CONNECT YOUR AQUARIUM WITH

Poulpy

Yveline Axilien
Léa De Mira Godinho
Jonathan Pleuron
Vicente Poveda Carías
Killian Tessier

INNOVATIVE SMART SYSTEMS

INSA TOULOUSE

Aquarium

23/01/2018

OUTLINE

- Context
- Poulpy's architecture
  - Data recovery
  - Data transmission
  - Data publishing
  - User management
- Improvements

CONTEXT

CONTEXT

CLIENT

Banyuls
Biodiversarium

CORE

Connected
Aquarium

TARGET

Schools &
Individuals

CONTEXT

Low-cost
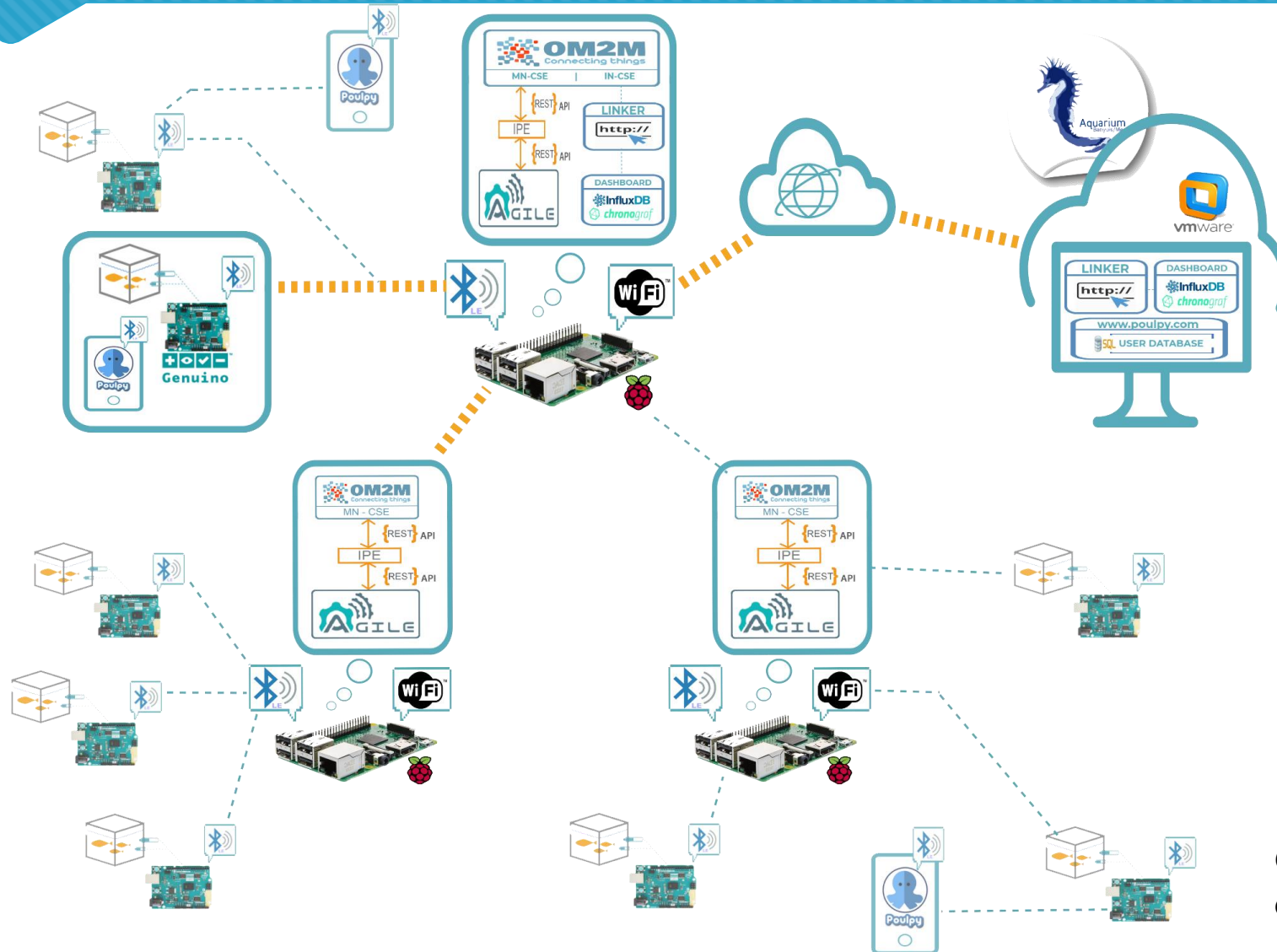

Open-source
& Community

Pedagogical

POULPY'S ARCHITECTURE

Global architecture

POULPY'S ARCHITECTURE

Data recovery

POULPY'S ARCHITECTURE
Data recovery

COMPONENTS USED

Turbidity sensor

Temperature sensor

Water level sensor

Arduino/Genuino 101
- Open source
- Low cost
- Bluetooth Low Energy communication
- Create your own library
- Many functions

Sensors
- Waterproof
- Low cost
- Easy to implement on Arduino

LIBRARY OVERVIEW

- Each sensor inherits the "Module" class

Library UML Diagram
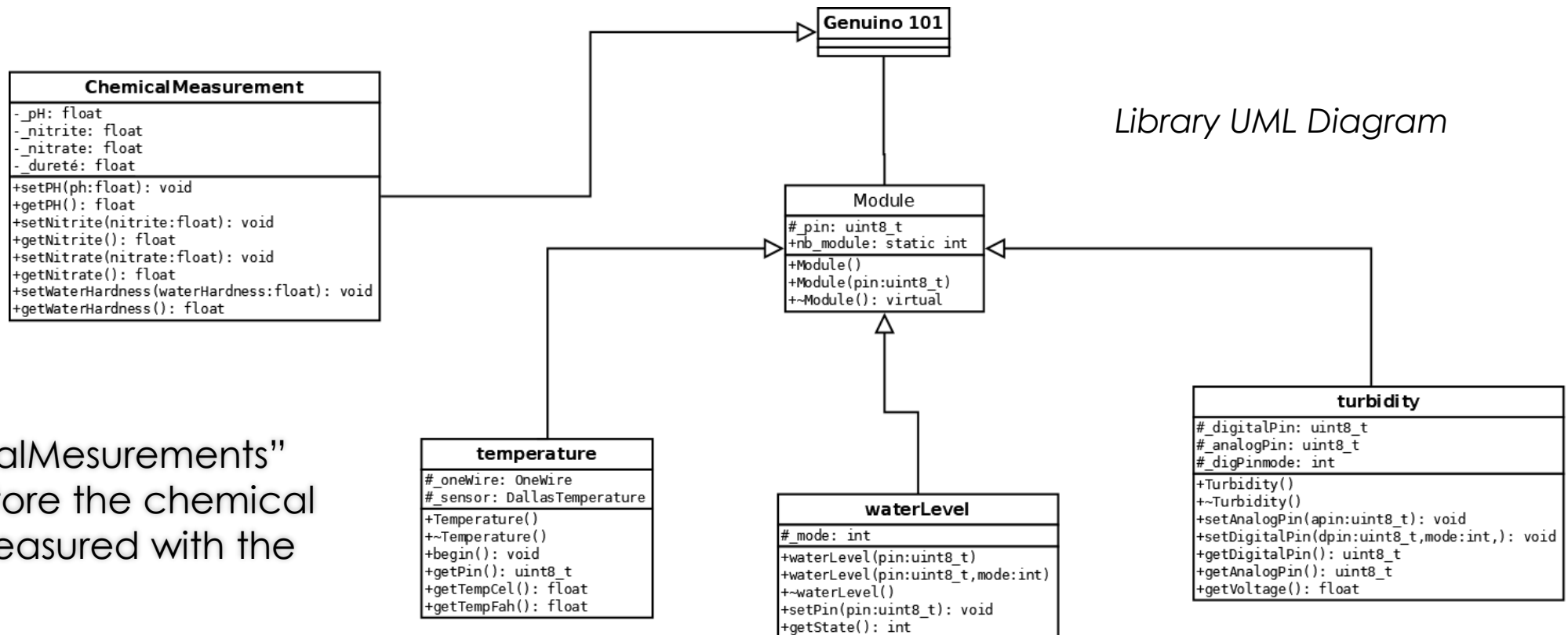
- "ChemicalMesurements" class to store the chemical values measured with the test strips
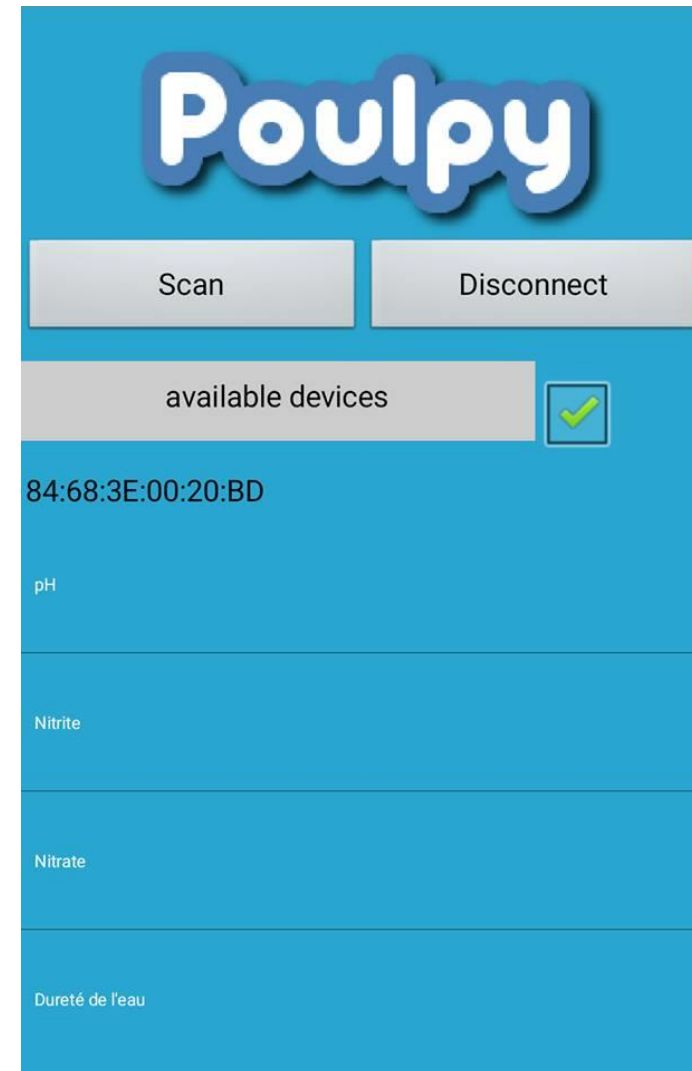
10

Data recovery

MOBILE APPLICATION

Poulpy App

○ Mainly developed to enter **new data**

⇒ Keep Poulpy low cost

Ex: pH strips

Poulpy App communicates via BLE

Poulpy

Scan   Disconnect

available devices ✓
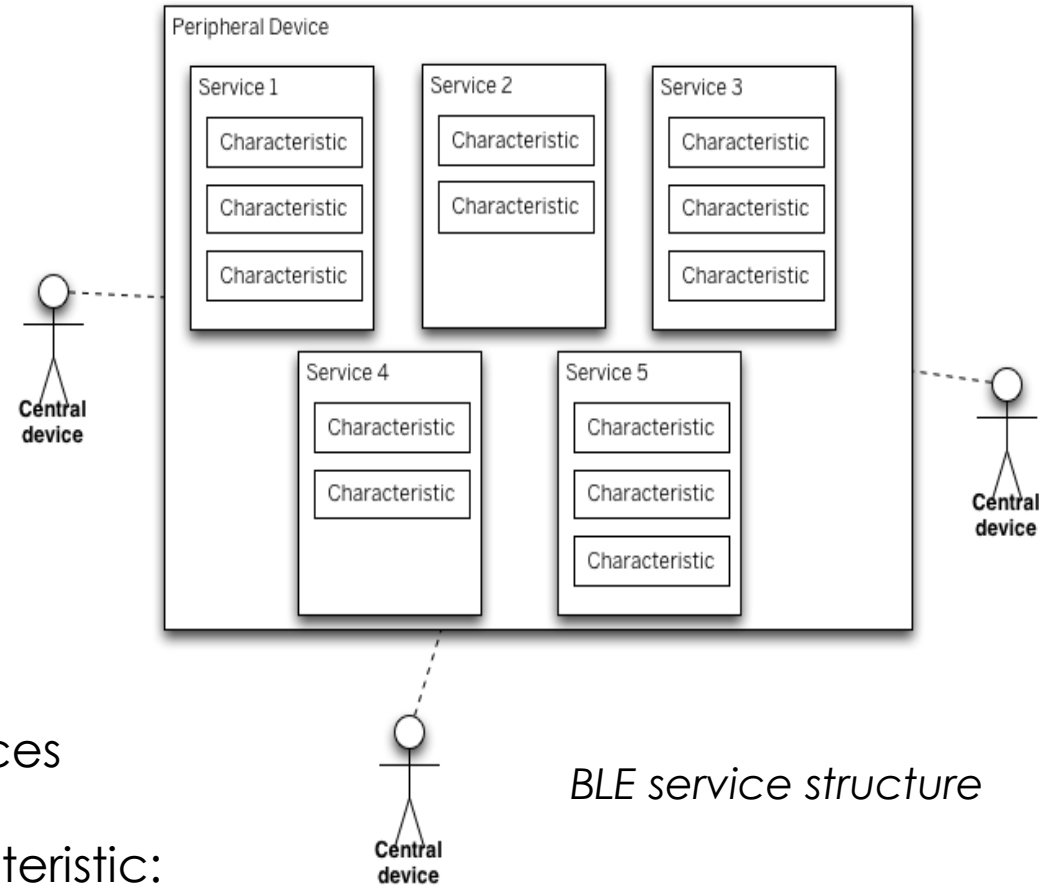
84:68:3E:00:20:BD

pH

Nitrite

Nitrate

Dureté de l'eau

11

POULPY'S ARCHITECTURE

Data transmission

QUICK INTRODUCTION TO BLE

o Bluetooth Low Energy (BLE, Bluetooth 4.0)

o CurieBLE Library for Genuino 101

o Based on a **client-server** architecture

BLE service structure

Server	**Client**
➢ **Peripheral** devices	➢ **Central** devices

- provide **services**
  - ➢ provide **characteristics**

- **4 actions** with a characteristic:
  Read -Write -Notify - Indicate

13

QUICK INTRODUCTION TO BLE

- **General Attribute Profile (GATT)** layer
  - defines services
  - Characteristics
  - enables read/write/notify/indicate

- We can define our own services, or use **standard services.**

- **1 unique UUID** per service and per characteristic

POULPY'S ARCHITECTURE
Data transmission

QUICK INTRODUCTION TO BLE

- **General Advertising Profile (GAP)** layer

- **Advertising packets** contain
  - device name
  - list of the services
  - characteristics
  - **service UUIDs**
  - **characteristic UUIDs**

- Advertising packets have a **limited size**, only a **single customized service**
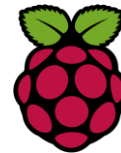
POULPY'S ARCHITECTURE
Data transmission

IMPLEMENTATION OF THE SERVICE

- Create our own service

- One value per characteristic

- **The peripheral (server)**: the Genuino

- **Central devices (clients)**: Raspberry Pi and the Poulpy application

- Data sent by the sensors: read, notify

- Chemical measurements : read , write, notify

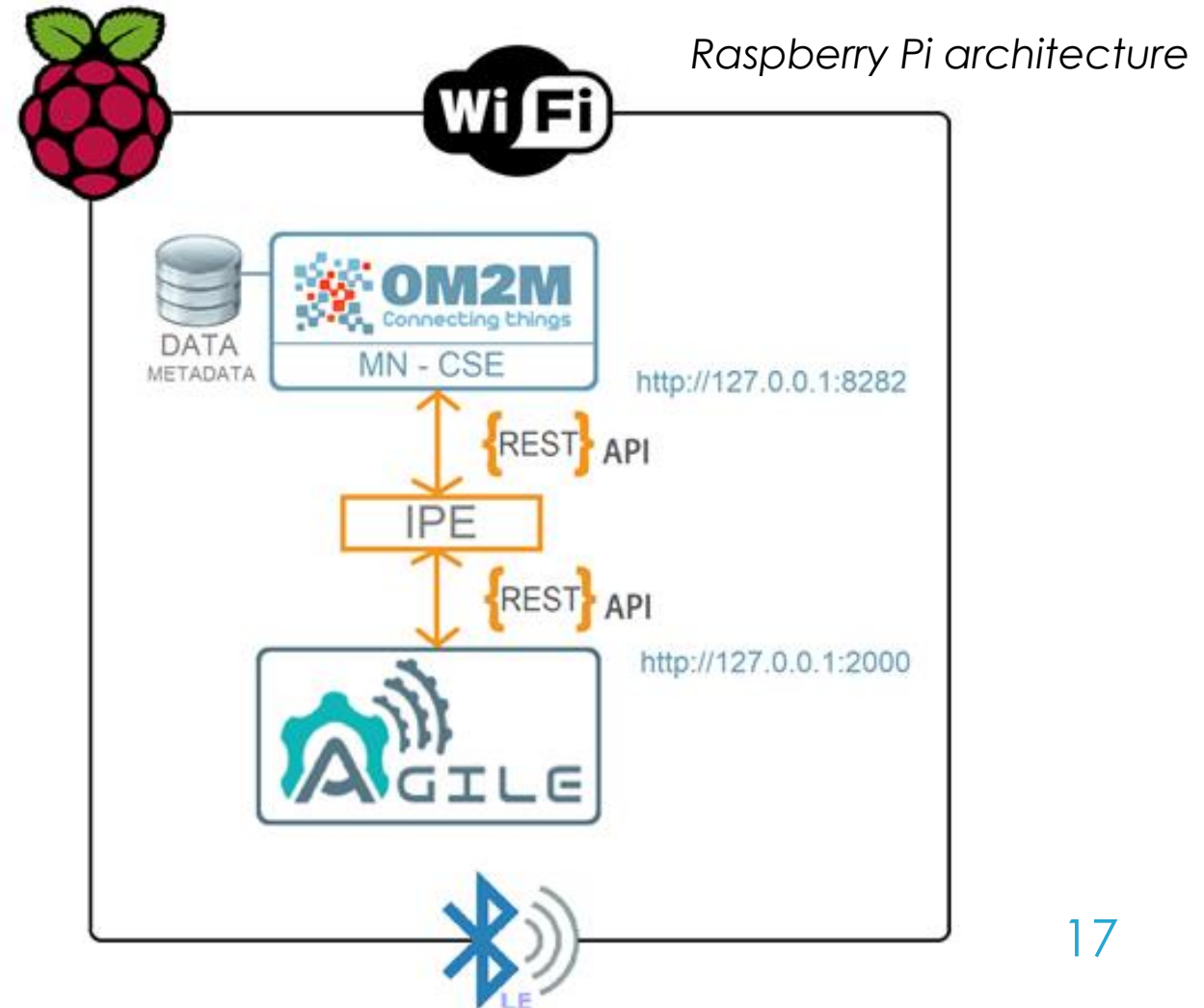| DATA |
|------|
| Water Level
Properties : read , notify |
| Temperature Celsius
Properties : read , notify |
| Turbidity analog value
Properties : read , notify |
| pH
Properties : read , write, notify |
| Nitrite
Properties : read , write, notify |
| Nitrate
Properties : read , write, notify |
| Water hardness
Properties : read , write, notify |

Structure of "DATA" service

POULPY'S ARCHITECTURE
Data transmission

GLOBAL ARCHITECTURE

Raspberry Pi architecture

- **Advantages of the architecture**

  - Low cost
    - ➤ Software
    - ➤ Hardware

  - Open source
    - ➤ Big community
    - ➤ New functions

  - Scalable network

  - Easy to implement (DIY)

POULPY'S ARCHITECTURE
Data transmission

MODULARITY & INTEROPERABILITY

AGILE

PROTOCOL MANAGER
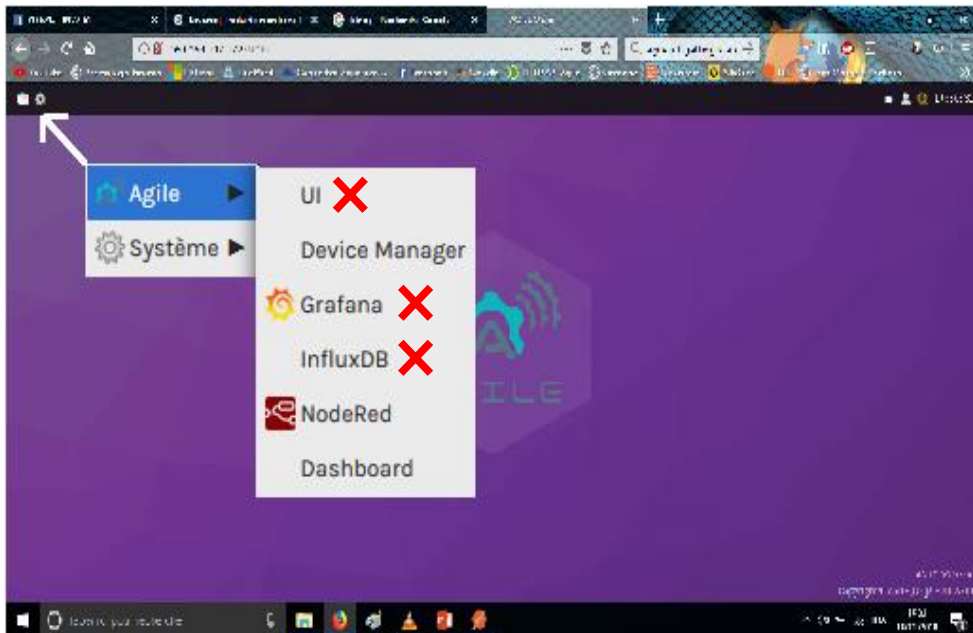
PROTOCOL

DEVICE MANAGER

DEVICE

DBUS
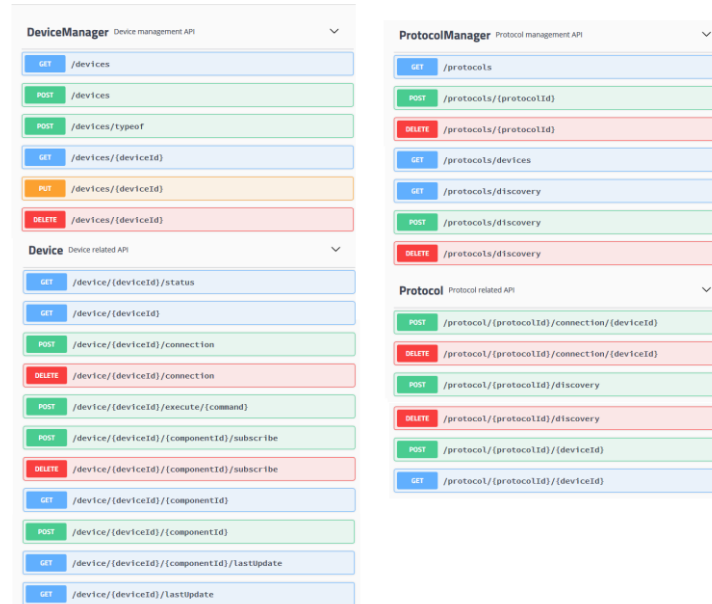
WiFi™

Communicating Technologies

BLE   Z-WAVE®   KNX   zigbee

POULPY'S ARCHITECTURE
Data transmission

EASY-TO-USE

User Interface
http:127.0.0.1:8000

Http API (REST)
http:127.0.0.1:2000

Java examples
https://github.com/Agile-IoT

POULPY'S ARCHITECTURE
Data transmission

MIDDLEWARE: OM2M

OM2M CSE Resource Tree

http://localhost:8282/~/mn-cse/cin-903347330

- POULPY-MN
  - acp_admin
  - acpae-20026838
  - GATEWAY
    - AQUARIUMS
      - Aquarium_1
      - Aquarium_2
    - META
      - Info
        - cin_903347330
      - NbOfAquariums
        - cin_553710149
  - in-name
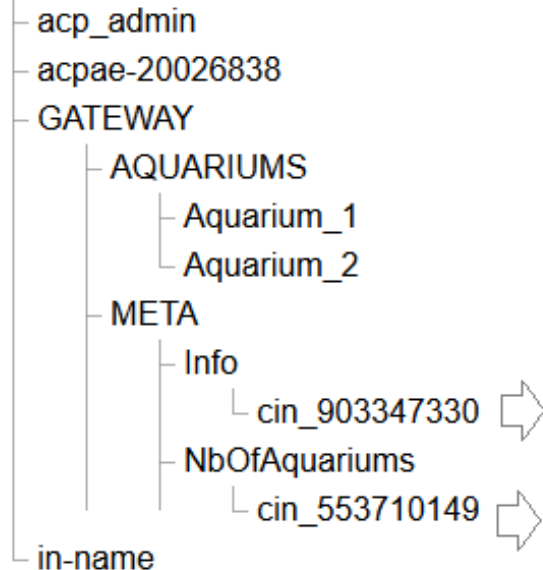
OM2M Resource Tree

Attribute	Value
GateWay ID	1A:3C:FF:00
Location	INSA gateway

Attribute	Value
Number of aquariums	2

○ **Advantages**
- Open source
- Scalability
- Easy-to-Use (REST API)
- Resource - oriented

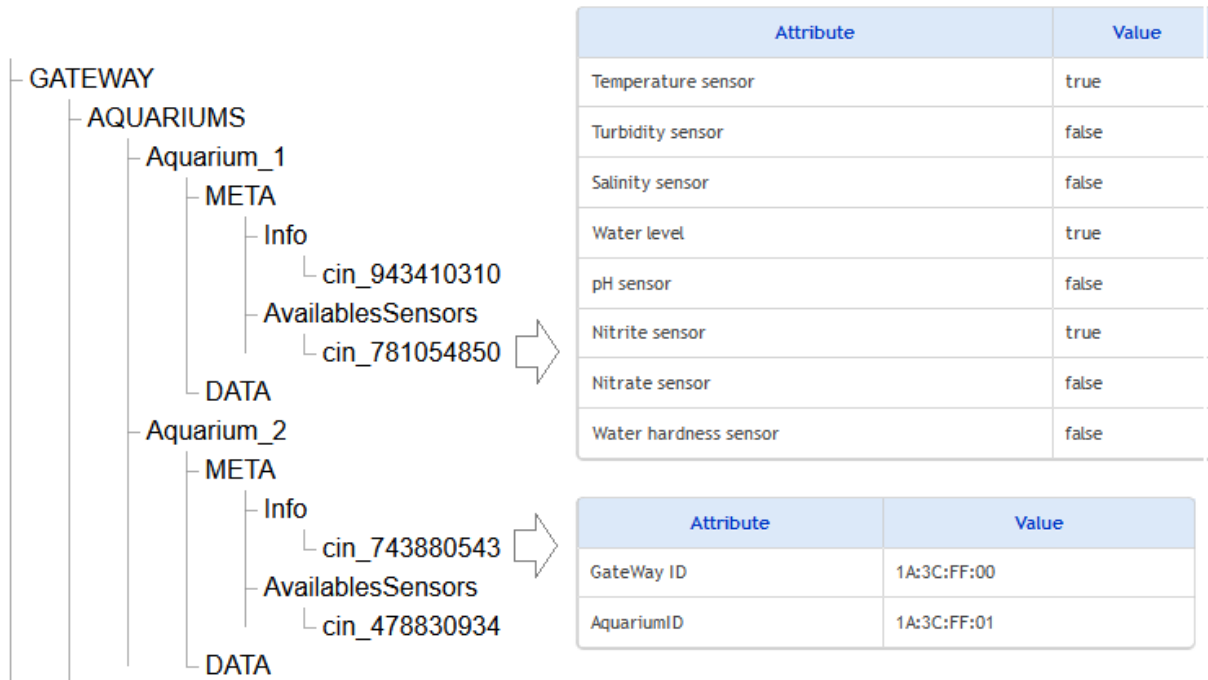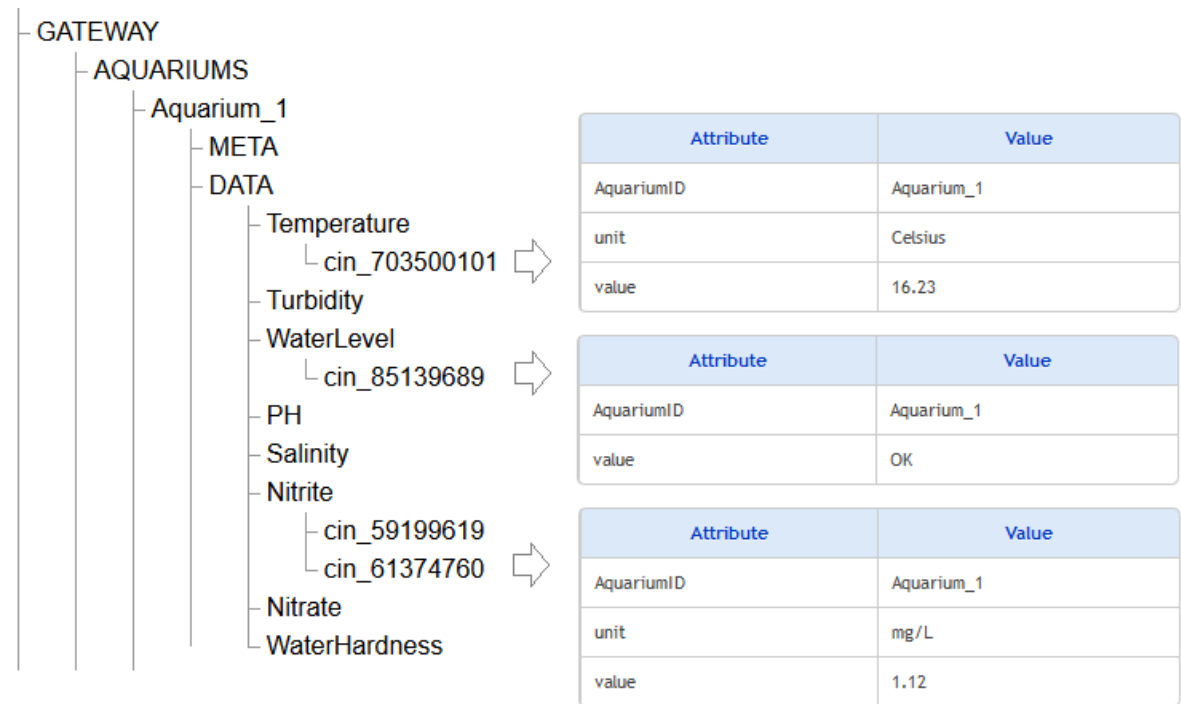# POULPY'S ARCHITECTURE
Data transmission

MIDDLEWARE: OM2M

METADATA

GATEWAY
— AQUARIUMS
— Aquarium_1
— META
— Info
— cin_943410310
— AvailablesSensors
— cin_781054850
— DATA
— Aquarium_2
— META
— Info
— cin_743880543
— AvailablesSensors
— cin_478830934
— DATA

Attribute	Value
Temperature sensor	true
Turbidity sensor	false
Salinity sensor	false
Water level	true
pH sensor	false
Nitrite sensor	true
Nitrate sensor	false
Water hardness sensor	false

Attribute	Value
GateWay ID	1A:3C:FF:00
AquariumID	1A:3C:FF:01

DATA

GATEWAY
— AQUARIUMS
— Aquarium_1
— META
— DATA
— Temperature
— cin_703500101
— Turbidity
— WaterLevel
— cin_85139689
— PH
— Salinity
— Nitrite
— cin_59199619
— cin_61374760
— Nitrate
— WaterHardness

Attribute	Value
AquariumID	Aquarium_1
unit	Celsius
value	16.23

Attribute	Value
AquariumID	Aquarium_1
value	OK

Attribute	Value
AquariumID	Aquarium_1
unit	mg/L
value	1.12

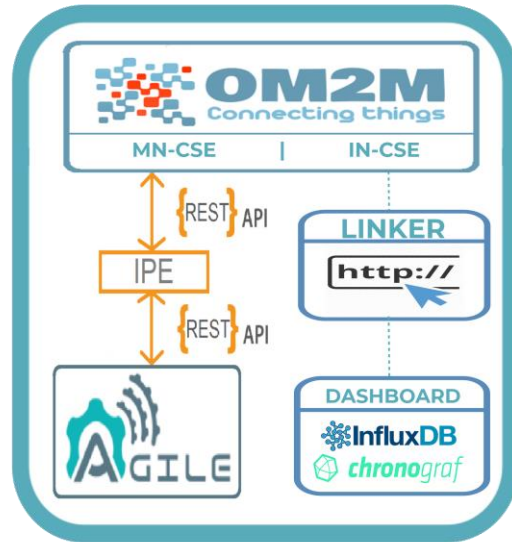*OM2M representations of METADATA and DATA*

21

POULPY'S ARCHITECTURE

Data publishing

POULPY'S ARCHITECTURE
Data publishing

OM2M LINKER

OM2M Linker in the Raspberry Pi

- 1 MN per gateway

- Addressed by the IPE that establishes a link with Agile IoT

- 1 IN per user

- Installed in a gateway

- Serves as a link only between user gateways

POULPY'S ARCHITECTURE
Data transmission

OM2M SUBSCRIPTIONS

Subscriptions

- o <u>To each IN</u>: to detect new MNs, which correspond to new gateways

- o <u>To the list of aquariums in an MN</u>: to detect new aquariums

- o <u>To the data</u>: to send it to Influx DB databases

POULPY'S ARCHITECTURE
Data publishing

DASHBOARD

- **2 different dashboards**
  - For the user
  - For Banyuls' laboratory

- **Advantages**
  - Unlimited access
  - Open source
  - Scalability

- InfluxDB linked to OM2M via subscriptions

- Chronograf periodically checks an InfluxDB database

Chronograd and InfluxDB communication
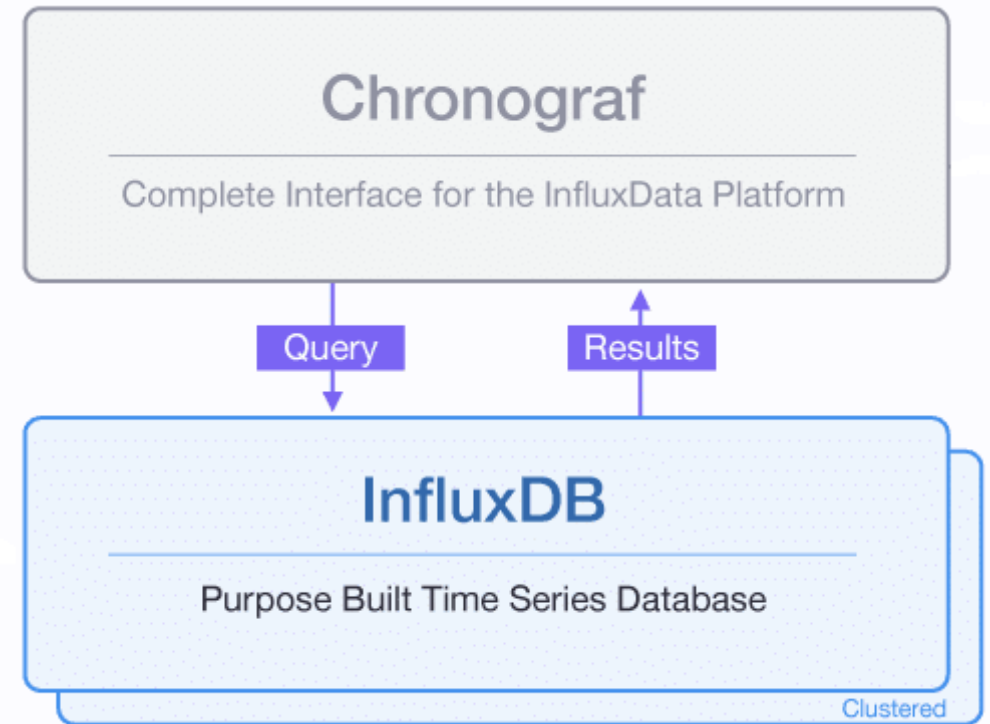
POULPY'S ARCHITECTURE
Data publishing

DASHBOARD
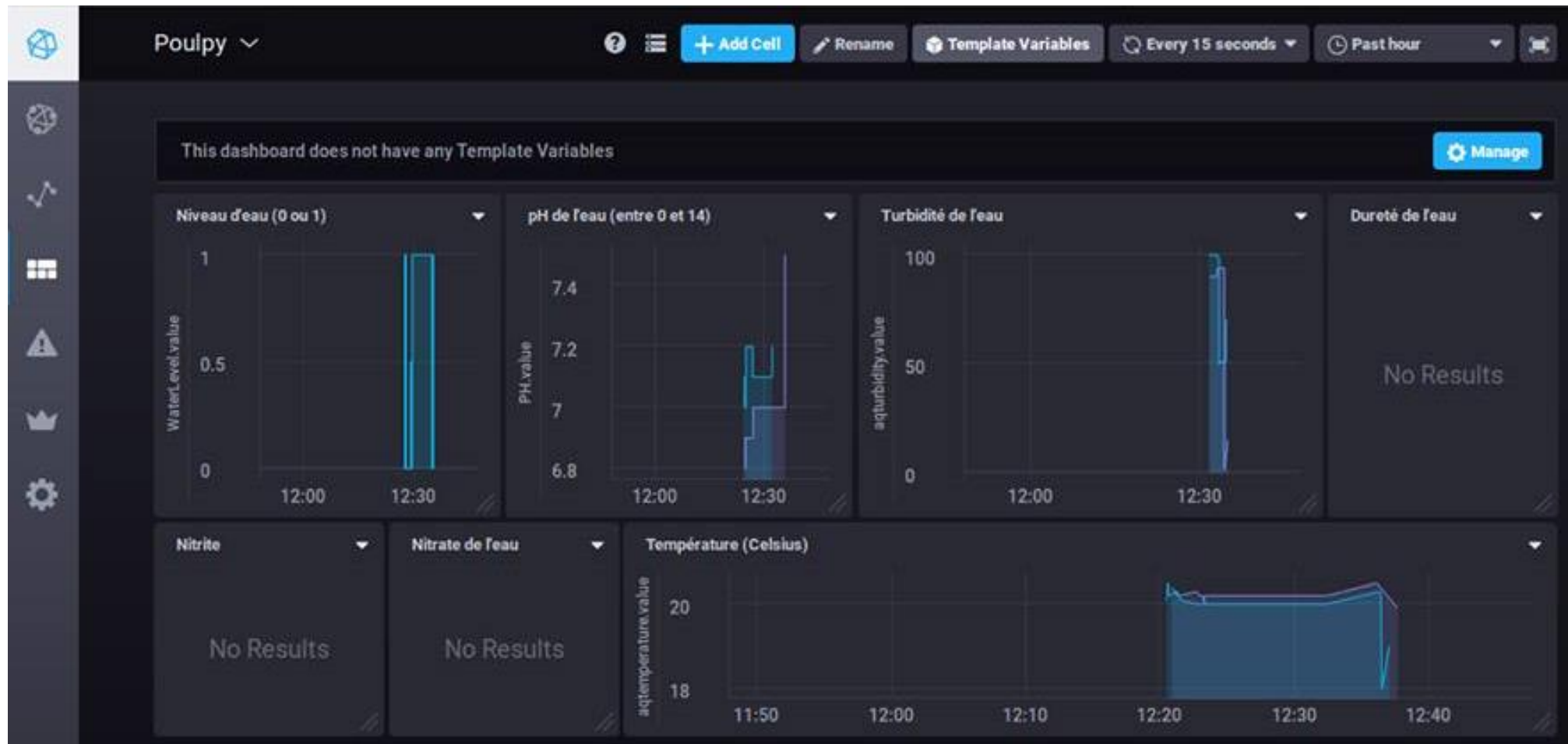
POULPY'S ARCHITECTURE

User management

POULPY'S ARCHITECTURE
User management

WEBSITE
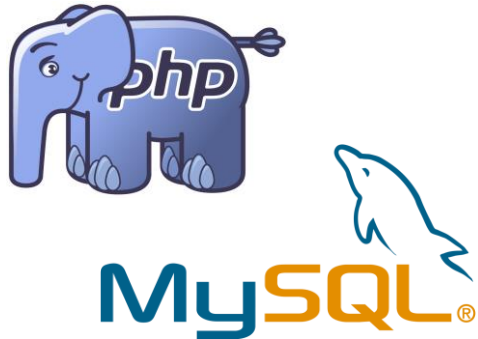
Poulpy Website

Functions

o User Guide: for installation and use

o BOM

o Download the code

o Account creation

POULPY'S ARCHITECTURE
User management

WEBSITE

Technologies

○ Html and CSS (Bootstrap)

○ PHP with MySQL database

○ Developed with WAMP and Brackets

○ Deployed with LAMP on the Virtual Machine

POULPY'S ARCHITECTURE
User management

USERBASE MANAGEMENT

id	1	username	password	nom	prenom	mail	etablissement	nombreAquarium
	1	Leeroy Jenkins	$2y$10$F9EcDzs2Xh9wlpM6pxvqUul1kbNcsthZUxYTjRp1Nw9...	Jenkins	Leeroy	l.j@insa.fr	INSA toulouse	1
	2	Pog Champ	$2y$10$OZBltZO60BlkHoaAg5YDPutrVjLXyf/8pYITPEaj0uO...	Tessier	Killian	k.t@oui.fr	ISIS Castres	3
	3	Le grand monarque	$2y$10$RcoaZcKCSwvGkPoML0bKZu/vz8RFKKgykxpB9IJ/W3P...	Duriff	Sylvain	homme.vert@oui.fr	Alderan	50
	4	UgandaWarrior	$2y$10$tmu0mYLZhi3ZvXx7t2QaPezFLR0cYApqCVTqhCKdKDF...	Knuckles	Ugandan	k.u@dewae.fr	DE WAE	2
	5	vis sans T	$2y$10$r37NuBI7ISJQVaTVBXG05.IKiXi4FmozV0fCX8094Zf...	poveda	vis sans T	v.p@insa.fr	INSA toulouse	3

The user has to submit:

- Full name
- E-mail address
- School
- Number of aquariums

Very simple User Database :

- Only one table
- Password Encryption

30

IMPROVEMENTS

IMPROVEMENTS

- o **Autonomous system**
  - ➤ Auto-run scripts
  - ➤ Use Agile IoT

- o **Security**
  - ➤ Manager authentication on Influx DB

- o **Expanded functionalities**
  - ➤ Website: create a Forum
  - ➤ BLE: improve it to support other sensors

- o **Design**
  - ➤ Completely waterproof water turbidity sensor
  - ➤ 3D model

THANK YOU FOR YOUR ATTENTION

Do you have any questions?