POLITECNICO
MILANO 1863

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IoT Challenge #1

Wokwi and Power Consumption

What to do?

1. **Develop on Wokwi a simple parking occupancy node using the HC-SR04 ultrasonic distance sensor and the ESP-NOW for the communication.**
   - **Go in Deep Sleep with a defined duty-cycle**

2. Perform an Estimation of the **Power** and **Energy** consumption for a full cycle and estimate the time it last with one battery of Energy Y

3. Comment the results and suggest some possible improvements in order to reduce the overall energy consumption

1. Parking occupancy node Specification (1)

- The Node aim is to communicate to a central ESP32 sink node the occupancy of a parking slot (in the emulation use the broadcast address: 8C:AA:B5:84:FB:90)
- Emulate an ESP32 using Wokwi and use the HC-SR04 ultrasonic distance sensor to estimate the presence of a car in a parking spot (distance < 50 cm)

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1. Parking occupancy node Specification (2)

- In order to save energy, the sensor node implements a duty cycle, where every **X seconds** it wakes up from Deep sleep and transmit a String «FREE»/«OCCUPIED» to the ESP32 sink node, to state if the parking spot is empty/occupied by a car
- As soon as the transmission is performed, the node goes back in Deep Sleep state.
- The sensor node will communicate the presence of a car using the ESP-NOW protocol to a central ESP32 sink node (The sink node has no energy constraints)

1. Parking occupancy node Specification (3)

- Assume the ESP32 sink node is always reachable by every sensor nodes.
- A sensor node is present on every parking spot

For the duty cycle period, compute **X** as follows:
Take the last 2 digits of the team leader person code, perform modulo 50 and add 5

leader_personcode= 106929**AB**

X=**AB%50+5**

E.g. code = 1069291**1**

X = 11%50+5 = 16 seconds

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2. Energy Consumption Estimation (1)

Given the implemented duty cycle perform an Energy Consumption estimation of the sensor node:

- **2.1 Estimate the average Power** consumption for each state of the node (Deep Sleep state, Idle, Transmission State, Sensor reading)
- **2.2 Estimate the Energy** consumption of 1 transmission cycle

Refer to the **Power** Consumption CSV file measurements (Seen in Lab 2) for the estimation of the power and energy consumption

2. Energy Consumption Estimation (2)

2.3 Estimate the time the sensor node last before changing the battery

Consider the **Energy** of the battery to be **Y** Joule, with **Y** computed as the last 4 digits of leader personcode plus 5:

leader_personcode= 1069**ABCD**

Y=ABCD+5

E.g. code=1069**2911**

Energy = **2911**+5=2916 Joule

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3. Comments Results and Improvements

3.1 Provide a small comment on the implemented system.

3.2 Starting from the system requirements, propose some possible Improvements in terms of Energy Consumption without modifying the main task «Notify to a Sink node the occupancy state of a parking spot»

Challenge deliverables

What to deliver:

- A **PDF** report containing the **(1)** explanation of the code logic, **(2)** the estimation of the power and energy consumption and battery lifetime, and **(3)** the reasoning on possible improvements of the sensor node.
  Organize a **clean** report! Very bad reports will be penalized
- **Export of Wokwi project and the shared Public link**
  COMMENT AND INDENT YOUR CODE
- YOUR NAMEs and **PERSON CODEs**

The files should be included in a ZIP which should be named as follows:

3/2-teams: <leader_personcode>_<personcode2>_<personcode3>.zip
Single: <leader_personcode>.zip
E.g. 10692911.zip or 10692911_10692912.zip or 10692911_10692912_10692913.zip

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Challenge delivery: HOW?

How to deliver?

- Upload the files in a zip archive as .zip file on the **folder #1** on WeBeep "Assignments" folder

- Fill this form with the Energy Consumption Estimation for 1 transmission cycle and the node lifetime

For two/three-people teams:

- Choose your team leader and name the file as:
  <leader_personcode>_<other_personcodes>.zip

- **Only the teamleader** should upload the challenge in WeBeep
  Do note upload the same challenge twice

- *Can I take the challenges with the other class students (Prof. Redondi/Cesana)*?
  YES, but only the team leader should upload the challenge in WeBeep

Delivery Deadline

- **STRICT Deadline:**

  March 20, 2024 h 23.59 (FIRM)

- Max 3 people
- Up to 4 points

Good Luck!

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