

# Final Project - Precision agriculture

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# Abstract

The goal of this project is to implement a smart agriculture gadget with a Fishino Piranha board. It can measure the environmental conditions of a particular plant, plantation or greenhouse, upload them to a remote database and control actuators to maintain the environmental conditions in the desired range.

# Operation

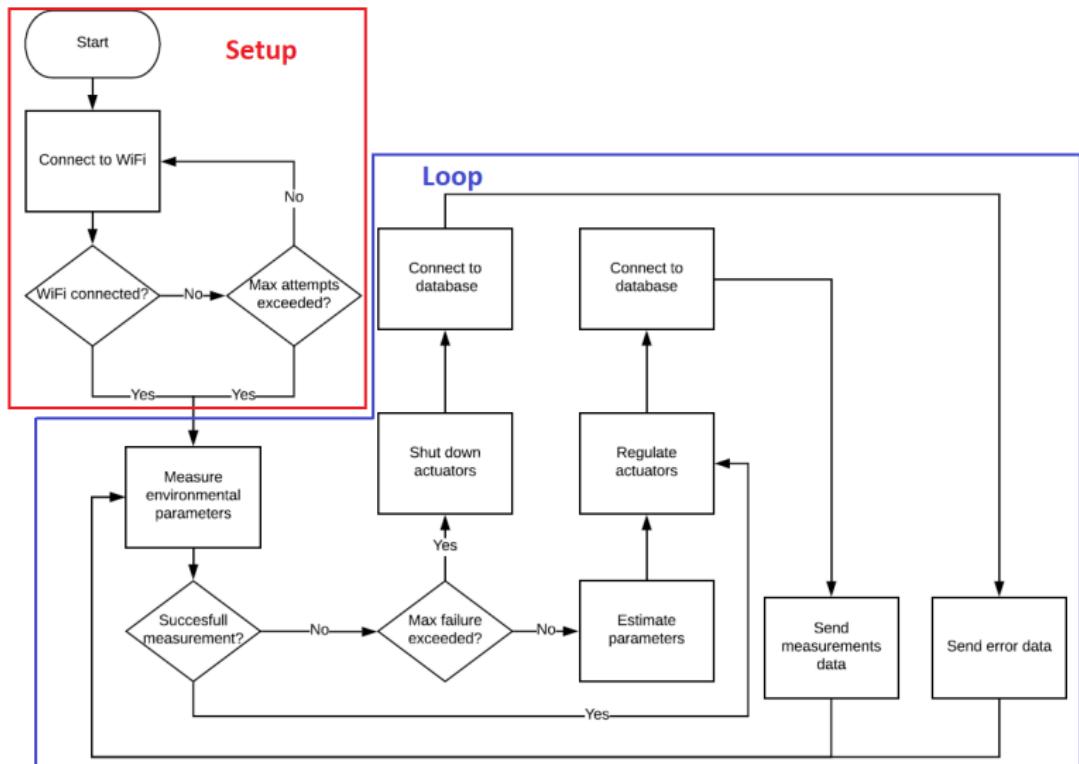
## Setup

- Connect to WiFi and database
- Define parameters

## Loop

- Acquire data
- Estimate and control
- Send data

# Algorithm



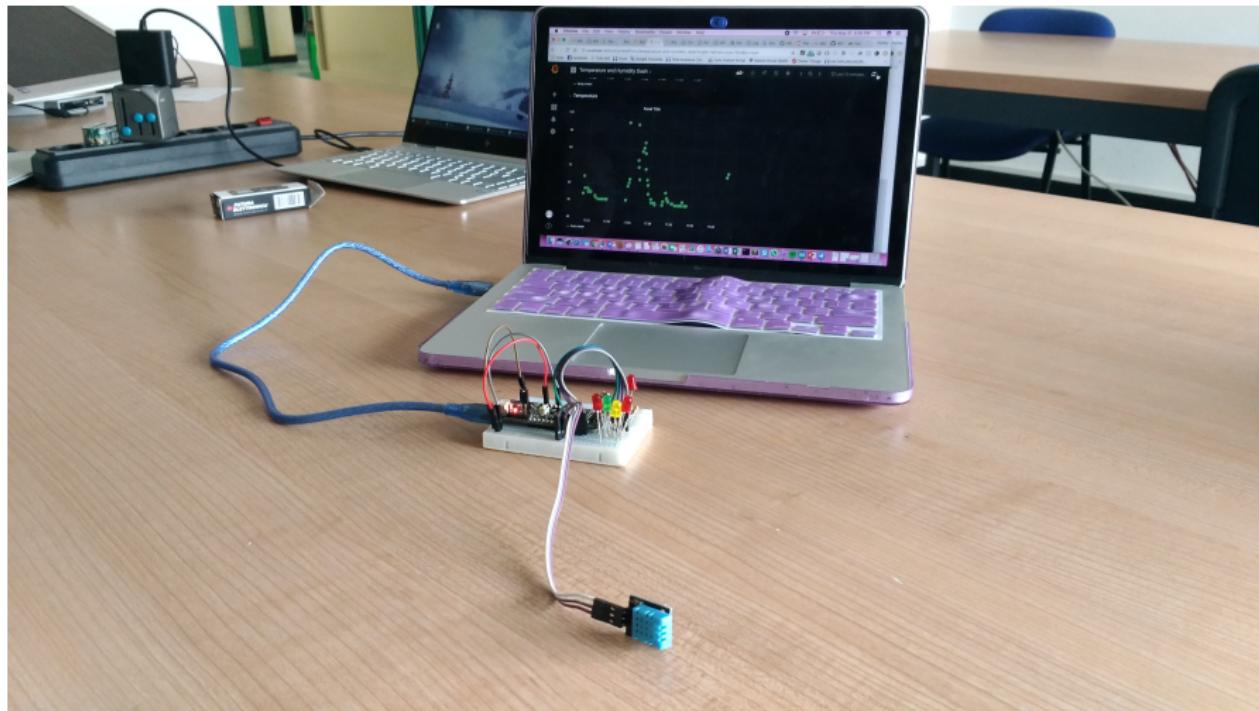
## Hardware used

- Fishino Piranha board
- DHT11 temperature and humidity sensor
- Proto board
- Flat cables
- Computer <sup>1</sup>
- 5V USB power source
- USB to micro USB cable (also used for flashing the device)
- LEDs
- $100\Omega$  resistors

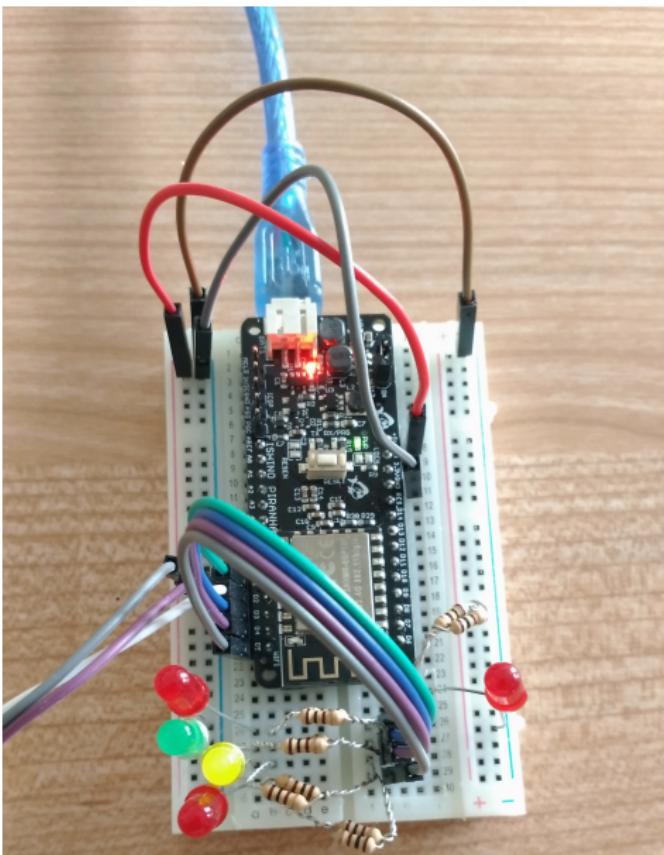
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<sup>1</sup>used to flash the device, store the database and visualize the data. In a real deployment, these three functions would be carried out by different entities

# Hardware



# Hardware



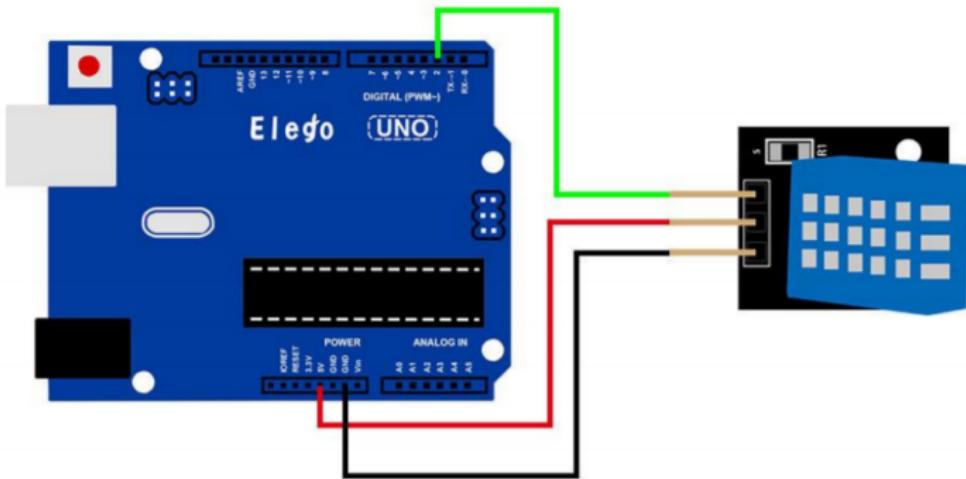
# Flashing the device

- ① Install Fishino drivers and libraries
- ② Connect to computer with USB to micro USB cable
- ③ Press reset button until LED start blinking
- ④ Upload the code via Arduino IDE

# Sensors

- We use the DHT11 humidity and temperature sensor
- 16 bit resolution
- Serial communication
- Common  $V_{cc}$  and ground

# Sensors



## Estimation

The last few samples are saved and a moving average prediction is made. If a sample is lost the prediction is used in its place

# Control

- *on/off control*
- Estimated value used if measurement fails
- System shuts down and informs user if sensors are lost

# Storage

- Open source time-series database system InfluxDB
- Database in the same network as the end device
- Packets sent through HTTP requests

# Storage

```
POST /write?db=mydb HTTP/1.1
Host: 192.168.43.137:8086
User-Agent: Arduino/1.6
Connection: close
Content-Type: application/x-www-form-urlencoded
Content-Length
tempLine.length()

temp value= temperature + "i";
```

# Visualization

- Grafana software provides a solution for visualization
- Integrated with InfluxDB
- As well as data, errors are recorded

# Visualization



# Happy path

```
/dev/cu.usbmodem1411
Send

Fishino IP ACQUISITION FAILED, RETRYING ...
My IP is ...192.168.43.202
Fishino IP Connected ...
Measured temperature:29.00 *C
Measured humidity: 50.00%
History:
Temp: 0.00 0.00 0.00 0.00 29.00
Hum: 0.00 0.00 0.00 0.00 50.00

loop...
Measured temperature:29.00 *C
Measured humidity: 50.00%
History:
Temp: 0.00 0.00 0.00 29.00 29.00
Hum: 0.00 0.00 0.00 50.00 50.00

loop...
Measured temperature:29.00 *C
Measured humidity: 49.00%
History:
Temp: 0.00 0.00 29.00 29.00 29.00
Hum: 0.00 0.00 50.00 50.00 49.00
```

# Sensor failure

```
loop...
Measured temperature:29.00 *C
Measured humidity: 51.00%
History:
Temp: 29.00 29.00 29.00 29.00 29.00
Hum: 49.00 49.00 49.00 49.00 51.00

loop...
Failed to read temperature from DHT sensor!
Failed to read humidity from DHT sensor!
Estimated temperature:29.00 *C
Estimated humidity: 49.00%
History:
Temp: 29.00 29.00 29.00 29.00 29.00
Hum: 49.00 49.00 49.00 51.00 49.00
```

# System failure

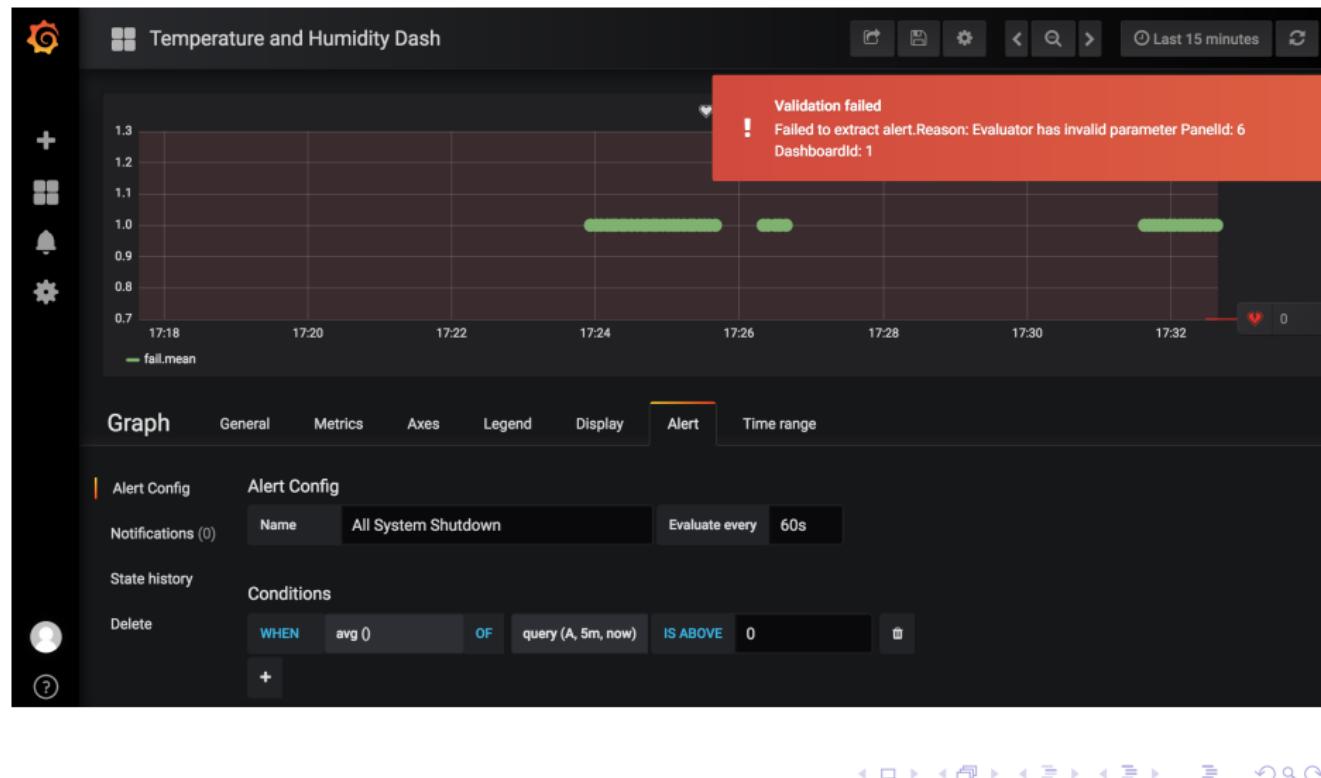
```
loop...
Failed to read temperature from DHT sensor!
Failed to read humidity from DHT sensor!
Estimated temperature:29.00 *C
Estimated humidity: 49.00%
History:
Temp: 29.00 29.00 29.00 29.00 29.00
Hum: 49.00 51.00 49.00 49.00 49.00

loop...
Failed to read temperature from DHT sensor!
Failed to read humidity from DHT sensor!
Estimated temperature:29.00 *C
Estimated humidity: 49.00%
History:
Temp: 29.00 29.00 29.00 29.00 29.00
Hum: 51.00 49.00 49.00 49.00 49.00

loop...
Failed to read temperature from DHT sensor!
Failed to read humidity from DHT sensor!
System failure, all actuators have been turned off for safety reasons, please check sensors urgent
loop...
```

Autoscroll      No line ending      9600 baud      Clear output

# System failure



# Conclusions

- ① The project was successful
- ② Control algorithm and actuators can be easily modified
- ③ InfluxDB, grafana, Arduino IDE, Fishino libraries provide a great deal of help

## Future work

- ① Specific, more complex control algorithms
- ② Exploration of different wireless protocols
- ③ Battery optimization