Distributed Sensing Solution for Home Efficiency Tracking

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IEEE 5th World Forum on Internet of Things
15th – 18th April 2019 - Limerick, Ireland
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Motivation and Framework

Internet of Things (IoT) have a capacity to:
- Turn a simple physical device in a smart one
- Connecting devices
- Reduce human effort

Create an IoT system, to make an ordinary home into a smart one with the objective of keeping track of consumptions to promote sustainability
Objectives

Create an IoT system to monitor in order to reduce:
- Natural and material resources savings
- Reduce monetary cost for the user
- Promote sustainable lifestyle

- Develop a Smartphone Application
- Create a Sensor Network
- Develop Algorithms
Proposed System Architecture

Hardware

• Wireless Sensor Network (WSN) is a network with several spatially distributed sensors, with the capacity to: gathering, analyzing and distributing the data to monitor a certain event. Design to be energy efficient, scalable, reliable and robust.
Proposed System Architecture
Hardware – Communications Protocol

• Server Side <-> Gateway: MQTT over WiFi, to send all sensor data to the server and commands to the network

• Wireless Communication Protocol: LoRa network, with addressing for identification of every node and guarantee that the messages are delivered to the right node.

The LoRa protocol is capable of having several nodes and a range of 5km.
Proposed System Architecture

Hardware - Network nodes

**Broker Node**
- ESP32 microcontroller
- RFM95W LoRa module
- The main node, the broker, is an aggregation node since it does not collect data, it just sends the information received from the other nodes to the server. The Broker serves as a bridge between the sensor nodes and the server.

**Sensor Node**
- ESP32 microcontroller
- RFM95W LoRa module
- Up to 8 sensors
- Responsible for retrieving sensor data in real time and send them to the broker. Powered by batteries.
Proposed System Architecture

Software

Algorithm:

The process when a new sensor value arrives at the server is simply a comparison with a threshold value for the type of sensor. This process is done in real time, ensuring that the user is alerted when the problem starts.
Proposed System Architecture

Software

Application Mobile:

In order that the user can check all the information that has been gathered from the sensors, an Android application serves as an information center, a place where all the consumption parameters and data is displayed.

- Daily reports as well as graphic charts every month, to ensure the user has all the details on demand.
Proposed System Implementation

- Kitchen: a gas sensor (MQ2) a water pressure and consumption sensor (water flow sensor);
- Bathroom: a water pressure and consumption sensor (water flow sensor)
- Garage: A gas sensor (MQ7) to obtain the levels of carbon monoxide.
- For all of the above and the remaining divisions: sensors for humidity and temperature (DHT22), luminosity (LDR), an electrical consumption sensor (electricity meter sensor), noise (sound sensor).
Conclusions and Future Work

• In this paper, we described a monitoring system in order to make an ordinary home into a smart one with the objective of keeping track of consumptions to promote sustainability.

• The next step is to implement the proposed system and test it in real environments in order to evaluate its efficiency, to ensure that the main goal is achieved, in order to promote sustainability and reduce the household consumptions.

• Create actuator nodes, capable of acting in the environment based on the data collected by the network, such as turn on/off lights, blinds or other appliances.
Thank you!