SUP'COM
Ecole Supérieure des Communications de Tunis

CLOUD OF THINGS

Scope Statement

SMART IRRIGATION SYSTEM

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CHAPTER 1 : GENERAL CONTEXT

1.1- Context :

Irrigation is the process of artificially supplying water to cultivated plants to increase production and support their natural growth, especially in cases of water deficit caused by insufficient precipitation, excessive evaporation, or a decline in the water table, particularly in arid areas. Inappropriate or poorly designed irrigation can lead to various issues. Over-irrigation can result in the spread of pathogens and pollutants in the garden, and rainfall can be unpredictable.

It is crucial to monitor the moisture level to preserve the plants as much as possible because each plant requires specific humidity and temperature levels. Manual irrigation is tedious, time-consuming, wasteful and harmful for the plants.

To ensure that our plants remain green and healthy, we are considering designing an intelligent irrigation system to take care of this task. There is no longer a need to be on site for irrigation. Our intelligent system will handle the task. In this report, we will detail the different phases we adopt to achieve such an intelligent system. Our work is divided into three chapters. The first introduces the general context of the project, the second chapter is dedicated to presenting the system architecture, and the last chapter covers the work carried out and the results obtained.

1.2- Problematic:

The insufficient water quantities and the constantly increasing water needs in agriculture, combined with conflicts of use with other sectors such as industry and drinking water consumption, constantly lead us to contemplate water and energy savings. This will inevitably involve efficient irrigation management as well as control over the use and selection of irrigation systems.

1.3- Proposed solution:

This project aims to build an intelligent irrigation system that monitors the humidity level to preserve the plants as much as possible, as each plant requires a specific humidity level. The irrigation system to be implemented automatically controls irrigation cycles and prevents water wastage by automatically cutting off irrigation using a Machine Learning model.

1.4- Clientele:

- Potential market: the Tunisian agricultural market.
- Target clientele profile : Farmers

CHAPTER 2 : PROJECT ARCHITECTURE

2.1- Architecture:

The detailed solution architecture is presented in the figure1 below:

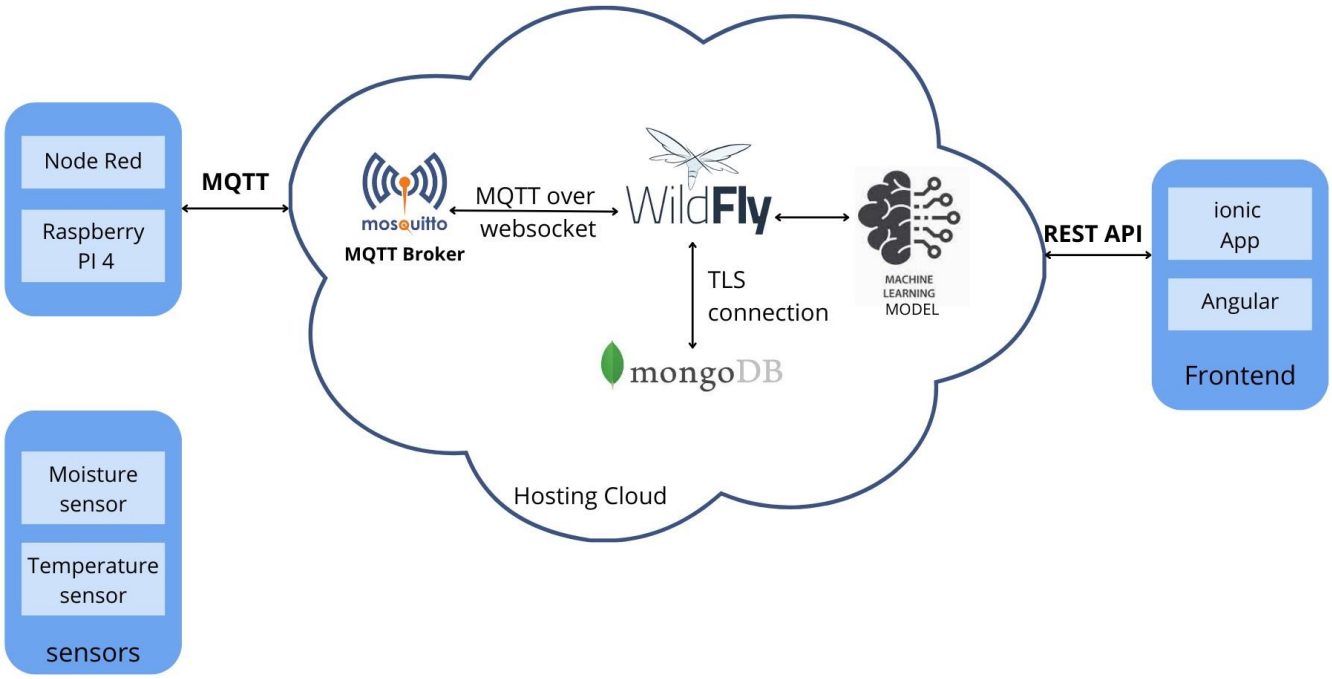

Figure1: Smart Irrigation system Architecture

2.2- Objectives:

Our project aims to reduce water wastage in irrigation by implementing a smart system that monitors humidity and temperature to predict whether plants require irrigation. Using data collected by sensors, the smart irrigation system allows farmers to optimize water consumption efficiently.

2.3- Advantages:

The performance of a smart irrigation system relies on its ability to accurately adjust the quantities of water delivered regularly. This requires having connected humidity sensors. It allows for maximizing water savings by detecting hidden leaks and ensuring more precise control through instant or regular flow monitoring.

3.3- Limits:

- The data transmission always goes through the cloud, which heavily relies on the Internet network being used. A poor internet connection can result in inadequate monitoring of our greenhouse parameters.
- Security vulnerabilities in the network can be a potential issue to address.
- In addition to temperature and humidity, irrigation may depend on various other factors such as soil moisture, plant type, weather conditions, and specific crop requirements. These additional factors can influence the irrigation decision-making process for more effective and efficient water management.

CHAPTER 3 : TECHNICAL CHOICES

3.1- Server Side:

— MongoDB

MongoDB Atlas is the global Cloud-based database for modern applications. Its design is easy to modify, and it has a rich and comprehensive documentation.

— Mosquitto MQTT Broker

Mosquitto is an open-source MQTT (Message Queuing Telemetry Transport) Broker that can be installed on a Raspberry Pi and almost any operating system (macOS, Windows, Linux, etc.). MQTT is a very fast and lightweight communication protocol, particularly well-suited for home automation and connected devices.

— Node-RED

Node-RED is a programming tool that allows the connection of hardware devices, APIs, and online services.

— WildFly

WildFly is a free Java EE (Enterprise Edition) application server written in Java, released under the GNU LGPL license. WildFly is written in Java and can be used on any operating system that provides a Java virtual machine. Our choice is justified for several reasons: -It is flexible and lightweight, which will help us develop our application smoothly. -Secure and reliable communication after establishing a TLS connection between the server and our MongoDB database.

3.2 - Client Side:

— Ionic

Ionic is a framework for building native applications using web technologies. Based partly on AngularJS and Cordova, Ionic enables the creation of Progressive Web Applications for mobile (iPhone and Android) that are similar to native applications, using HTML, CSS, and JavaScript. It is: - Open source The framework is 100% free and supported by a vast community, making it a major development platform. - Large helpful community The Ionic framework is based on AngularJS and Cordova technologies, benefiting from the performance of these frameworks and their communities. - Cross-platform deployment One significant advantage of Ionic is that it allows coding the application once and then deploying it easily on multiple platforms (iOS, Android, Web).

— Angular

It enables the creation of cross-platform mobile applications for Android and iOS using Ionic components and Angular code. The advantage of Angular over React is the availability of packages. Indeed, there is a vast repository of open-source packages available for Angular developers, such as NgBootstrap, NgTranslate, Angular Material, etc. These packages allow us to code mobile applications in a flexible manner.

— Capacitor

Capacitor is an open-source project that allows running modern web applications natively on iOS, Android, and the Web (using Progressive Web App technology), while providing a powerful and easy-to-use interface to access the native SDKs and APIs of each platform.

3.3 – Hardware Used:

* Raspberry Pi Board: The Raspberry Pi 4 is a nano-computer presented in the form of a processor card. It can be directly connected to a screen or monitor.
* Moisture Sensor
* Temperature Sensor

CHAPTER 4: BUSINESS MODEL

4.1- 4P Marketing Matrix:

The marketing mix, or the 4Ps, is an essential step to ensure that you will achieve the objectives you have set to the project:

Product Policy

Our Product will be at the core of our marketing strategy.

Brand: "Smart Irrigation System" solution that combines both hardware and software, summarized in a hybrid application. Product-related services:

- After-Sales Service.
- Updates, new features, and daily improvements. Warranties extend up to 3 years.
- Features: Diversification and variety in terms of functionality, options, design.

Price Policy

Price is at the heart of positioning and a key element of communication.

The policy followed is a skimming strategy. The price of the solution depends on the features the customer wishes to implement in their system. The commercial discount policy:

- Discounts and promotions will be applied depending on the number of devices.
- Payment methods vary from bank transfer to online payment.
- Exceptional discounts granted to customers in case of quality issues or non-compliance.

Distribution Policy

Distribution and the choice of distribution channels determine the product's visibility and accessibility.

Distribution channels: Direct delivery to our farmers.

Communication Policy

We offer all public promotional techniques to support the product.

- Offline advertising measures: television, radio, newspapers, magazines, posters, etc.
- Online advertising measures: Display Advertising, Videos (on YouTube, Facebook, etc.), advertising on social networks, etc.
- Personal communication: Interactions with the customer.
- Internet communication: Emailings, newsletters, social media marketing.
- Sales: Prospecting, Demonstrations, Participation in trade shows and fairs.
- Advertising: radio, press, newspapers, billboards, brochures, pamphlets.
- Public Relations: press releases, press kits, sponsorship or patronage operations, lobbying, event hosting.

4.2- Deliverables:

Conceptual Notebook

This document provides a detailed and structured overview of the specifications, services to be delivered, constraints of the solution, as well as the architectural and detailed design.

Executables and Source Code

All the instructions and files within a GitHub repository containing the code for the IoT solution and the developed mobile application.

Technical Documentation

A comprehensive compilation of the libraries and technologies used in the development of this solution, along with the references used.

Demonstration Video

An mp4-format video showcasing a demonstration of the proposed solution.