



# 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)



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# 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
  - Select EU868 or EU433 version
  - <http://intel-irris.eu/>



## Be sure that

```
#define TO_WAZIGATE
```

# is uncommented

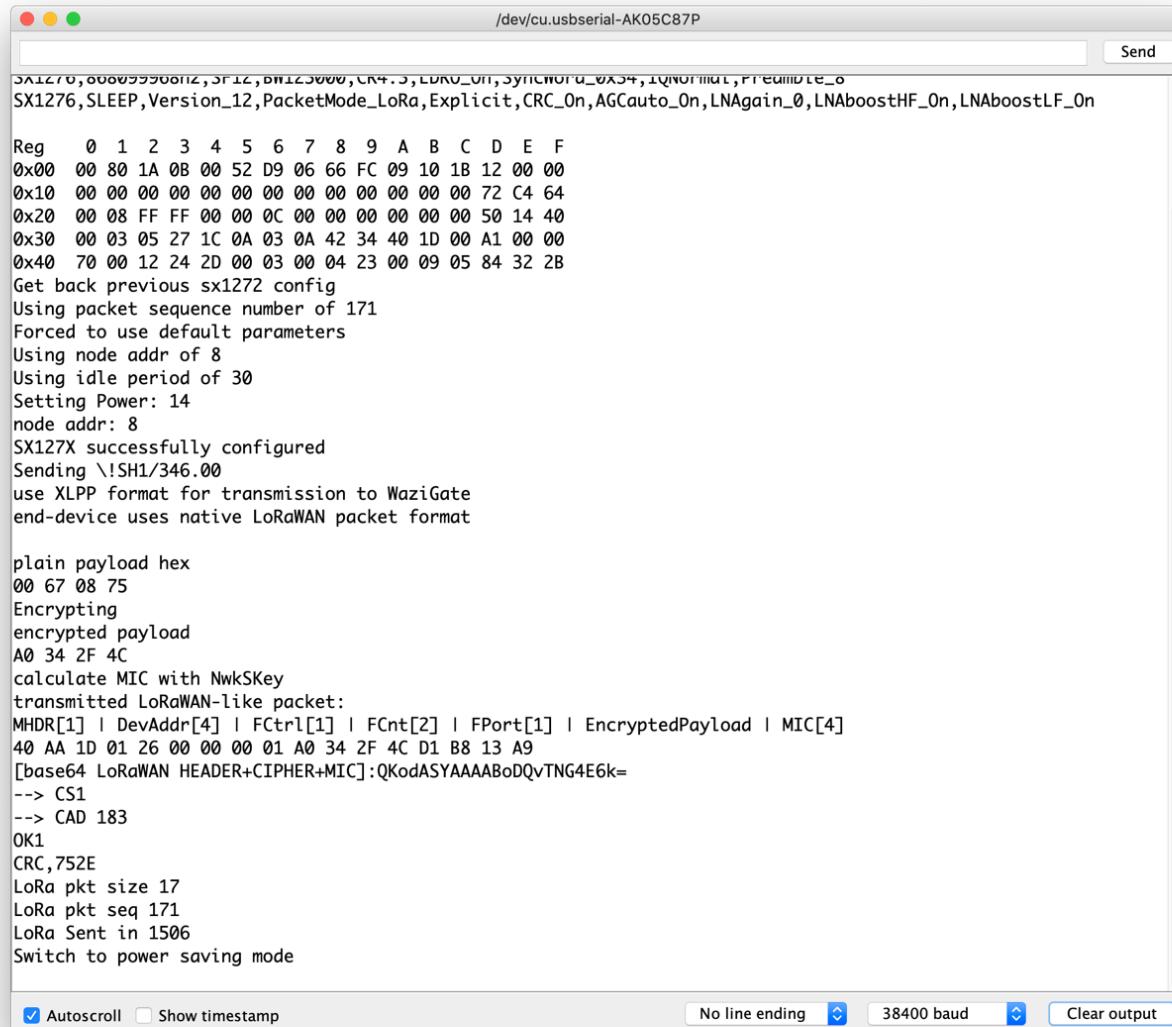
**Click on the "upload" button**



**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**

# Configuring for EU433 band

Intelirris\_Soil\_Sensor - SX127X\_RadioSettings.h | Arduino 1.8.13

```

Intelirris_Soil_Sensor DS18B20.cpp DS18B20.h RadioSettings.h SX126X_RadioSettings.h SX127X_RadioSettings.h
56 const uint8_t IQ_Setting = LORA_IQ_NORMAL;
57 //*****
58 // End from SX12XX example - Stuart Robinson
59 ****
60
61 // IMPORTANT SETTINGS
62 /////////////////
63 // please uncomment only 1 choice
64 //
65 #define ETSI_EUROPE_REGULATION
66 // #define FCC_US_REGULATION
67 // #define SENEGAL_REGULATION
68 /////////////////
69
70 /////////////////
71 // please uncomment only 1 choice
72 // #define BAND868
73 // #define BAND900
74 #define BAND433
75 /////////////////
76
77 // #define USE_20DBM
78 /////////////////
79
80
81 /////////////////
82 // DO NOT CHANGE
83
84 #ifdef ETSI_EUROPE_REGULATION
85 #define MAX_DBM 14
86 #elif defined SENEGAL_REGULATION
87 #define MAX_DBM 10
88 #elif defined FCC_US_REGULATION

```

74

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

**Edit SX127X\_RadioSettings.h**

**comment**

// #define BAND868

**and uncommented**

#define BAND433

# Transmission to LoRaWAN gateway



Parameters for  
WaziGate



SF12BW125  
868.1MHz | 433.175MHz  
Node id is 26011DAA  
1 msg/30mins  
1 sensor  
XLPP data

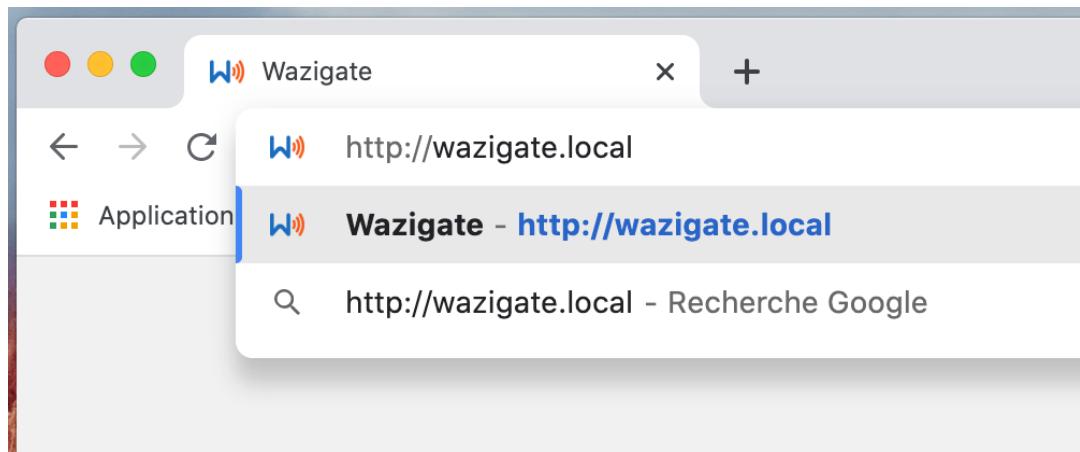


This dedicated video will show all these steps, from connecting the SEN0308 to testing transmission to the WaziGate  
<https://youtu.be/j-1Nk0tv0xM>



# Accessing your WaziGate

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



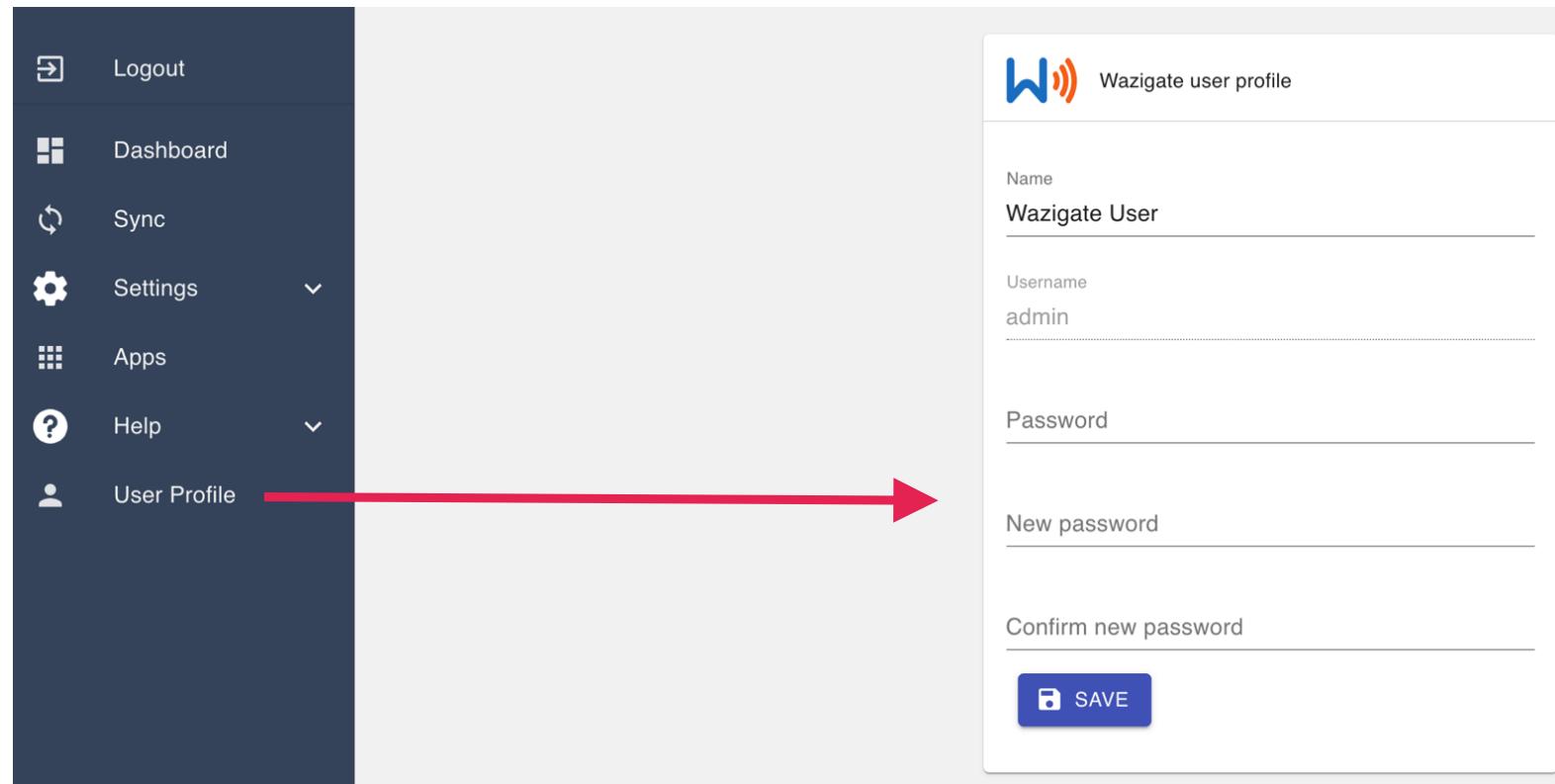
Login to the Wazigate dashboard

Username *	<input type="text" value="admin"/>
Password *	<input type="password" value="....."/>
<b>LOGIN</b>	
Default username: <b>admin</b> Default password: <b>loragateway</b>	

- 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



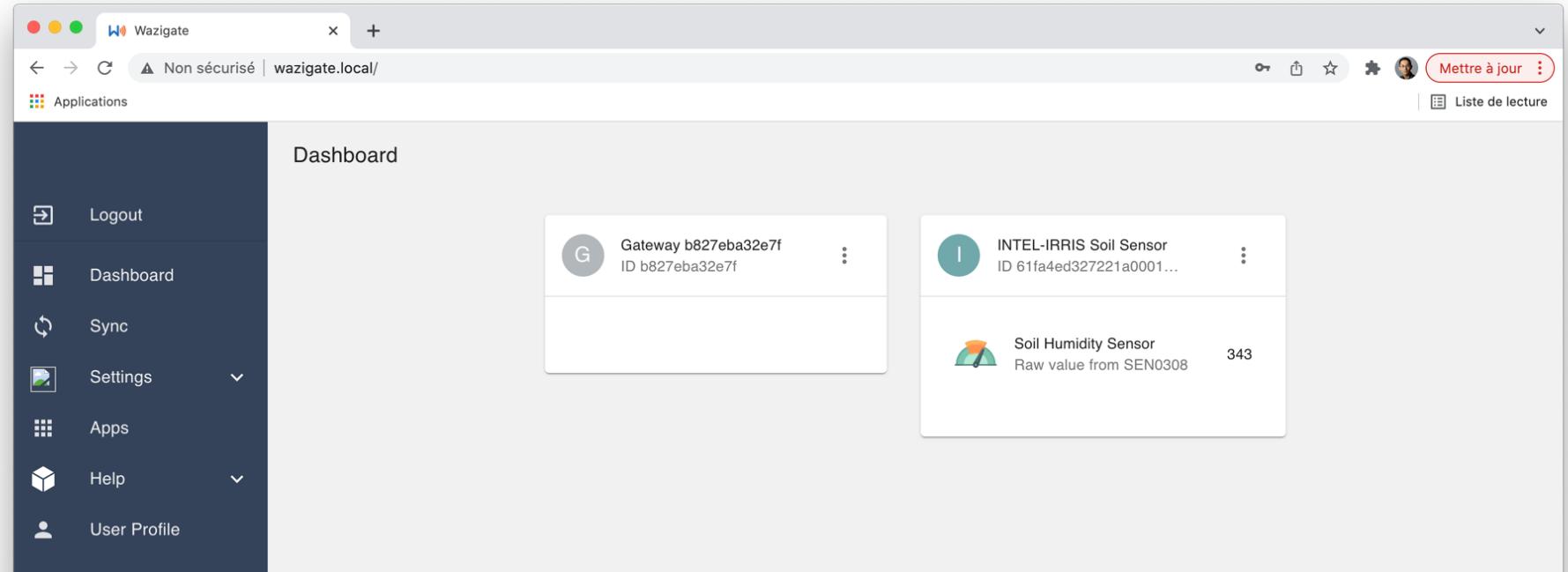
The screenshot shows a user interface with a dark blue sidebar on the left containing the following items:

- Logout
- Dashboard
- Sync
- Settings
- Apps
- Help
- User Profile

A red arrow points from the "User Profile" item in the sidebar to a detailed view of the Wazigate user profile settings page on the right. The settings page has the following fields:

- Name: Wazigate User
- Username: admin
- Password (empty field)
- New password (empty field)
- Confirm new password (empty field)
- SAVE button

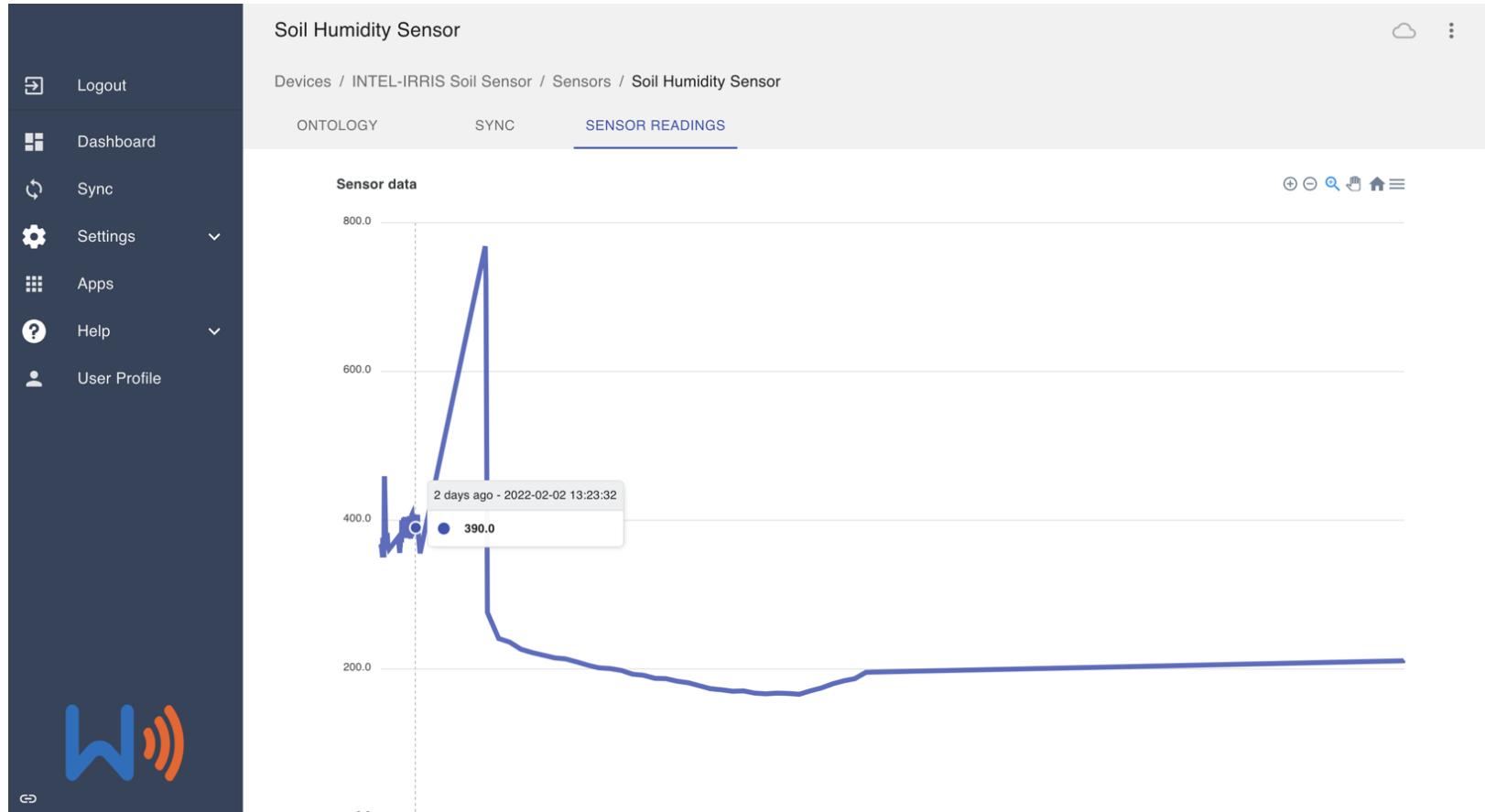
# WaziGate dashboard



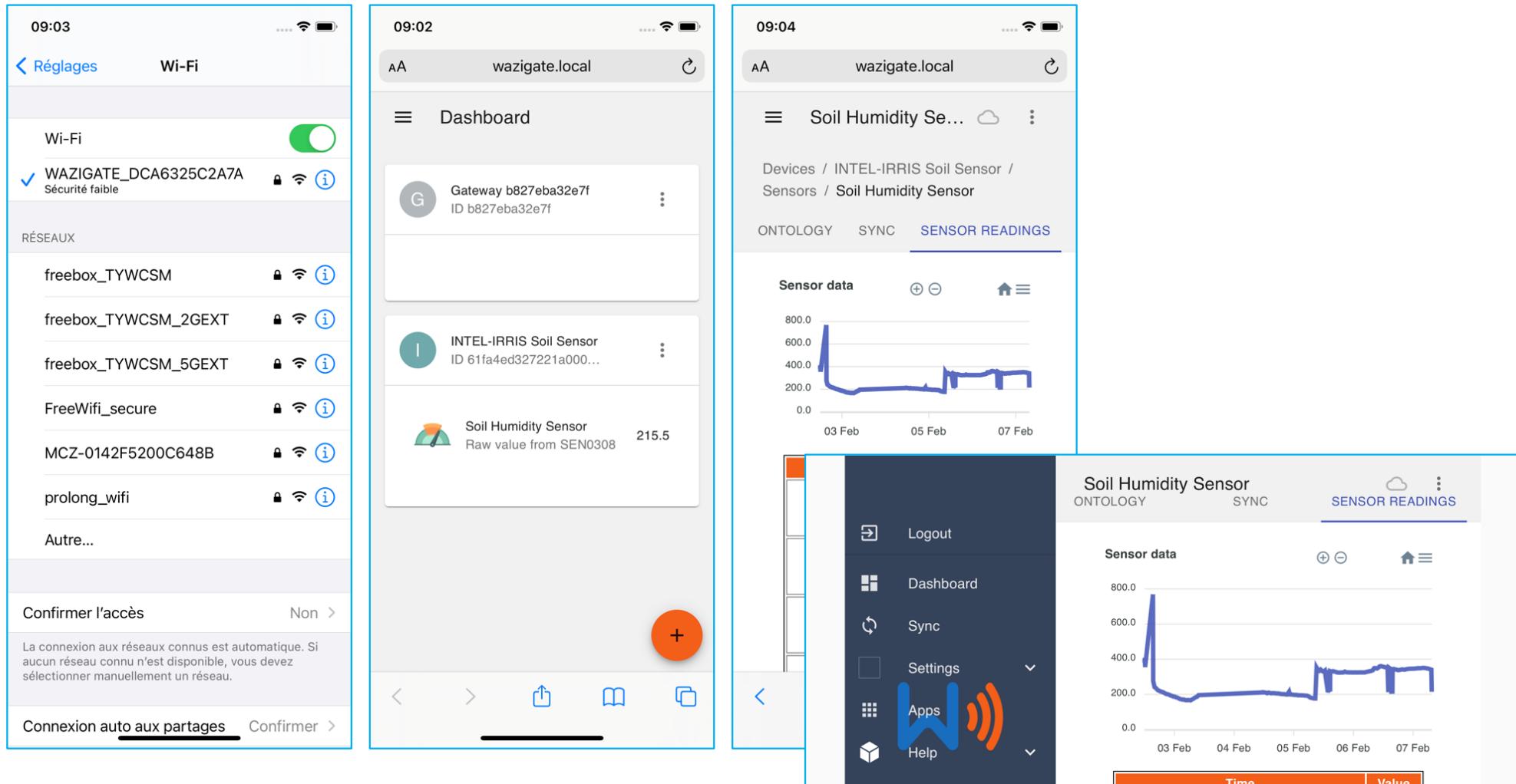
There is already a pre-configured INTEL-IRRIS soil sensor device with a SEN0308 soil humidity sensor ready to received data

The last received value is displayed in the device block

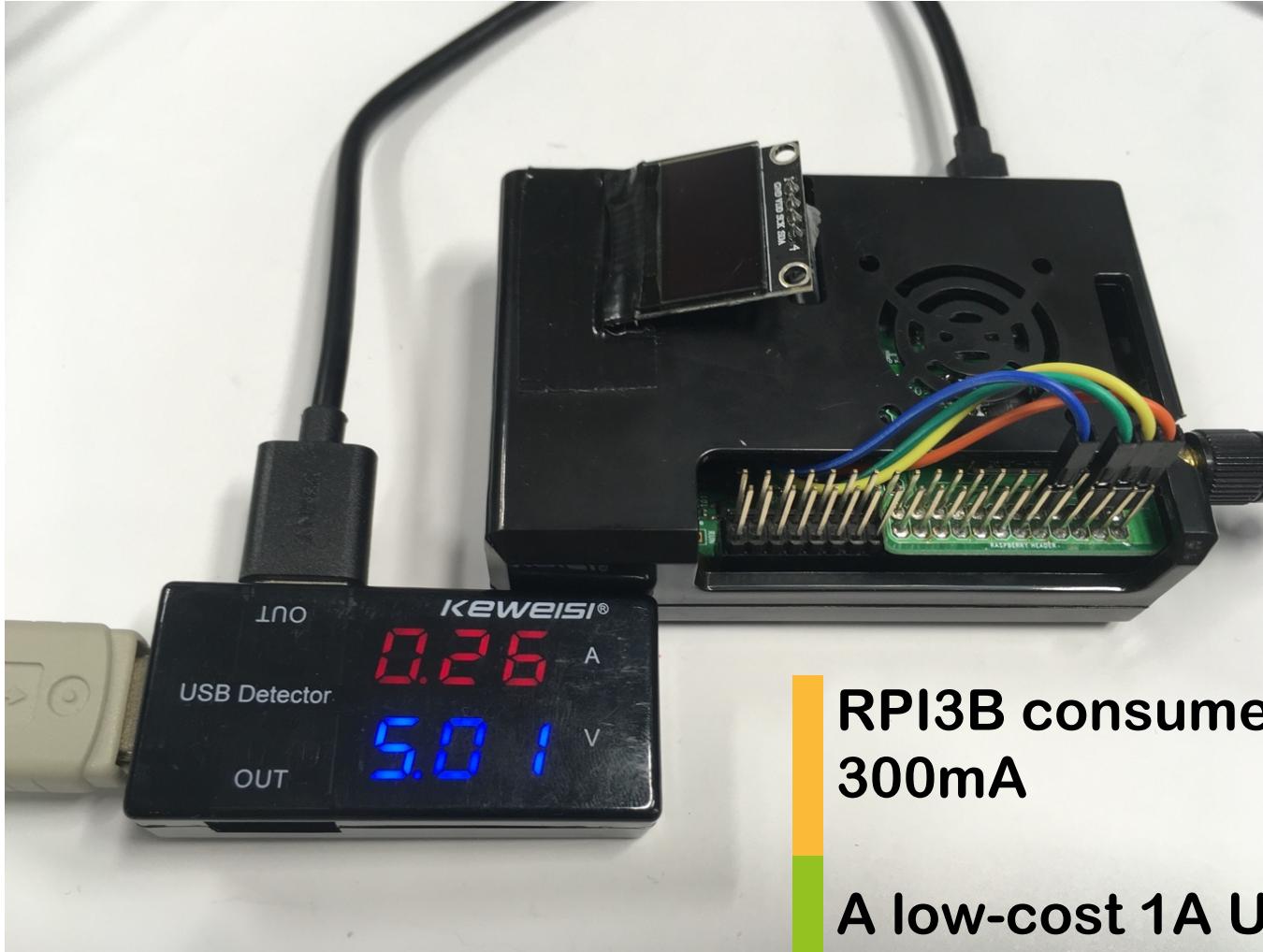
# Display sensor data



# 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