Implementation of intelligent modules with ESP8266

Semestral project

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Project aims

Project aims

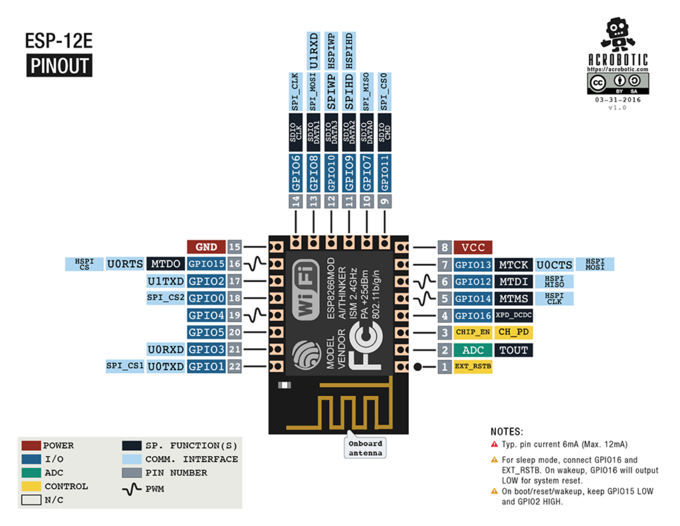
- Explore the development options for ESP8266 modules.
- Create a coherent system made up of ESP8266 modules connected with suitable sensors and display modules.
- Implement server that handles the communication between modules.
- Design a communication protocol that allows you to communicate with any number of modules, with PUSH notification and the ability to dynamically add modules.

Introduction of ESP8266

Introduction of ESP8266

- Originally a simple WiFi (802.11 b/g/n) to serial converter with full TCP/IP stack.
- Driven by 32-bit Tensilica Xtensa MCU, CPU frequency 80 or 160 MHz, with 96 KiB of RAM and up to 4 MiB external flash memory.
- Provide SPI, I2C, UART, 10-bit ADC and 16 multipurpose GPIO pins.

Introduction of ESP8266



NOTES:

- Typ. pin current 6mA (Max. 12mA)
- For sleep mode, connect GPIO16 and EXT_RSTB. On wakeup, GPIO16 will output LOW for system reset.
- On boot/reset/wakeup, keep GPIO15 LOW and GPIO2 HIGH.

Development options

Development options

- Official Non-OS SDK and RTOS SDK based on FreeRTOS real-time operation system.
- Community SDK based on Xtensa open-source GCC toolkit
- Arduino Core for ESP8266 - the most popular
- NodeMCU Lua
- MicroPython
- Espruino based on JavaScript

Arduino Core for ESP8266

Pros

+ Support wide spectrum of libraries.
+ Easy to use with Arduino IDE.
+ Great community support.

Cons

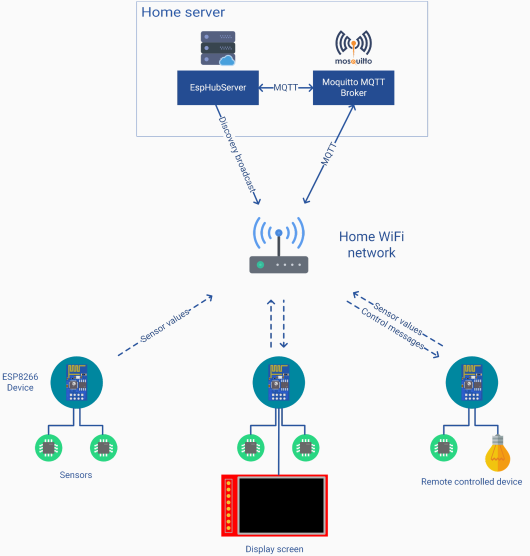
- Arduino vs ESP8266 hardware incompatibility.
- Forever loop.

Introduction of EspHub

Motivation

- Create system that allows easily connect new device to existing infrastructure.
- Notify user when a new device pops up.
- Manage devices and collect data from sensors.
- Visualize data.
- Visualize data on remote display.

EspHub overview



EspHub library

EspHub library

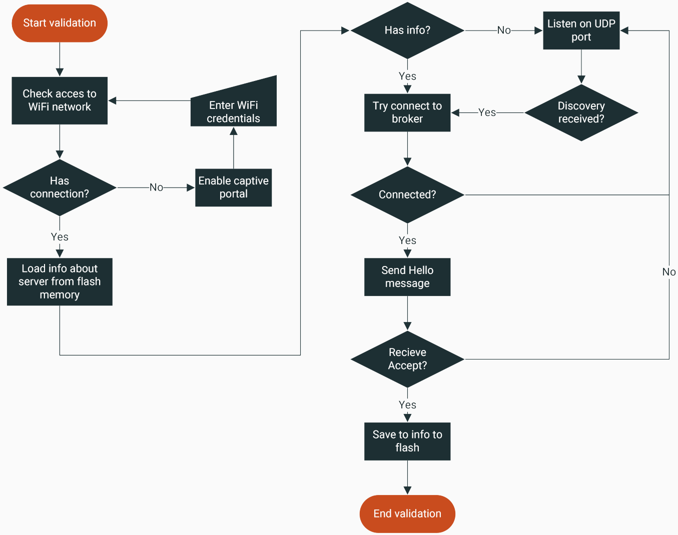
- Library for Arduino platform which handles connection between ESP8266 and EspHub server.
- Searches for active servers on the network and tries connect to them.
- Save info about server into internal flash memory if server is authorized.
- Provide simple user API for communication with server.
- Send device telemetry data, such as SSID, RSSI, IP address, etc..
- Allows the user to set a callback on specific messages from the server, such as `turn_on_led`, `push_button`, etc..

User API

Library provide some basic methods for communication with server:

- `setAbilities(abilities)`
- `sendData(type, value)`
- `sendJson(topic, JSON)`
- `setCallback()`

Communication protocol



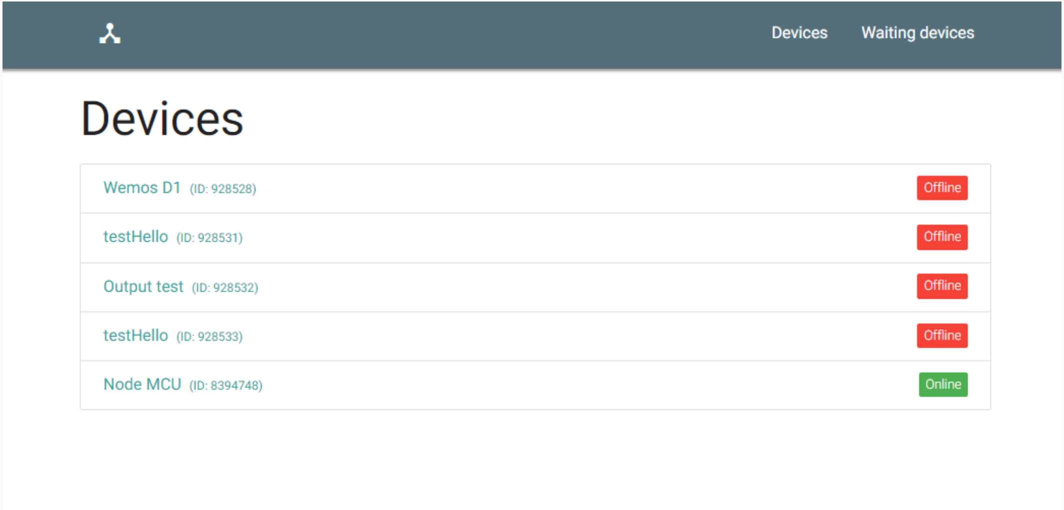
EspHub server

EspHub server

- Collecting data and telemetry from devices.
- Visualize data.
- Periodically send data to remote display.
- Broadcasts discovery messages.
- Notification when new device appear on network.

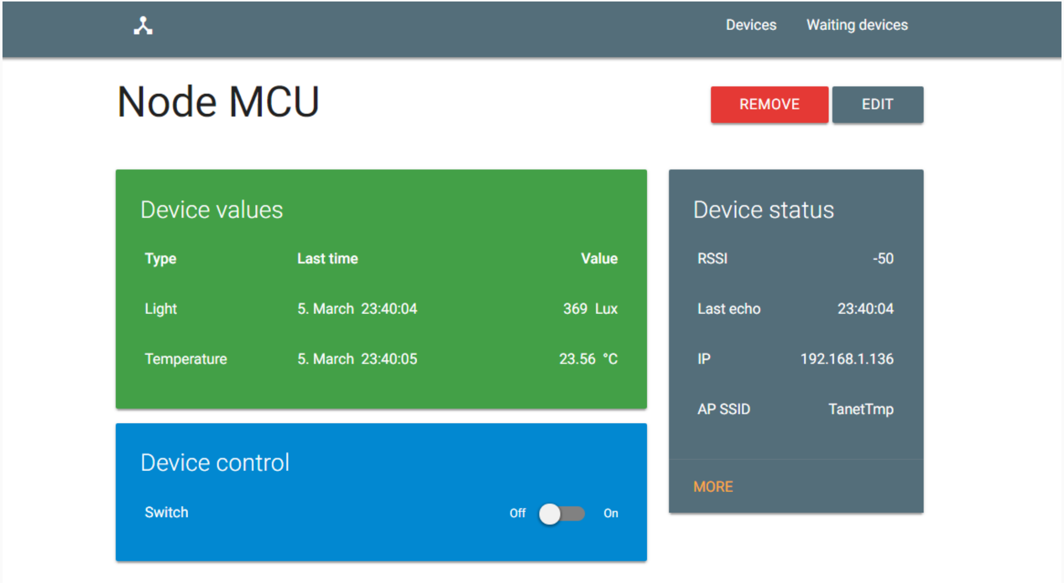
In background

- Python + Django framework + Click library.
- Installation with PIP.
- Simple CLI for testing and configuration.
- Internal scheduled tasks.



Devices

Wemos D1 (ID: 928528)	Offline
testHello (ID: 928531)	Offline
Output test (ID: 928532)	Offline
testHello (ID: 928533)	Offline
Node MCU (ID: 8394748)	Online



Node MCU

Device values

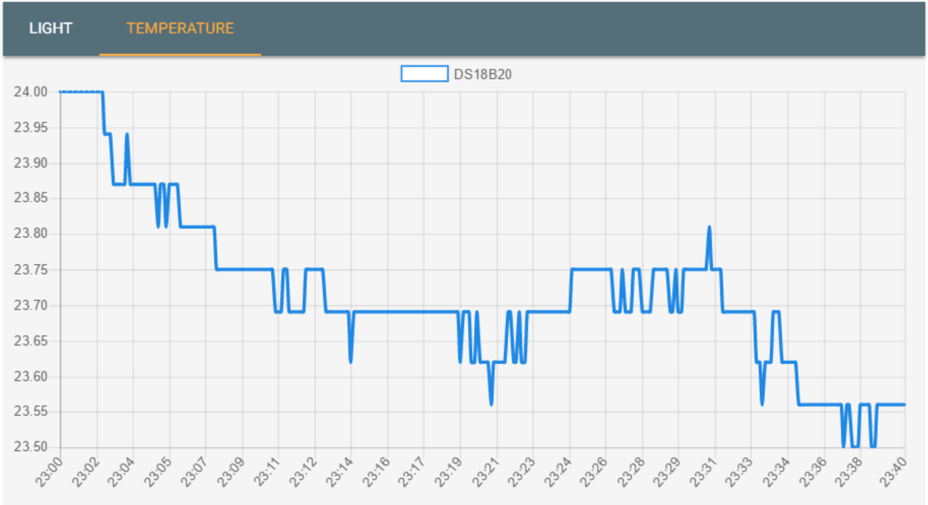
Type	Last time	Value
Light	5. March 23:40:04	369 Lux
Temperature	5. March 23:40:05	23.56 °C

Device control

Switch Off ○ On

Device status

RSSI	-50
Last echo	23:40:04
IP	192.168.1.136
AP SSID	TanetTmp


LIGHT
TEMPERATURE
□ DS18B20
24.00
23.95
23.90
23.85
23.80
23.75
23.70
23.65
23.60
23.55
23.50
23:00
23:02
23:04
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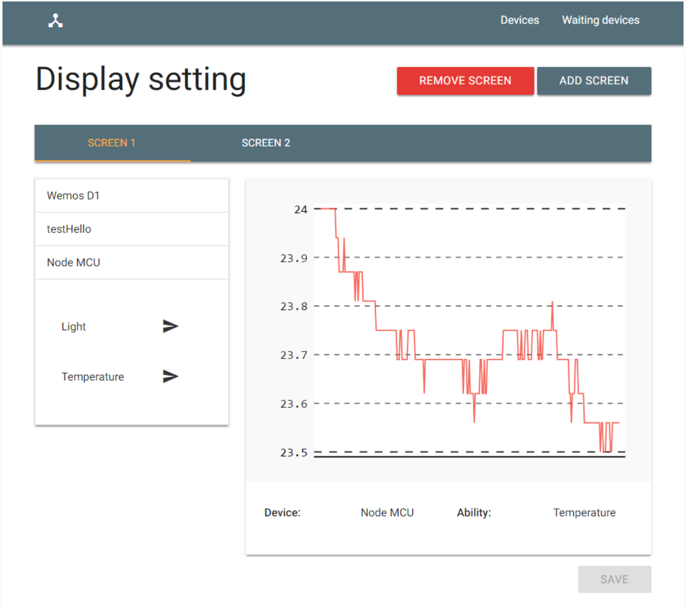
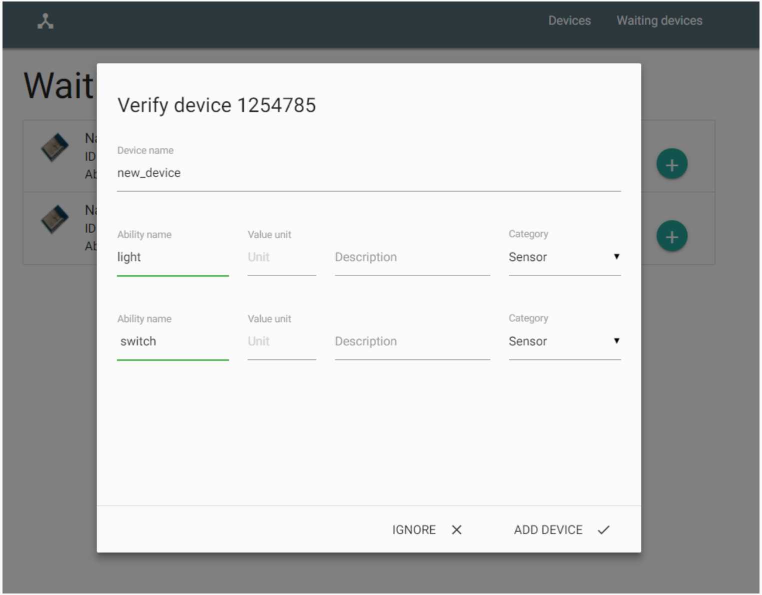


Device: Node MCU

Ability: Temperature



Verify device 1254785

Device name: new_device

Ability name: light
Value unit: Unit
Description
Category: Sensor ▾

Ability name: switch
Value unit: Unit
Description
Category: Sensor ▾

Future

Future

- Better visualization.
- Support custom display layout.
- Periodic tasks.
- Support ESP32.

Thanks for attention

github.com/TanasVlachopulos/EspHub