

INTRODUCTION

As the world moves to a technology dependent future, more and more devices and applications have begun implementing more advanced connectivity options to access the internet for data analysis and information. This idea of different appliances and products connecting to the cloud is known as the Internet of Things. The goal of the Internet of Things (IoT) is to increase the features and services of regular consumer goods, as well as automating different procedures for efficiency and reliability. Examples of such systems include smart fridges, tooth brushes, and vehicles. Although many companies have made way in incorporating smart aspects into their products, not all industries have benefited from these emerging technologies. One such industry is the farming industry, which has remained relatively untouched by this trend. Farmers are some of the hardest workers in the country, and are generally considered the backbone of our nation. Because of this it only makes sense that these hardworking individuals should be able to enjoy newer devices that will help improve their day-to-day activities so that they may concentrate on other aspects of their work. The Smart Irrigation System (SIS) is an embedded application solution that uses live information to maintain a desired humidity level of farmland, in our case for optimal plant growth. In order to achieve this, it uses a microcontroller to repeatedly check the moisture level of the soil, and local weather information, to determine the appropriate amount of water to provide using an electronically controlled valve. This system can be used by any individual or company that seeks to regulate the humidity level of soil.

COMPONENTS

- 1 - TI Tiva C Series EK-TM4C123GXL Microcontroller
- 1 - TI SimpleLink Wi-Fi CC3100BOOST BoosterPack
- 1 - SparkFun Soil Moisture Sensor
- 1 - 12V Solenoid Valve - 3/4"
- 1 – RC Switch w/ Digital Output

DESIGN



CONCLUSION

SIS is built on a Real-Time Operating System for Microcontrollers from TI. Through this RTOS, a timer module is used to check the system every 3 hours. It does this by sending an activation signal to the moisture sensor which in turn returns a voltage signal of varying amplitude based on the humidity level of the soil. SIS then detects when the moisture level of the soil is below a designated threshold and proceeds to check the weather using an attached Wi-Fi module that has access to the internet. Through this module, the program receives a downloaded API from a weather monitoring service. This API contains the current time and precipitation probability percentages of the following 3 hours, which are used by an algorithm to determine the appropriate amount of water that should be provided to the soil. The algorithm determines if it is likely to rain in the following hour, 2nd hour, or 3rd hour, and decides the amount of time an electronic control valve should be operated. Finally, an activation signal is sent to the solenoid valve for the designated amount of time, allowing water to flow to the soil, regulating the moisture level for the plant.

COMPLETE SYSTEM



STAGE 1

Soil Moisture

- A hardware timer module produces a function call signal every 3 hour intervals
- Output pin PD1 is set to 5 V, powering on the moisture sensor
- Input pin PE3 is used to receive 2 analog readings converted to digital values through an ADC module
- Output pin PD1 is set to 0 V, powering off the moisture sensor (this is done to prevent sensor corrosion as a result from a constant power-on state)
- The 2 readings are averaged and tested for possible errors
- Final moisture value is compared to a minimum threshold and a decision is made on whether the soil is dry or not

```
Console
SIS Moisture Sensor State:CIO
Checking moisture level...
Moisture level: 420
Moisture level below threshold, PROCEED to next state
```

```
Console
SIS Moisture Sensor State:CIO
Checking moisture level...
Moisture level: 508
Moisture level above threshold, STOP at this step
```

STAGE 2

Weather Information

- The microcontroller establishes a connection to the attached Wi-Fi access module and starts it up in its default state
- The module is set up to connect to a designated Network Access Point using 3 parameters, its SSID name, security type, and passkey
- The system accesses the internet and downloads a weather api from accuweather.com
- Downloaded information is parsed to obtain precipitation probability values for the next 3 hours

```
Downloading weather information...
Configure Default State
Download Weather Information
Parse Information
Received Information:
HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
Access-Control-Allow-Methods: GET, PUT, POST, DELETE
Access-Control-Allow-Headers:
Access-Control-Allow-Content-Type:
Cache-Control: public, max-age=600
Content-Type: application/json; charset=utf-8
Date: Sat, 06 Sep 2018 22:33:36 GMT
Server: Apache/2.4.18 (Ubuntu)
Vary: Accept-Encoding
X-Content-Type-Options: nosniff
X-Frame-Options: DENY
X-XSS-Protection: 1; mode=block
[{"dateLine": "2018-09-08T18:00:00-05:00", "epochDate": "1536470400", "weatherIcon": "c", "temp": "70", "tempUnit": "F", "tempMin": "60", "tempMax": "80", "humidity": "70", "humidityUnit": "%", "windSpeed": "10", "windSpeedUnit": "mph", "windDir": "100", "windDirUnit": "deg", "precipProb": "10", "precipProbUnit": "%", "precipProb1": "10", "precipProb2": "10", "precipProb3": "10", "precipProb4": "10", "precipProb5": "10", "precipProb6": "10", "precipProb7": "10", "precipProb8": "10", "precipProb9": "10", "precipProb10": "10", "precipProb11": "10", "precipProb12": "10", "precipProb13": "10", "precipProb14": "10", "precipProb15": "10", "precipProb16": "10", "precipProb17": "10", "precipProb18": "10", "precipProb19": "10", "precipProb20": "10", "precipProb21": "10", "precipProb22": "10", "precipProb23": "10", "precipProb24": "10", "precipProb25": "10", "precipProb26": "10", "precipProb27": "10", "precipProb28": "10", "precipProb29": "10", "precipProb30": "10", "precipProb31": "10", 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