



# INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control  
in Small-scale Agriculture



# INTELLIGENT IRRIGATION SYSTEM FOR LOW-COST AUTONOMOUS WATER CONTROL IN SMALL-SCALE AGRICULTURE



## Building the Intel-IrriS LoRa IoT platform Part 2: edge-enabled gateway (WaziGate)



Prof. Congduc Pham  
<http://www.univ-pau.fr/~cpham>  
Université de Pau, France



# Review: Technology components



# Review: Low-cost sensors



- Build on low-cost, low-power IoT expertise
- Increase accuracy of low-cost sensors by automatic and remotely controlled procedures for advanced calibration
- Enable deployment of several complementary low-cost sensors
- Include agricultural models / knowledge with corrective & predictive analytics

# Review: Smart embedded control

- Build on low-cost embedded & open IoT gateway expertise
- Implement the “Intelligent Irrigation in-the-box” with "plug-&-sense" approach
- Model complex water-soil-plant interaction
- Embed Decision Support System (DSS) and disruptive Artificial Intelligence (AI)
- Integration of various knowledge streams
- Fully autonomous



# Review: Starter-kits

- "Intelligent Irrigation in-the-box", "plug-&-sense"
- At least 100 starter-kit will be distributed



# WaziGate

- WaziGate is an IoT LoRa Gateway developed by WAZIUP
- WaziGate implements the edge-enabled IoT gateway approach
  - customized applications can be directly hosted in the gateway
  - the gateway can easily work without Internet connectivity
  - data are available to end-users in an embedded database
  - web-based visualization module provides graphical user interface
- You can find all the WaziGate documentation on the [WaziGate documentation page](#). There are 4 main sections describing the WaziGate main features:
  - Quick start: [https://www.waziup.io/documentation/wazigate/v2/quick\\_start/](https://www.waziup.io/documentation/wazigate/v2/quick_start/)
  - Installation: <https://www.waziup.io/documentation/wazigate/v2/install/>
  - LoRaWAN: <https://www.waziup.io/documentation/wazigate/v2/lorawan/>
  - WaziApps: <https://www.waziup.io/documentation/wazigate/v2/waziapps/>

# Install your WaziGate

- General WaziGate distribution
  - <https://www.waziup.io/documentation/wazigate/v2/install/>
  - Look at the installation video: <https://youtu.be/DvGdmDsGZHA>
- INTEL-IRRIS WaziGate distribution
  - comes pre-configured with a soil sensor device
  - will work out-of-the box with the INTEL-IRRIS soil sensor device
  - will be updated to host the INTEL-IRRIS irrigation application
  - Download the INTEL-IRRIS WaziGate SD card image from project website
  - <http://intel-iris.eu/>



# Configure soil device for WaziGate

Intelirris\_Soil\_Sensor | Arduino 1.8.13

```

 28
 29 ****
 30 -----
 31 / \ / \ -----
 32 | / \ | / \ |
 33 | | / \ | / \ |
 34 | \ / \ | / \ |
 35 \ / \ | / \ |
 36 | | | | | | | |
 37 | | | | | | | |
 38 ****
 39
 40 // sends data to INTEL-IRRIS WaziGate edge-gateway
 41 #define TO_WAZIGATE
 42
 43
 44 // WAZISENSE and WAZIDEV v1.4 boards have
 45 // - an embedded SI7021 sensor
 46 // WAZISENSE has an integrated solar panel level monitoring circuit
 47 // - input voltage comming from solar panel is exposed on pin A2
 48 // WAZIDEV has a battery voltage level monitoring circuit
 49 // - exposed on pin A7, and D7 must then be at LOW level
 50
 51
 52 //choose either WAZISENSE or WAZIDEV14, or NONE of them for DIY ProMini
 53 //#define WAZISENSE
 54 //#define WAZIDEV14
 55
 56
 57 //can be uncommented for both WAZISENSE and WAZIDEV14
 58 //#define SI7021_SENSOR
 59
 60 //uncomment to use XLPP format to send to WAZIGATE for instance
 61 //so uncomment XLPP only with !ORAWAN to WAZIGATE

```

Done Saving.

42 Arduino Pro or Pro Mini, ATmega328P (3.3V, 8 MHz) on /dev/cu.usbserial-AK05C87P

Be sure that

#define TO\_WAZIGATE

is uncommented

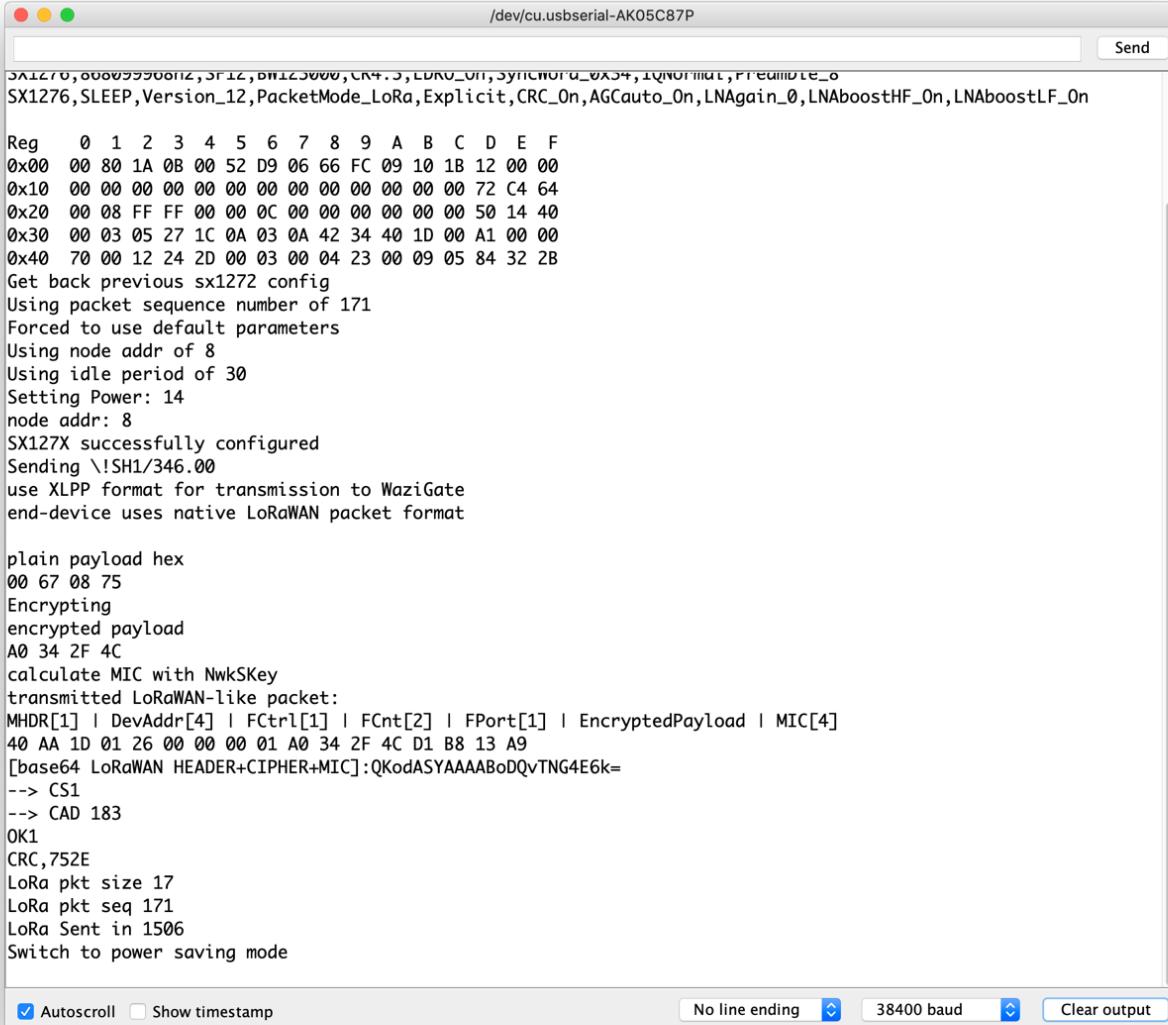
**Click on the "upload" button**



And wait until upload is completed

```
27 */  
28  
29  
30  
  
Done uploading.  
Using library LowPower at version 1.0 in folder: /Users/cpham/Dropbox/Arduino/sketch/libraries/  
Using library OneWire at version 2.3.2 in folder: /Users/cpham/Dropbox/Arduino/sketch/libraries/  
Using library Dallas-Temperature at version 3.7.7 in folder: /Users/cpham/Dropbox/Arduino/sketch/  
Using library AES-128_V10 in folder: /Users/cpham/Dropbox/Arduino/sketch/libraries/AES-128_V10  
Using library Base64 at version 1.0.0 in folder: /Users/cpham/Dropbox/Arduino/sketch/libraries/  
/Users/cpham/Library/Arduino15/packages/arduino/tools/avr-gcc/7.3.0-atmel3.6.1-arduino7/bin/avr  
Sketch uses 14208 bytes (46%) of program storage space. Maximum is 30720 bytes.  
Global variables use 476 bytes (23%) of dynamic memory, leaving 1572 bytes for local variables
```

# Checking that device is operational



```

/dev/cu.usbserial-AK05C87P
Send

SX1276,0000000000000000,3F12,B0123000,CRC4.5,LDRU_0H,SYNCHRO_0X34,TQ_NORM,PREDECODE_0
SX1276,SLEEP,Version_12,PacketMode_LoRa,Explicit,CRC_On,AGCAuto_On,LNAgain_0,LNAboostHF_On,LNAboostLF_On

Reg 0 1 2 3 4 5 6 7 8 9 A B C D E F
0x00 00 80 1A 0B 00 52 D9 06 66 FC 09 10 1B 12 00 00
0x10 00 00 00 00 00 00 00 00 00 00 00 00 00 00 72 C4 64
0x20 00 08 FF FF 00 00 0C 00 00 00 00 00 00 00 50 14 40
0x30 00 03 05 27 1C 0A 03 0A 42 34 40 1D 00 A1 00 00
0x40 70 00 12 24 2D 00 03 00 04 23 00 09 05 84 32 2B
Get back previous sx1272 config
Using packet sequence number of 171
Forced to use default parameters
Using node addr of 8
Using idle period of 30
Setting Power: 14
node addr: 8
SX127X successfully configured
Sending \!SH1/346.00
use XLPP format for transmission to WaziGate
end-device uses native LoRaWAN packet format

plain payload hex
00 67 08 75
Encrypting
encrypted payload
A0 34 2F 4C
calculate MIC with NwkSKey
transmitted LoRaWAN-like packet:
MHDR[1] | DevAddr[4] | FCtrl[1] | FCnt[2] | FPort[1] | EncryptedPayload | MIC[4]
40 AA 1D 01 26 00 00 00 01 A0 34 2F 4C D1 B8 13 A9
[base64 LoRaWAN HEADER+CIPHER+MIC]:QKodASYAAABoDQvTNG4E6k=
--> CS1
--> CAD 183
OK1
CRC,752E
LoRa pkt size 17
LoRa pkt seq 171
LoRa Sent in 1506
Switch to power saving mode

 Autoscroll  Show timestamp
  No line ending  Clear output

```

**Open serial monitor**

**Set baud rate to 38400**

**See output from board**

**Check that transmission is OK**

# Testing transmission to gateway



Parameters for  
WaziGate



SF12BW125

868.1 MHz

Node id is 26011DAA

1 msg/30mins

1 sensor

XLPP data

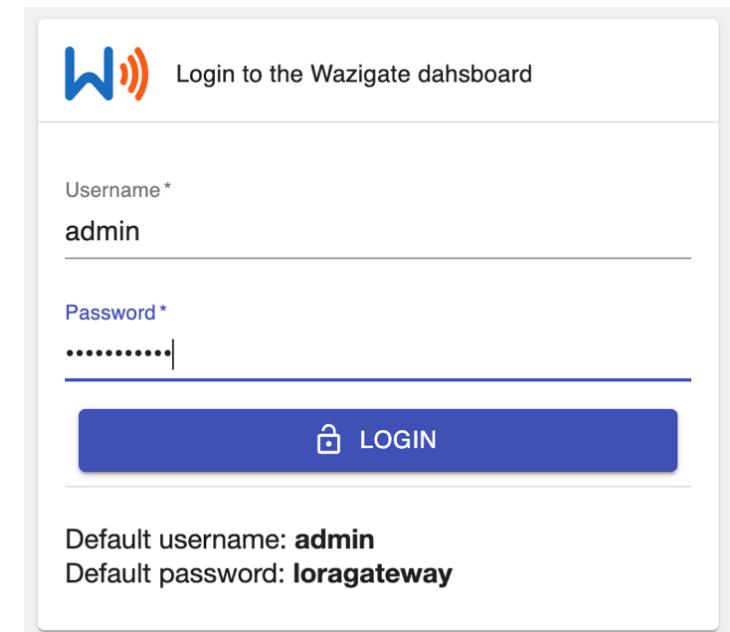
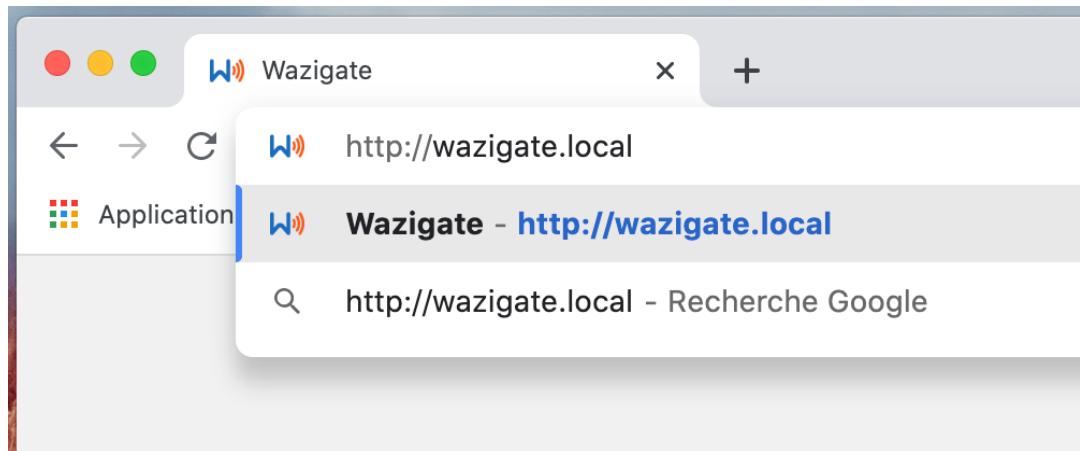


This dedicated video will show all these steps, from connecting the SEN0308 to testing transmission to the WaziGate  
<https://youtu.be/j-1Nk0tv0xM>



# Accessing your WaziGate

- Connect to WAZIGATE\_XXXXXXXXXXXX WiFi network
  - default WiFi password is loragateway
- Open web navigator and to go <http://wazigate.local>



Login to the Wazigate dashboard

Username \*

admin

Password \*

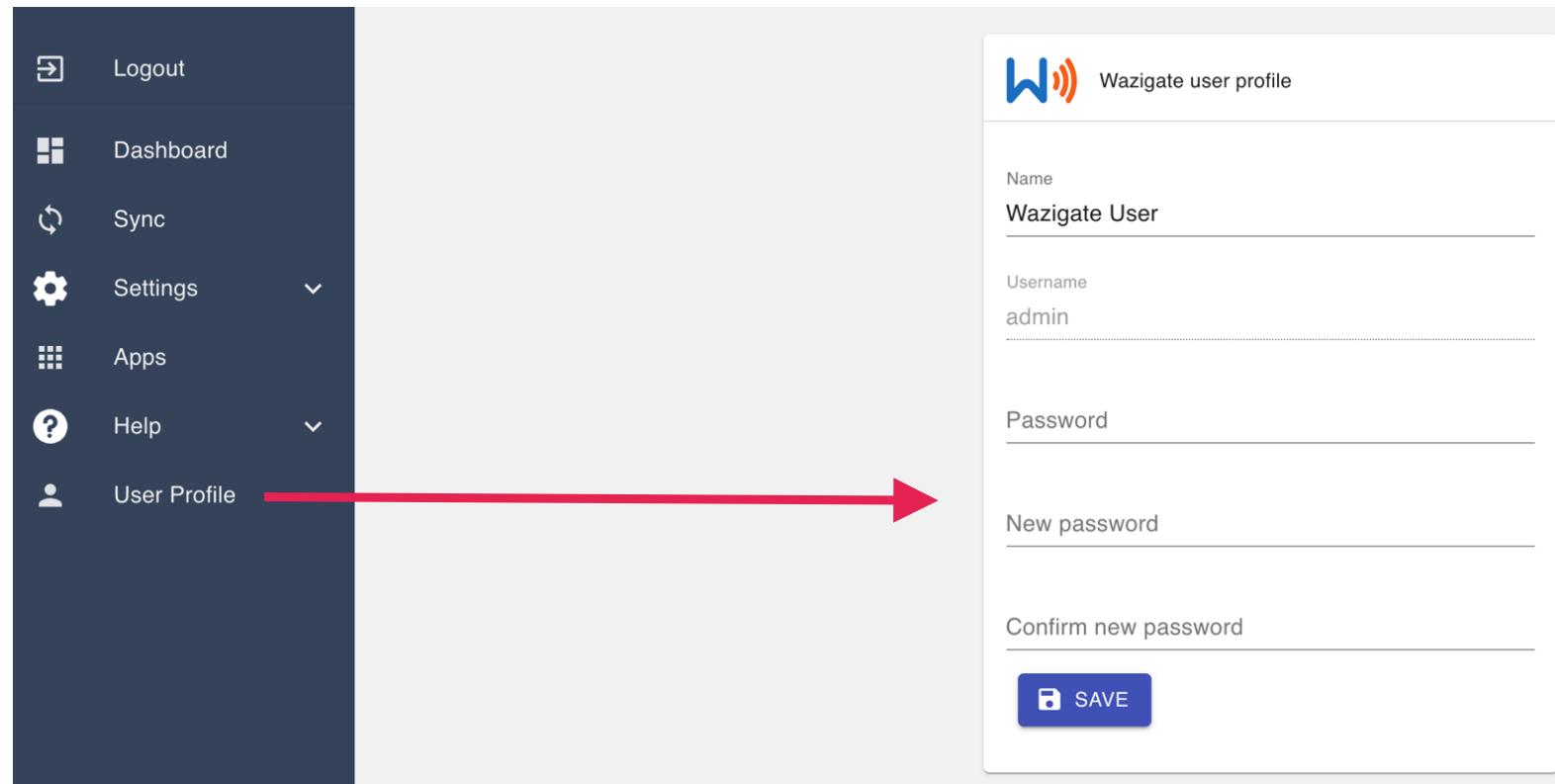
.....

Default username: **admin**  
Default password: **loragateway**

- Use default login to connect to WaziGate
  - User: admin
  - Password: loragateway

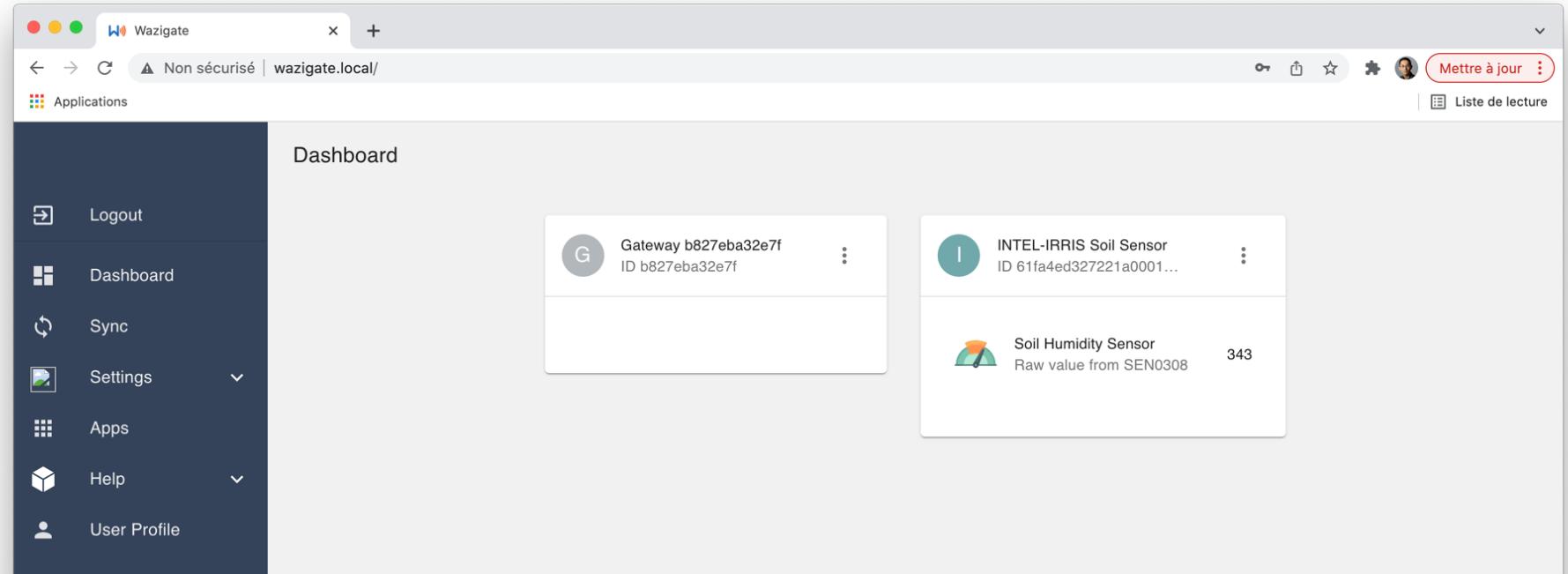
# Change default password

- Once connected, it is recommended to change your password in the User Profile left menu



The screenshot illustrates the process of changing a default password. On the left, a dark-themed sidebar menu includes options like Logout, Dashboard, Sync, Settings, Apps, Help, and User Profile. The User Profile option is highlighted with a red arrow pointing to a detailed configuration screen on the right. This screen is titled 'Wazigate user profile' and contains fields for Name (set to 'Wazigate User'), Username (set to 'admin'), and Password, New password, and Confirm new password fields. A prominent blue 'SAVE' button is located at the bottom of the profile form.

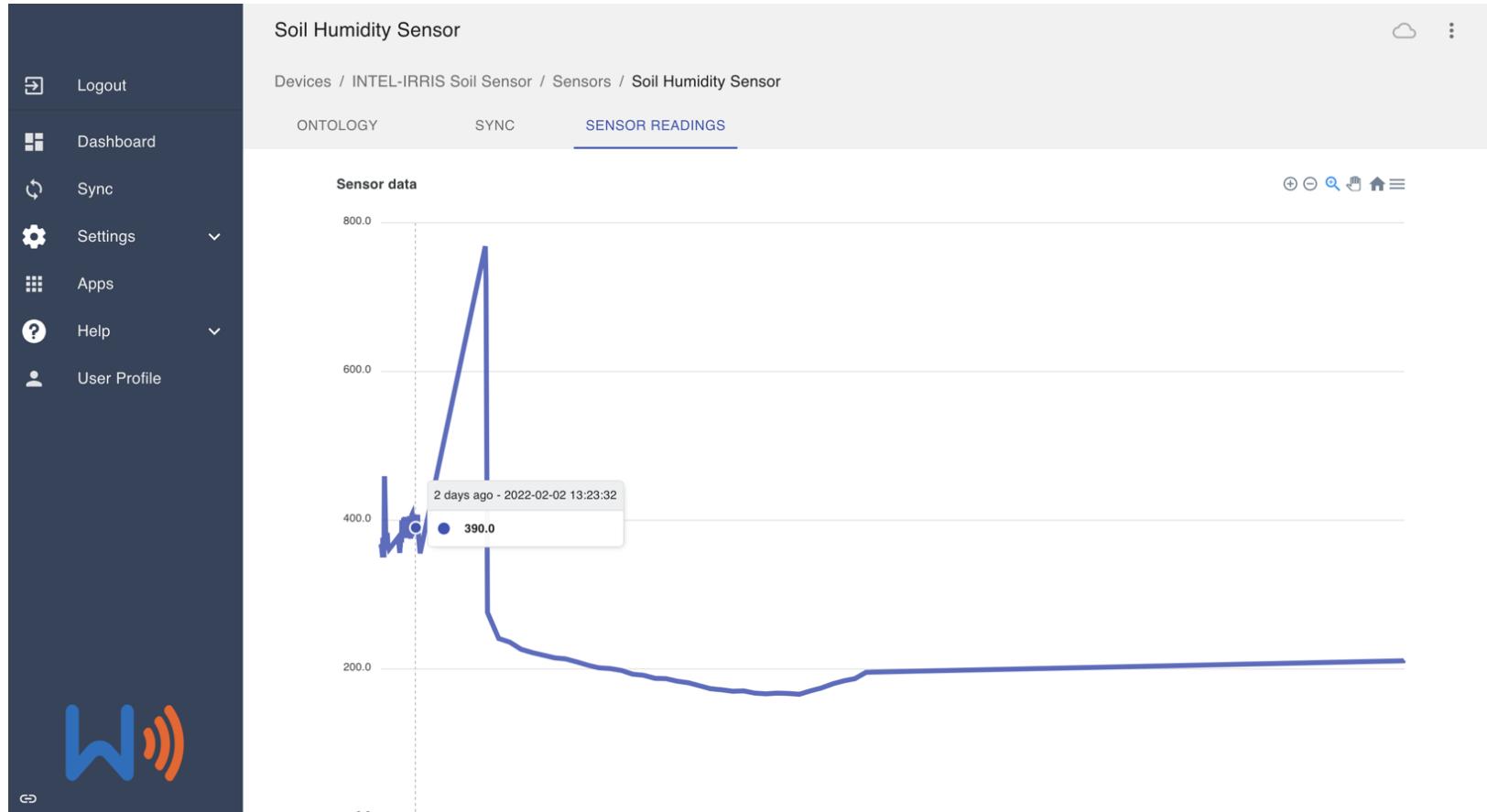
# WaziGate dashboard



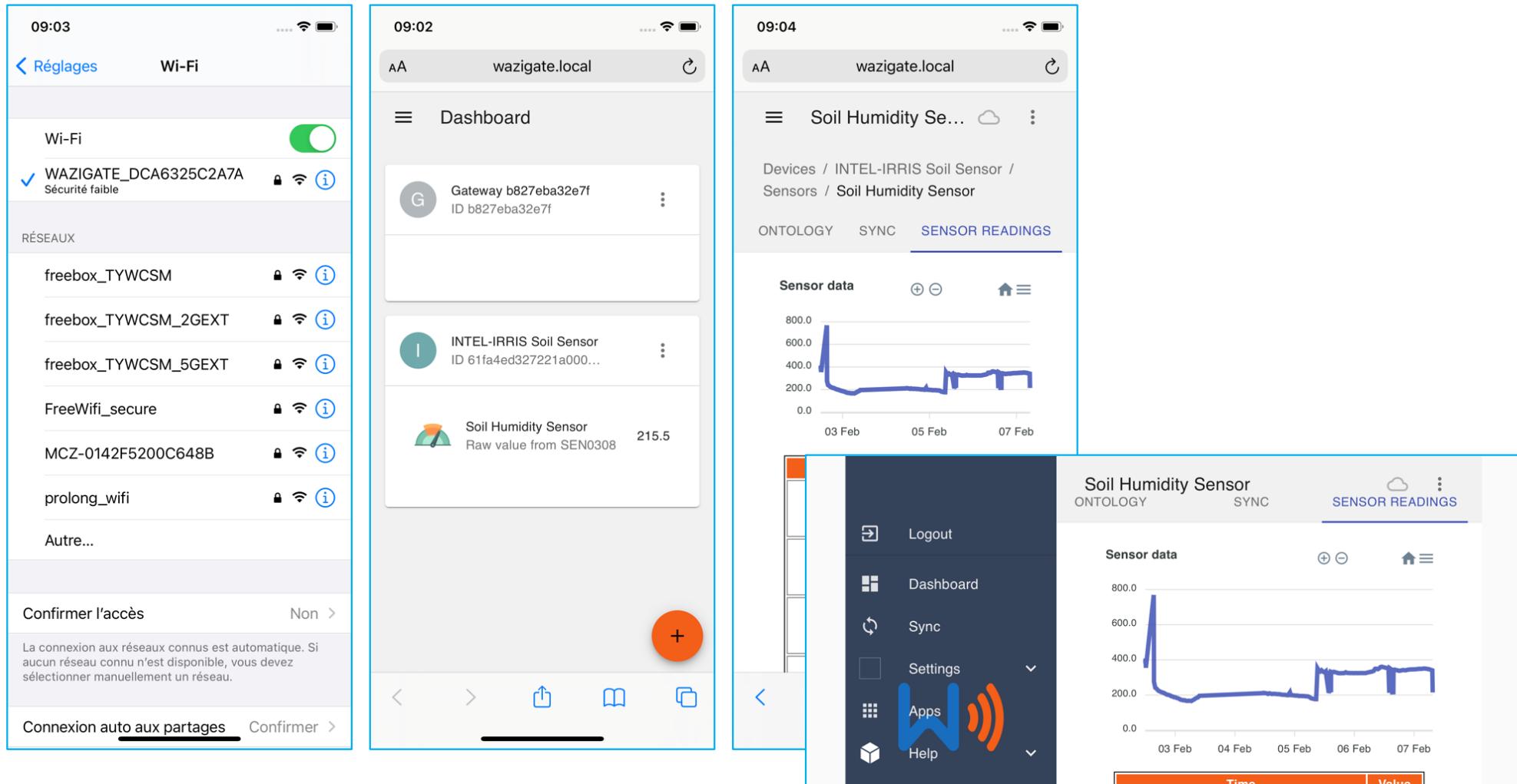
There is already a pre-configured INTEL-IRRIS soil sensor device with a SEN0308 soil humidity sensor ready to received data

The last received value is displayed in the device block

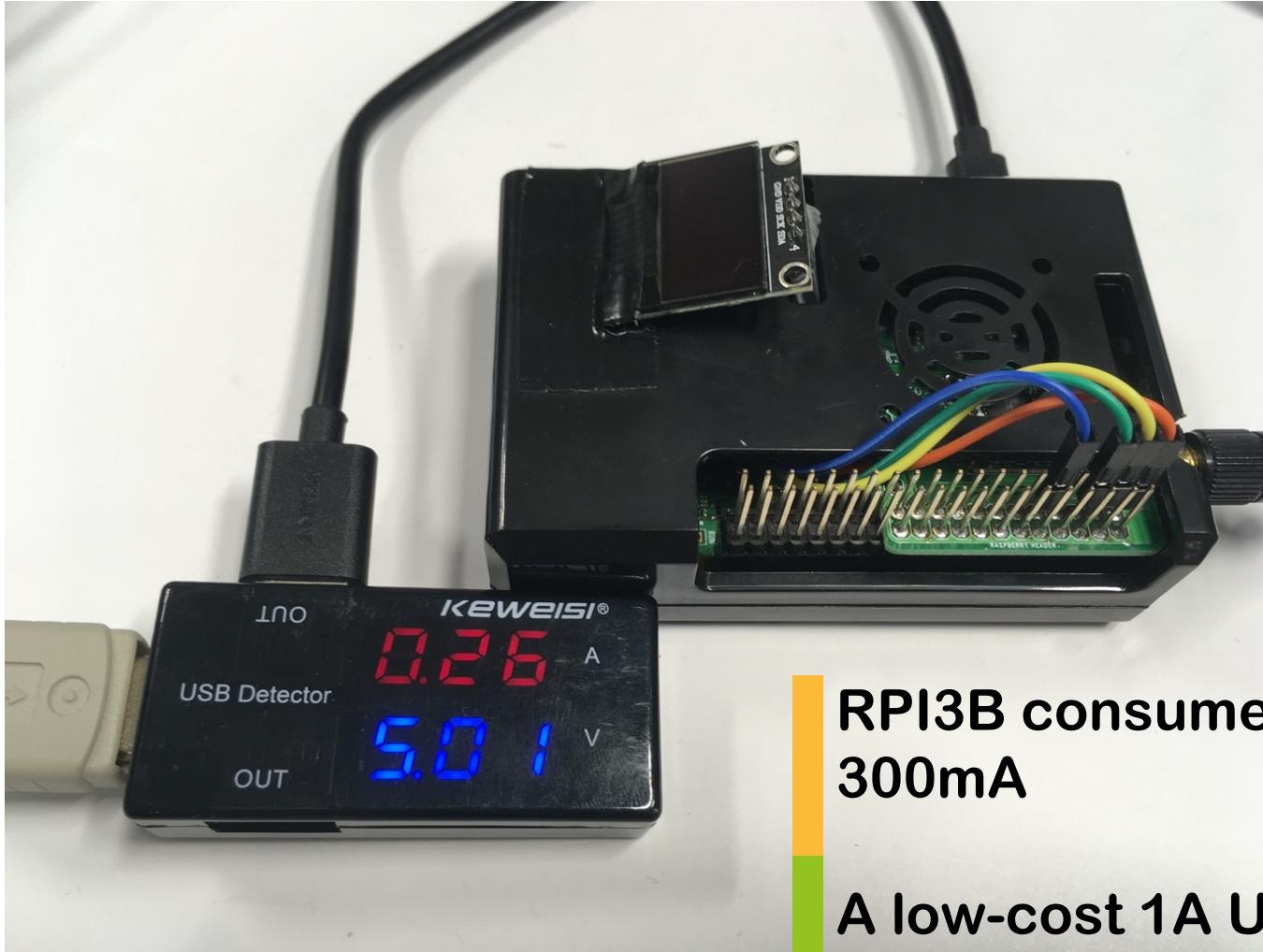
# Display sensor data



# All these steps with a smartphone



# WaziGate power consumption



RPI3B consumes less than  
300mA

A low-cost 1A USB mobile  
charger is suitable



Starter-kit

Autonomous

*Intelligent Irrigation*

Plug-&-Sense

In-the-box