UNIVERSITÀ DI PISA

Artificial Intelligence and Data Engineering

Internet of Things

IoT Smart Irrigation System

Project Documentation

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Academic Year: 2020/2021

Contents

1 — Introduction

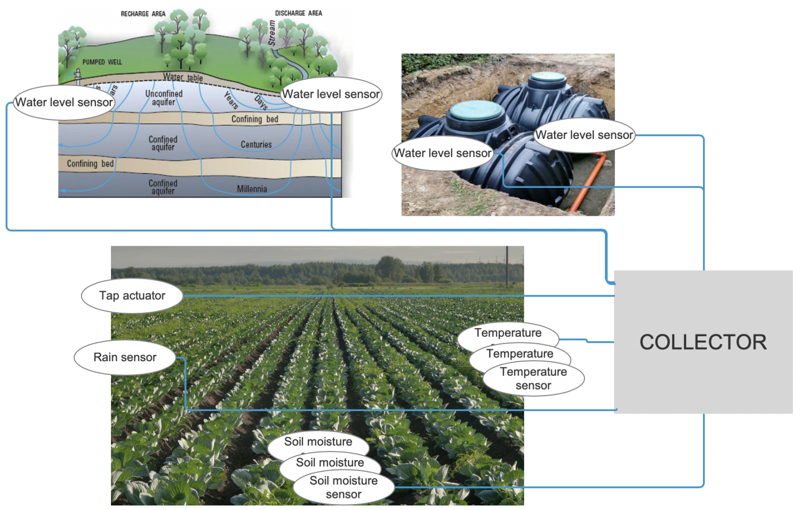
Agriculture is one of the most fundamental resource of food production and also plays a vital role in keeping the economy running of every nation by contributing to the Gross Domestic Production. But there are several issues related to traditional methods of agriculture such as excessive wastage of water during irrigation of field, dependency on non-renewable power source, time, money, human resource etc. Since every activity now a days becoming smart it needs to smartly develop agriculture sector for growth of country. Out project aims at developing a Smart Irrigation System using IoT Technology with an objective of automating the total irrigation system which provide adequate water required by crop by monitoring the moisture of soil and climate condition in order to prevent the wastage of water resource. It will also have many advantages for farmers. The irrigation at remote location from home will become easy and more comfortable. In addition, it will not only protect the farmer from scorching heat and severe cold but also save their time for to and from journey to the field.

1.1 Deployment Structure

The objective of this project is to adopt a smart irrigation system to water cultivated fields making use of the local water resources, such as aquifers and water catchment areas (i.e., basins), in the way of using the water resources as more eco-friendly as possible (e.g., without disrupting aquifers). Thus, we can consider two different locations to takes care: the **field** and the **water provisioning site**,

For what concern the *water provisioning site*, it is composed of sensors which have the mean of monitoring the water level both of the aquifers and water catchment areas. In this way, the system and the user can know where to take water (by default the basin). Although, a single device for source may be enough, we decided to deploy multiple water level sensors in the same source in order to avoid errors in the monitoring (e.g., in the case of a single device if it is detected that the basin is empty, but it is not, the irrigation system will use the water from the aquifer pointlessly). All water level sensors will make use of *MQTT* as explained in the "MQTT Network" chapter.

The *field site* is more articulated and will exploit multiple types of sensors and a single type of actuator. The actuator needed is the one capable of providing the water to the plants, which we called "tap actuator". This we be used in conjunction with the other sensors presents in the fields that will monitor the environment, specifically there will be temperature sensors, soil moisture sensors and a rain sensor. All these sensors and the tap actuator will exploit *CoAP* as explained in the "CoAP Network" chapter.



2 — CoAP Network

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2.1 Temperature Sensor

The temperature sensor measures the local temperature in Celsius (at the Collector level will be given the possibility to display the results in Fahrenheit, see the Collector chapter for further details). The goal of this sensors is for quantifying and scheduling the water provisioning.

2.1.1 Resources

The temperature sensor exposes two resources: the *temperature_sensor* resource and the *temperature_switch* resource.

2.1.2 Data Generation

2.2 Soil Moisture Sensor

2.3 Rain Sensor

Rain sensor or rain switch is a switching device activated by rainfall. It is used for water conservation since it is connected to the automatic irrigation system, which will cause the system to shut down in the event of rainfall in order to do not waste water and to reduce energy consumption.

2.3.1 Resource

The only resource provided by the rain sensor is a value indicating if it is raining or not, named **isRaining** and stored as a boolean. Since we are only interested when the status of the variable change, we opt to use the observable pattern provided by CoAP in order to minimize the number of interactions with the sensor.

The only possible action is the **GET** method, which will respond with a text saying *"raining"* or *"not raining"* based on the status of *isRaining*.

2.3.2 Data Generation

Data is generated every *CLOCK_SECOND* in order to have a rapid simulation. The value of **isRaining** flips (i.e., if it was indicating raining it turns to not raining, and vice versa) with a probability of 10%. This is done in the textitirain_event_handler function in the following way:

```c
static void rain_event_handler(void)
{
    srand(time(NULL));
    int random = rand() % 10; // generate 0, 1, ..., 9

    if (random == 0) // 10% probability of changing the value
        new_isRaining = !isRaining;

    // if not equal, notify
    if (new_isRaining != isRaining)
        coap_notify_observers(&rain_sensor);
}
```

In case the value changes, this is notified to all the subscribers.

2.4 Tap Actuator

3 — MQTT Network

4 — Collector

4.1 MQTT Side

4.2 CoAP Side

4.3 Database And Data Visualization