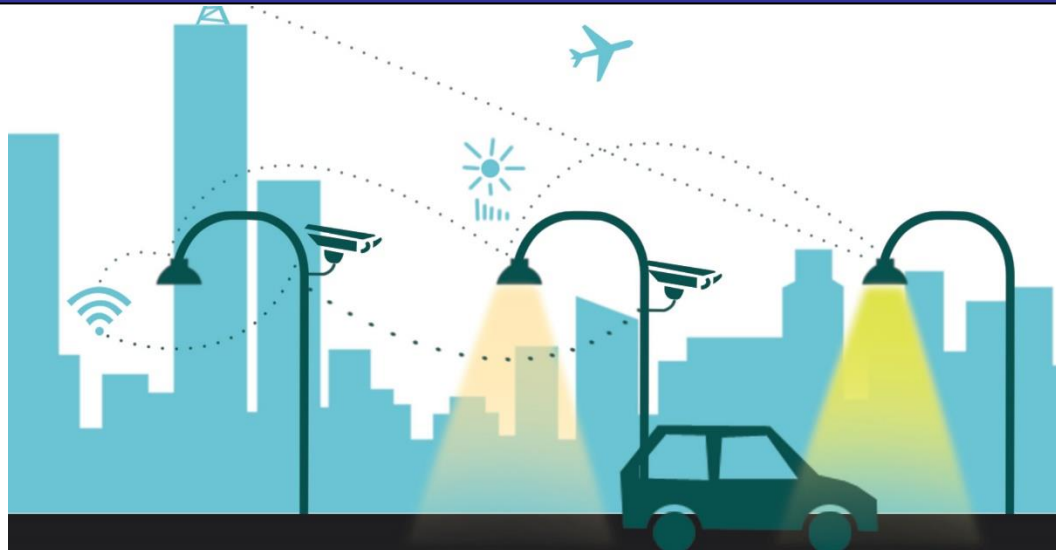


Smart Lighting Project

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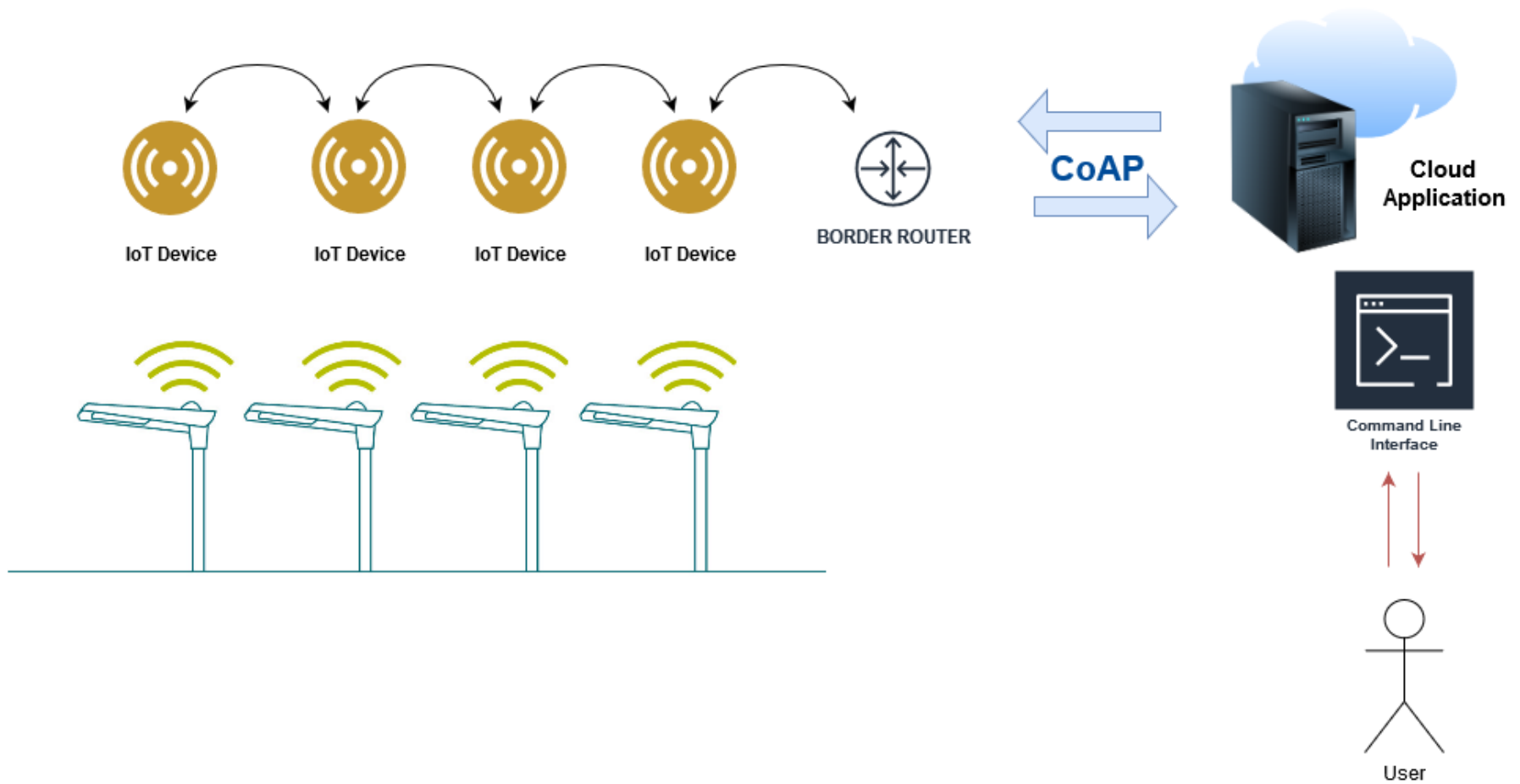
Internet of Things
A.Y. 2019-2020

Introduction

This project develops a smart lighting system, based on sensors and actuators installed in **streetlights** all over the city.

These devices are able to interface with a cloud application, that collects their data and offers to the user the possibility of changing their status.

System scheme and structure



Each streetlight is equipped with:

- A **light sensor** that constantly collects data about the light intensity in its area.
 - The light is measured in percentage of luminosity (value from 0 to 100).
- A **light actuator** that controls the bulb of the streetlights, turning it on or off.
 - The bulb can be controlled in a *manual mode*, from the application user, or in an *automatic mode* from the device.
- Both these devices are controlled in a single smart **node**, installed on the streetlight.

All the nodes are managed by a **border router**.

If the actuators are in **automatic mode**, then each node automatically turns on or off the bulb depending on the luminosity detected by the sensor.

On the other hand, if the actuators are in **manual mode**, then they switch the bulbs only after a request from the cloud application.

Each node has a **button** to switch between modes.

In addition, the user can change modes via an interface command.

Cooja Simulation

My simulation - Cooja: The Contiki Network Simulator

File Simulation Notes Tools Settings Help

Network View Zoom

Simulation control

Run Speed limit

Start Pause Step Reload

Time: 01:02.998
Speed: 99.80%

Serial Socket (SERVER) (Contiki 1)

Listen port: 60001 Stop

socket -> mpte: 2740 bytes
mote -> socket: 4268 bytes
Status: Client /127.0.0.1:38984 connected.

Mote output

File Edit View

Time	Mote	Message
00:13.581	ID:3	[INFO: NODE] REGISTERED
00:13.711	ID:1	?3h[registration`Y?3YhE[4U-(
00:14.214	ID:3	[DBG : Light Sensor] Received GET
00:14.262	ID:3	[DBG : Light Actuator] Received GET
00:23.581	ID:3	[INFO: NODE] Checking bulb status (timer expired event)
00:26.548	ID:2	[INFO: NODE] REGISTERED
00:26.661	ID:1	</well-known/core>;ct=40,</sensors/light>;title="Photosynthetic`Y?3YhE[4U-(and solar light";rt="Li...
00:27.081	ID:2	[DBG : Light Sensor] Received GET
00:27.099	ID:2	[DBG : Light Actuator] Received GET
00:29.126	ID:5	[INFO: NODE] REGISTERED
00:29.226	ID:1	</well-known/core>;ct=40,</sensors/light>;title="Photosynthetic`Y?3YhE[4U-(and solar light";rt="Li...
00:29.923	ID:5	[DBG : Light Sensor] Received GET
00:29.969	ID:5	[DBG : Light Actuator] Received GET
00:33.581	ID:3	[INFO: NODE] Checking bulb status (timer expired event)
00:36.548	ID:2	[INFO: NODE] Checking bulb status (timer expired event)
00:39.126	ID:5	[INFO: NODE] Checking bulb status (timer expired event)
00:43.581	ID:3	[INFO: NODE] Checking bulb status (timer expired event)
00:46.288	ID:4	[INFO: NODE] REGISTERED
00:46.437	ID:1	</well-known/core>;ct=40,</sensors/light>;title="Photosynthetic`Y?3YhE[4U-(and solar light";rt="Li...
00:46.548	ID:2	[INFO: NODE] Checking bulb status (timer expired event)
00:47.154	ID:4	[DBG : Light Sensor] Received GET
00:47.192	ID:4	[DBG : Light Actuator] Received GET
00:49.126	ID:5	[INFO: NODE] Checking bulb status (timer expired event)
00:53.581	ID:3	[INFO: NODE] Checking bulb status (timer expired event)
00:56.288	ID:4	[INFO: NODE] Checking bulb status (timer expired event)
00:56.548	ID:2	[INFO: NODE] Checking bulb status (timer expired event)
00:59.126	ID:5	[INFO: NODE] Checking bulb status (timer expired event)
01:02.178	ID:6	[INFO: NODE] REGISTERED
01:02.278	ID:1	</well-known/core>;ct=40,</sensors/light>;title="Photosynthetic`Y?3YhE[4U-(and solar light";rt="Li...

Filter:

Mote Interface Viewer (Contiki 2)

Select interface: Button

Click button

Mote Interface Viewer (Contiki 3)

Select interface: Button

Click button

Mote Interface Viewer (Contiki 4)

Select interface: Button

Click button

Mote Interface Viewer (Contiki 5)

Select interface: Button

Click button

Mote Interface Viewer (Contiki 6)

Select interface: Button

Click button

Timeline showing 6 motes

File Edit View Zoom Events Motes

1 2 3 4 5 6

The cloud application has:

- A **CoAP server** that registers the smart nodes and starts monitoring them through the CoAP observing.
- A **command line interface** that the user can exploit to send request to each node of the network:

```
osboxes@osboxes:~/contiki-ng/IoT-project/app$ java -jar target/app-0.0.1-SNAPSHOT.jar
-----
TYPE ONE OF THE FOLLOWING COMMANDS AND PRESS ENTER:
"resources"          -> to get the available resources and their addresses
"ON $index"          -> to switch on the bulb at the corresponding index (-1 for all bulbs)
"OFF $index"         -> to switch off the bulb at the corresponding index (-1 for all bulbs)
"AUTO $index"        -> to automate the bulb at the corresponding index (-1 for all bulbs)
"MANUAL $index"      -> to disable automatic mode for the bulb at the corresponding index (-1 for all bulbs)
"sensor $index"      -> to print the status of the $index sensor (-1 for all sensors)
"actuator $index"    -> to print the status of the $index actuator (-1 for all actuators)
"exit"              -> to close the application
```

Command Line Interface

```
"exit"                -> to close the application

resources
INDEX  RESOURCE INFO
(0)    Node: fd00:0:0:0:203:3:3:3, Path: sensors/light, title="Photosynthetic and solar light";rt="Light Sensor";obs
(1)    Node: fd00:0:0:0:203:3:3:3, Path: actuators/bulb, title="Bulb controller: ?POST/PUT mode=ON|OFF automatic=ON|OFF";rt="Light Control";obs
(2)    Node: fd00:0:0:0:202:2:2:2, Path: sensors/light, title="Photosynthetic and solar light";rt="Light Sensor";obs
(3)    Node: fd00:0:0:0:202:2:2:2, Path: actuators/bulb, title="Bulb controller: ?POST/PUT mode=ON|OFF automatic=ON|OFF";rt="Light Control";obs
(4)    Node: fd00:0:0:0:205:5:5:5, Path: sensors/light, title="Photosynthetic and solar light";rt="Light Sensor";obs
(5)    Node: fd00:0:0:0:205:5:5:5, Path: actuators/bulb, title="Bulb controller: ?POST/PUT mode=ON|OFF automatic=ON|OFF";rt="Light Control";obs
(6)    Node: fd00:0:0:0:204:4:4:4, Path: sensors/light, title="Photosynthetic and solar light";rt="Light Sensor";obs
(7)    Node: fd00:0:0:0:204:4:4:4, Path: actuators/bulb, title="Bulb controller: ?POST/PUT mode=ON|OFF automatic=ON|OFF";rt="Light Control";obs
(8)    Node: fd00:0:0:0:206:6:6:6, Path: sensors/light, title="Photosynthetic and solar light";rt="Light Sensor";obs
(9)    Node: fd00:0:0:0:206:6:6:6, Path: actuators/bulb, title="Bulb controller: ?POST/PUT mode=ON|OFF automatic=ON|OFF";rt="Light Control";obs

sensor -1
(0) Node 3 sensors/light      TIMESTAMP      VALUE
                                2020-06-25 13:18:50.0  49.61
                                2020-06-25 13:19:50.0  41.42
                                2020-06-25 13:20:50.0  48.97
                                2020-06-25 13:21:50.0  49.59
                                2020-06-25 13:22:50.0  44.63

(2) Node 2 sensors/light      TIMESTAMP      VALUE
                                2020-06-25 13:19:02.0  45.93
                                2020-06-25 13:20:03.0  35.86
                                2020-06-25 13:21:03.0  45.27
                                2020-06-25 13:22:03.0  30.61

(4) Node 5 sensors/light      TIMESTAMP      VALUE
                                2020-06-25 13:19:05.0  38.13
                                2020-06-25 13:20:05.0  41.74
                                2020-06-25 13:21:05.0  46.15
                                2020-06-25 13:22:05.0  41.73

(6) Node 4 sensors/light      TIMESTAMP      VALUE
                                2020-06-25 13:19:23.0  41.82
                                2020-06-25 13:20:25.0  33.32
                                2020-06-25 13:21:25.0  29.76
                                2020-06-25 13:22:25.0  25.48

(8) Node 6 sensors/light      TIMESTAMP      VALUE
                                2020-06-25 13:19:39.0  54.0
                                2020-06-25 13:20:39.0  53.62
                                2020-06-25 13:21:39.0  46.61
                                2020-06-25 13:22:39.0  44.31
```