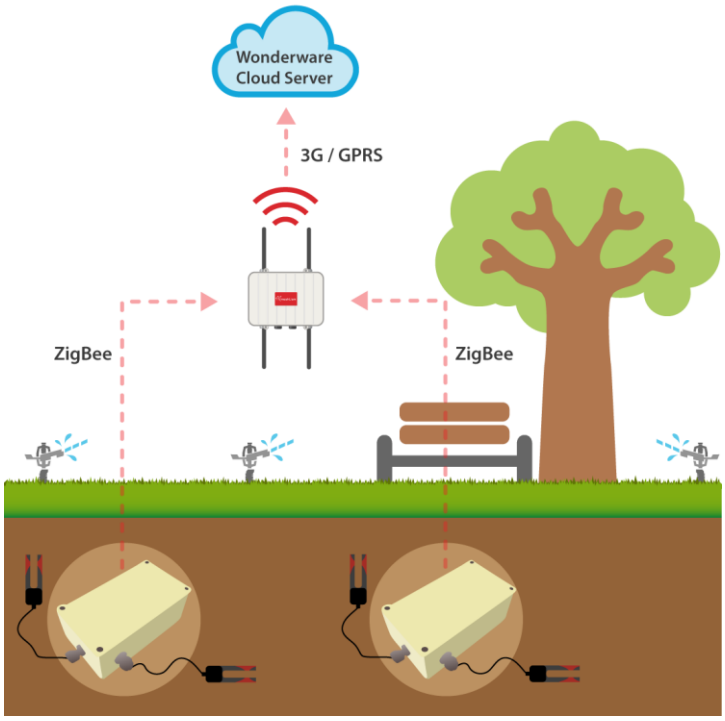
Group 4
EEL 4914
6/21/2018

Water Smart



University of Central Florida
Department of Electrical Engineering and Computer Science

Senior Design I
Dr. Lei Wei

Divide and Conquer

Group 4

Kenyatta Samuels - Electrical Engineering
Winston Baptiste -Electrical Engineering
Marc Simon - Computer Engineering
Donald Miller - Computer Engineering

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Project Motivation

The idea of Smart Irrigation came about when I was driving to school one rainy day. I noticed that while there was a downpour, the sprinklers were still enabled. What a waste right? Having heritage from third-world countries, we all heard of cases where there would be frequent water outages due to draughts and rupturing pipes. Water is life. There are countries out there that do not have access to water at all. So, this is what motivated us towards an idea for the Water Smart System.

After coming up with the Water Smart System we thought of other things we can include in the system. We all agreed that at some point in time we dreaded having to go to where the sprinkler controls were to change the settings. This will be taken care of with the use of a mobile app which will enable the user to change the settings wherever they are with internet connection. The implementation of wi-fi brings us to another feature which is weather updates from the local weather station. These updates will influence the system to adjust its settings for the specific readings. For example, during hurricane season in Florida there are weeks on end of anywhere between 50 to 80 percent chance of rain. With these readings, the irrigation system will more than likely be disabled for that day or week. Instead of coming on and measuring the moisture then turning off right after. Also, helps with overwatering.

Project Objective

Our main objective of the Water Smart system is quite simple. During a downpour or even a light rain, the system will turn completely off. This will be done by integrating moisture sensors near each sprinkler or at cut off vales of each zone. So now, “what will happen after the rain has ceased? Will the sprinklers turn back on? If it turns back on, would that be counterproductive?” These are great questions. We would incorporate moisture sensors to measure the saturation in the soil. If the rain has watered the lawn or plants enough then the sprinklers will stay off until the next cycle. If not, then the sprinklers will turn back on to reach its optimal watering level.

Another objective of Water Smart is to be able to cut off when humans and/or animals walk through the sprinklers field of view. To accomplish this goal, the sprinkler heads will have proximity sensors on them to that monitor a few degrees outside the range of its peripherals. This information will be transmitted back to the actuating device via a communication module and will shut off the system at that area. When the sensor detects either a human or an animal it will cut that sprinkler off until the path is clear.

Project Features

Our main feature of the system is to cut off during times of rain and function accordingly based on the saturation of the soil. There are multiple companies that are creating and have created smart irrigation systems that incorporate the features of our project. The company Tevatronic, incorporates sensors that optimize watering and fertilizing. The sensors can detect both under and overwatering. Another company called Skydrop, uses a controller that monitors the weather and will adjust the system based on the data. Having sensors monitor specific zones for humans and or animal detection is a feature that I have found much companies using in their system. This is somewhat of a new feature in smart irrigation.

Requirements Specifications

Section 1 Purpose

The purpose of the System Requirements section is to outline the overall system and application requirements that will govern the development and implementation of the system. It will also establish relevant system standards, policies, and acceptable system compliance.

Section 2 General System Objectives and Requirements

2.1 Major System Objectives

- System shall have the ability to be remotely operated
- System shall have the ability to be controlled through a mobile application
- System shall have the ability to be controlled through a web application
- System shall have the ability to turn off during rainy conditions
- System shall have the ability to turn off when leak detected
- System shall have the ability to turn off given passing objects
- System shall have the ability to turn off when depressurized do to broken head
- System shall have the ability to be powered using renewable technology

2.2 Major System Requirements

- System shall have the ability to properly water a residential landscape after initial calibration of soil moisture levels using soil moisture sensors
- System shall have the ability to measure water flow from 1 to 30 liters per minute
- System shall have the ability to recognize and turn off given passing objects larger than a medium sized dog
- System shall measure soil moisture on a scale from 0 at driest to 880 at most saturated with an initial calibration
- System shall have the ability to stop and start watering from a remote command on a web application
- System shall have the ability to communicate over a 2.4 GHz WIFI connection
- System shall have the ability to turn off when rain is detected from rain sensor

- System shall have the ability to recognize and turn off due to passing objects larger than a medium sized dog

2.3 Major Application Objectives

- Application shall be able to control system
- Application shall be able to schedule watering
- Application shall be able to display water consumption
- Application shall be able to turn off different zones of the system
- Application shall be supported on most android devices
- Application shall be supported on most recent browsers
- Application shall connect to the hardware via a wireless network

2.5 Major System Conditions

- System shall be easy to install
- System shall be low cost
- System shall be durable
- System shall not consume high levels of water
- System shall be unobtrusive
- System shall conform to relevant standards

2.6 Major System Constraints

- Pipe leaks
- Sprinkler heads breaking
- WIFI connection/bandwidth

2.7 System User Characteristics

Location: Central Florida
Training: None
Age range: 18+
Language and Culture: English will be the main language
Educational Level/Qualifications: Any
Special Skills: None

Section 3 Policy and Regulation Requirements

3.1 Policy Requirements

This project regarding irrigation systems has relevant standards for Florida defined in the Florida Statutes Chapter 373. There it points out that all landscape and irrigation design are to be standardized according to the irrigation code defined in Florida Building Code, Plumbing Volume, Appendix F. From this irrigation code, local governments are required

to use it to shape necessary Florida-friendly landscaping ordinances and to design landscape irrigation systems. The standards covered in the irrigation code include topics such as plans and drawings, system zoning, application uniformity, sprinkler selection, pumps, pipelines, automatic irrigation controllers, control valves, and materials. These standards are both easily accessible online at the URL stated below.
http://www.floridabuilding.org/fbc/commission/FBC_0317/commission_education_poc/823/823-0-MATERIAL.pdf

QFD: House of Quality
Project: Smart Irrigation
Revision: 1.0
Date: 6/7/2018

Direction of Improvement	
Maximize	▲
Target	◇
Minimize	▼

Correlations	
Positive	+
Negative	−
No Correlation	

Relationships	
Strong	●
Moderate	○
Weak	▽

Row #	Customer Requirements (Explicit and Implicit) \ Functional Requirements	1 Installation Time	2 Dimensions	3 Auto Shut-off	4 Rain detection	5 Cost	6 Self Correction	7 Remote Access	8 Sense Soil Saturation
	Column #	1	2	3	4	5	6	7	8
	Direction of Improvement	▼	▼	◇	▲	▼	▲	◇	▲
1	Water Conservaation	▽	▽	●	●	▽	●	▽	○
2	Energy Conservatrion	▽	○	●	●	▽	●	▽	○
3	Effectivness	▽	▽	▽	▽	○	○	▽	●
4	Reliability	▽	▽	●	▽	●	●	▽	○
5	Automation	▽	▽	●	○	▽	▽	▽	○
6	Durability	▽	○	▽	▽	●	●	▽	▽
7	Low Cost	●	▽	▽	▽	●	●	▽	▽
8	Ease of Use	▽	▽	●	▽	▽	▽	●	▽
9	Convenience	●	▽	●	▽	▽	●	●	▽
	Target	1 hour	12' x 8' x 4'	<= 2 minutes	5 mm rain fall	<= $400	90 % success rate	100% availabilty	25 % soil moisture

Figure 1: House of Quality

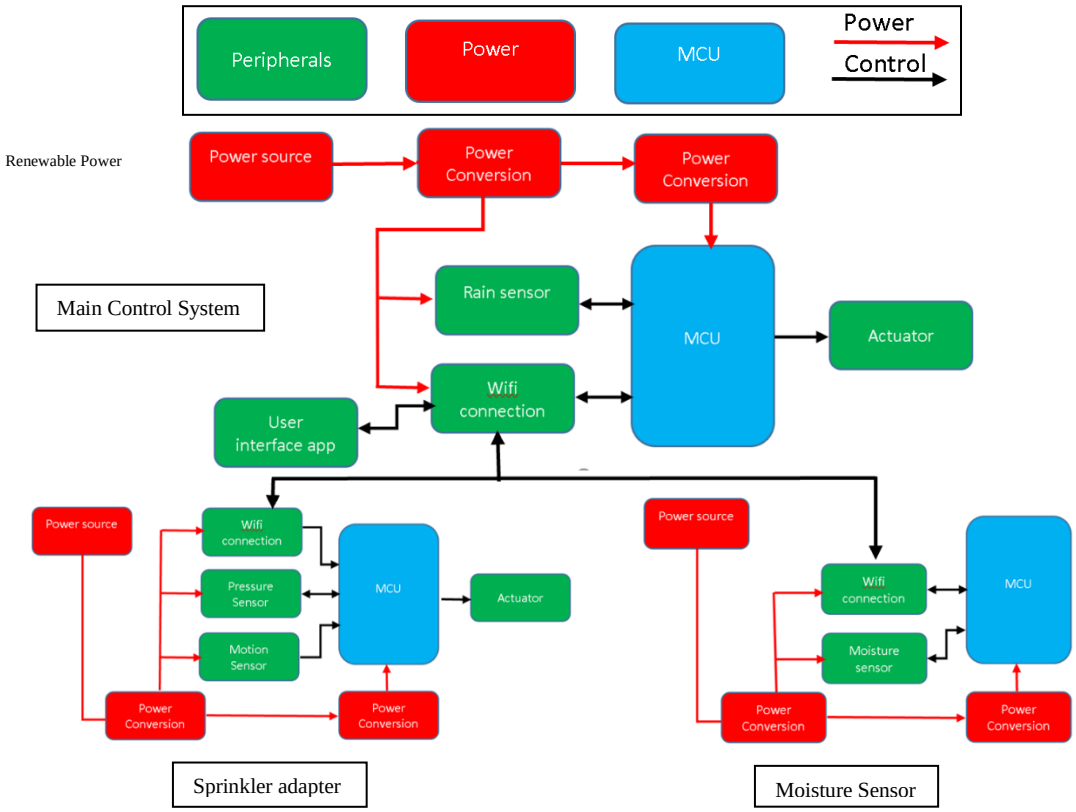

Figure 2: Smart Irrigation System Block Diagram

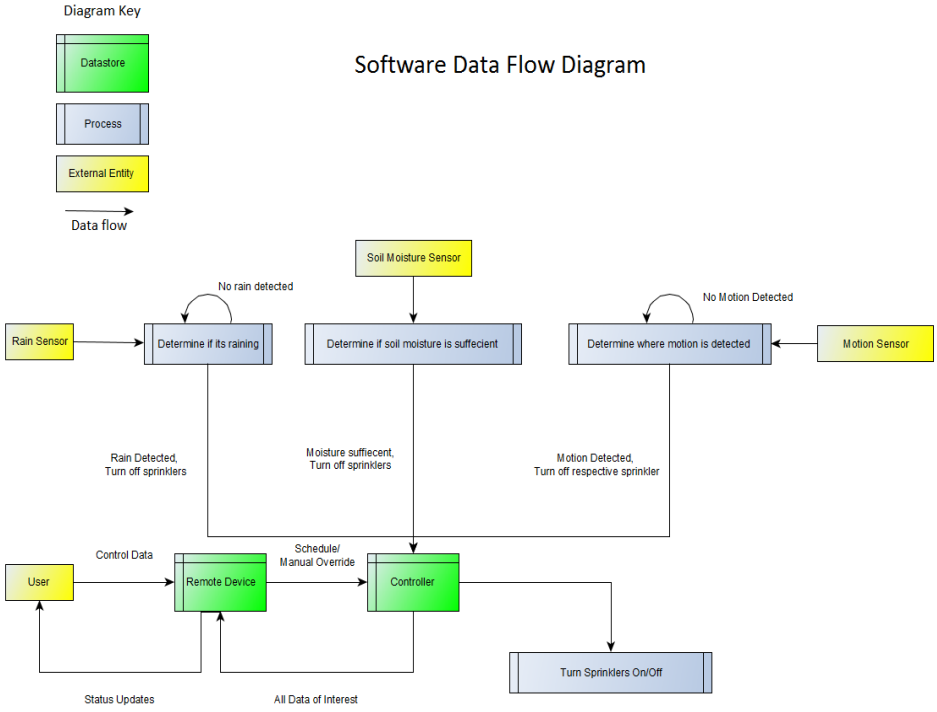

Figure 3: Software Data Flow Diagram

Project Budget Smart Irrigation

	INCOME	ESTIMATE	ACTUAL	UNDER/OVER
	Team Members			
	Kenyatta	$ 250.00	$ -	$ (250.00)
	Winston	$ 250.00	$ -	$ (250.00)
	Kyle	$ 250.00	$ -	$ (250.00)
	Marc	$ 250.00	$ -	$ (250.00)
	TOTAL	**$ 1,000.00**	**$ -**	**$ (1,000.00)**
	EXPENSES	ESTIMATE	ACTUAL	UNDER/OVER
Quantity	**Materials**			
1	PVC Pipe	$ 10.00	$ -	$ (10.00)
2	Smart Controller	$ 140.00	$ -	$ (140.00)
6	Control Actuators	$ 70.00	$ -	$ (70.00)
1	Water Pump	$ 15.00	$ -	$ (15.00)
1	Model Ecosystem	$ 60.00	$ -	$ (60.00)
6	Soil Moisture Sensors	$ 8.00	$ -	$ (8.00)
2	Temperature Sensors	$ 20.00	$ -	$ (20.00)
2	Humidity Sensors	$ 20.00	$ -	$ (20.00)
6	Liquid Flow Meters	$ 60.00	$ -	$ (60.00)
2	Power Source	$ 30.00	$ -	$ (30.00)
6	Communication Modules	$ 18.00	$ -	$ (18.00)
6	Adapters	$ 18.00	$ -	$ (18.00)
4	Motion Sensors	$ 20.00	$ -	$ (20.00)
6	Sprinkler Heads	$ 90.00	$ -	$ (90.00)
1	Water Tank	$ 10.00	$ -	$ (10.00)
2	Motor	$ 50.00	$ -	$ (50.00)
1	3-Valve Irrigation Manifold	$ 60.00	$ -	$ (60.00)
	TOTAL	$ 699.00	$ -	**$ (699.00)**

Table 1: Project Budget

Milestones

Number	Milestone	Due Date	Status
Senior Design 1			
1	Project Choices	5/18/18	Complete
2	Ideas	5/28/18	Complete
Project Report			
3	10 page Divide & Conquer	6/7/18	In-Progress
3a	Divide & Conquer Update	6/13/18	In-Progress
4	60 page Draft	7/1/18	In-Progress
5	100 page Draft	7/18/18	In-Progress
6	Final Document	7/19/18	In-Progress
Research & Design			
7	Begin Software Development	6/16/2018	In-Progress
8	PCB Layout	6/21/2018	In-Progress
9	Microcontroller Programming	7/02/2018	In-Progress
10	Order Parts & Test	7/14/2018	In-Progress
11	Recording & Data Abstraction	7/14/2018	In-Progress
12	Finalize Software	7/21/2017	In-Progress
Senior Design II			
13	Build Prototype	08/12/18	In-Progress
14	Testing & Redesign	9/15/18	In-Progress
15	Prototype	10/25/18	In-Progress
16	Peer Presentation	11/15/18	In-Progress
17	Final Report	12/01/18	In-Progress
18	Final Presentation	12/04/18	In-Progress

Table 2: Project Milestone