins do.



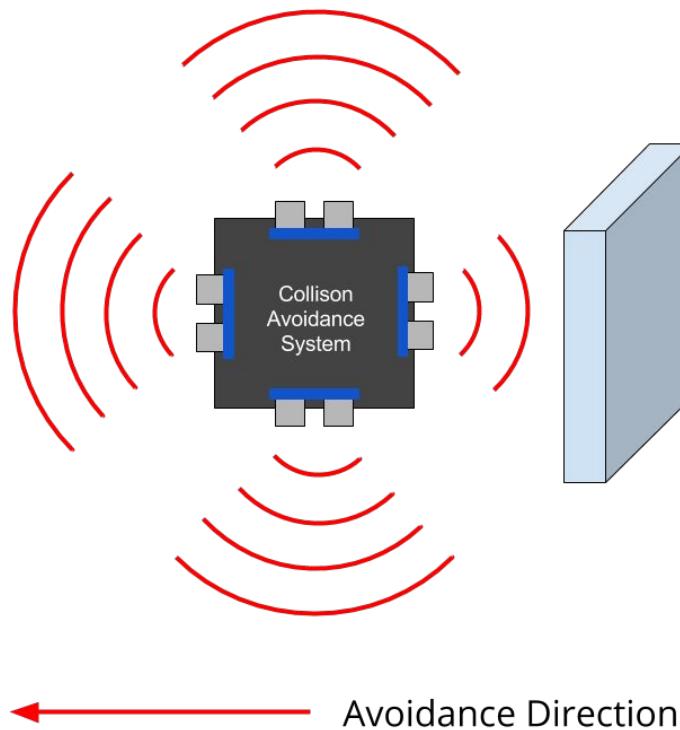
How Does it Work?

A distance measurement can be obtained by sending out a burst of ultrasound and listening for the echo when it bounces off of an object.

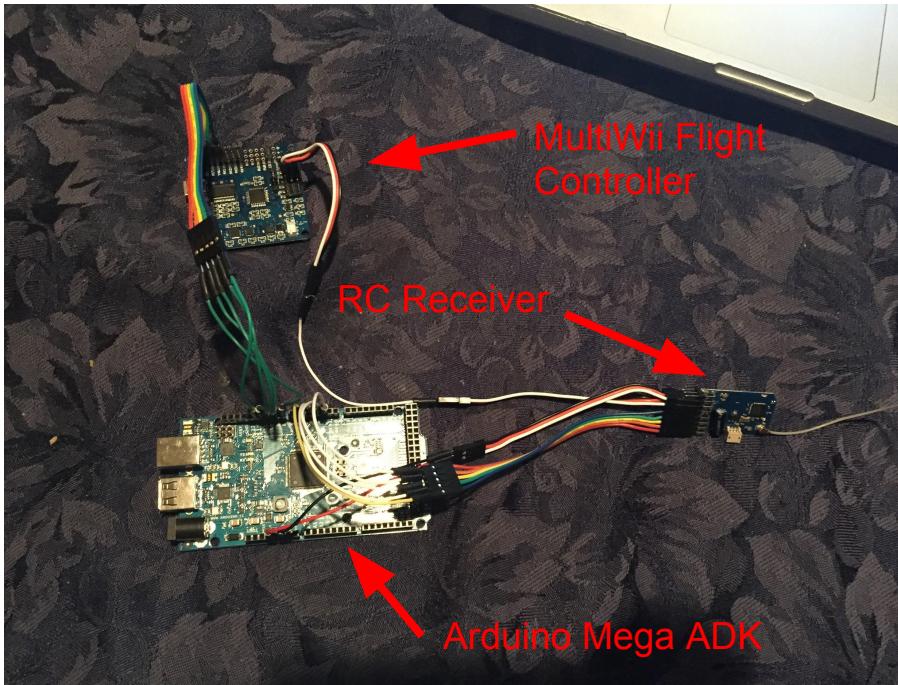


*Practical test of performance,
Best in 30 degree angle*

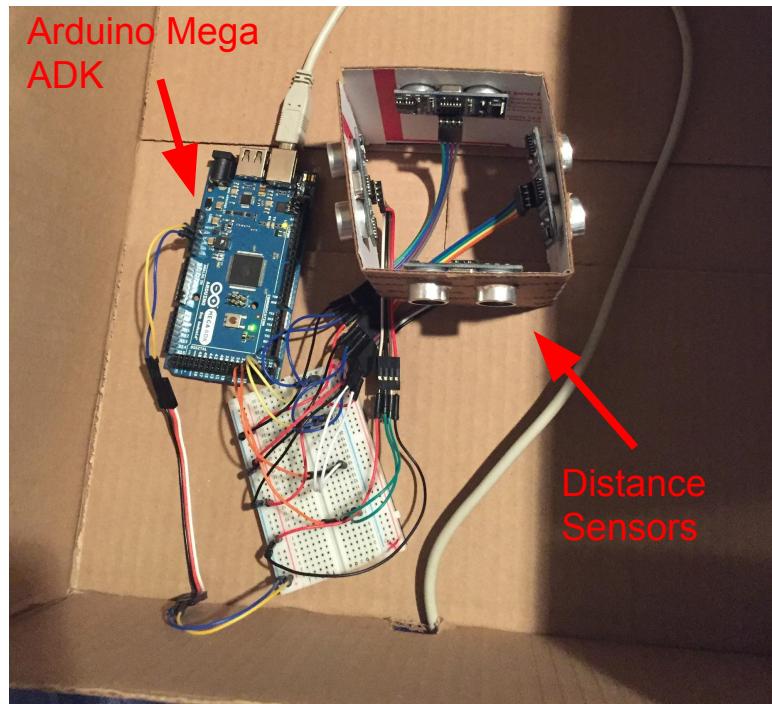
What does the Closest Algorithm Do?



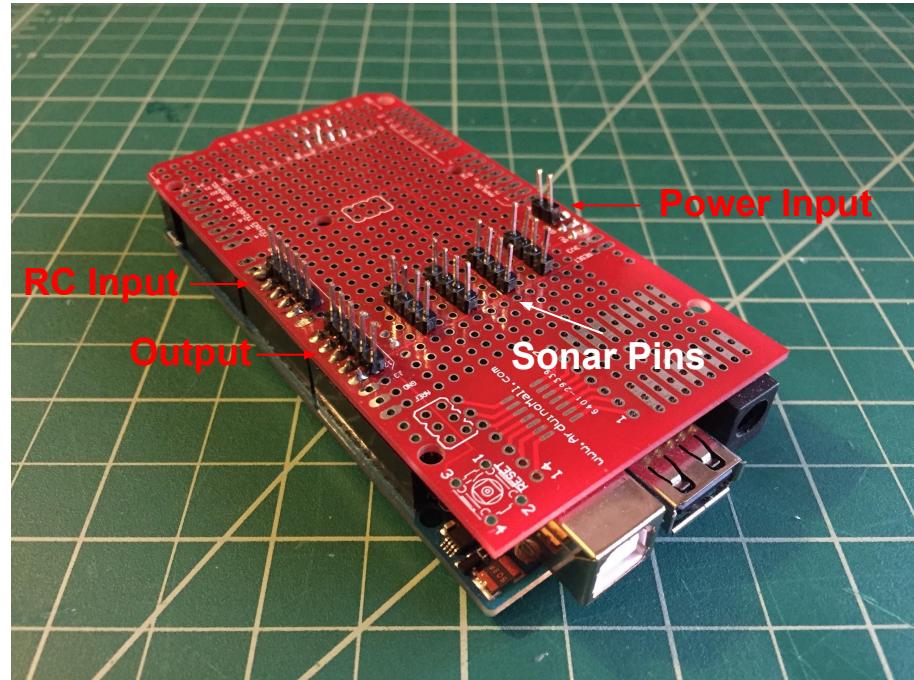
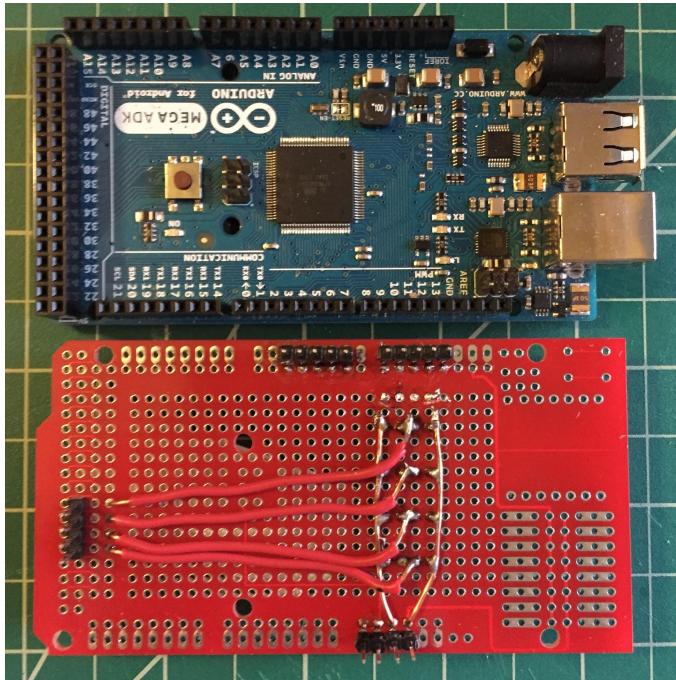
Prototyping RC Input / Output With Arduino



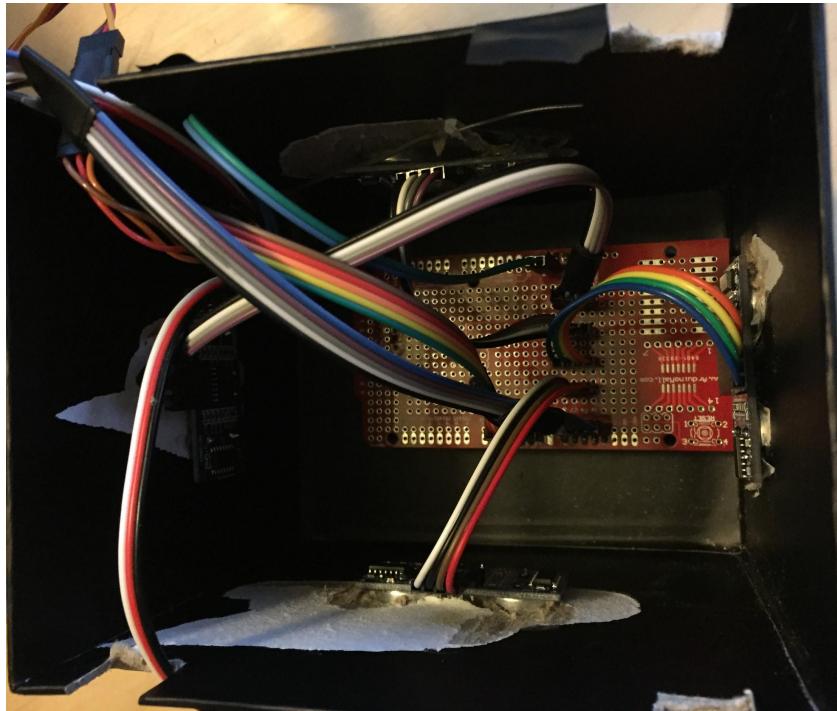
Prototyping Reading Multiple Distance Sensors



The Final Circuit: Custom Arduino Shield



The Final Build



Small Scale Demonstration

- [ProcessRCInput.ino](#)
- [ReadMultipleSonarSensors.ino](#)
- [GetClosestSensorReading.ino](#)
- [CollisionAvoidance.ino](#)
 - Digital Sonar Filtering
 - Simple Avoidance
 - Markov Avoidance

Full Scale Demonstration

[Link to Video](#)

Challenges

- Learning to fly a quadcopter ... safely
- I ran out of digital I/O pins on the Arduino Micro.
- The MultiWii Flight Controller was difficult to program/configure and was largely unstable during flight.
- The turbulence from the propellers caused frequent false-positive distance measurements.

What Would I Have Done Differently?

Lidar measurements are far more accurate than sonar.

- Faster pings
- Longer range
- It is unaffected by turbulence
- And 360°s of detection



Plans After Graduation

Software Engineer at Sampleminded.

- Client/Server-side Web Development.
(java, javascript, html, scss)
- Infrastructure Automation
(python)
- Playing with 3D a Printer

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Any Question?

Don't be shy!