EEL 4914 Electrical Engineering Design
(Senior Design)

Project Abstract with Diagram(s)

18 January 2008

Project Title: *Plant Sitter*

Team Name: *H2O Inc.*

Team Members:

Name: Adam Wright
Email: bluesforsalvador@gmail.com
Phone: 352-316-4271

Name: Christian Davis
Email: cdavi010@ufl.edu
Phone: 954-854-5257

Project Abstract:

Plant Sitter is an automatic multiple plant watering system. Each plant to be watered is fitted with a remote device equipped with a water reservoir and pump that will wirelessly receive commands from a central hub. The central hub will keep time and send watering commands at user programmed time intervals for each plant. The user is capable of programming different watering times for each plant as well as monitor the water level in each reservoir with the use of a water level sensor in each pump. This will all be done through a user interface consisting of a keypad and LCD screen. The central hub will utilize a timer to maintain a system clock which a microprocessor will use to transmit the programmed watering commands and water level inquiries as well as receive the level status and confirmations of received commands. Each remote watering device will also contain a microprocessor with a wireless transceiver that will send and receive information to and from the water level sensors and pumps.

Table of Contents

Introduction

The Plant Sitter project find its purpose in the homes and offices of plant owners who would like to water their plants less often or not worry about watering their plants while they are away. The ability to automatically and wirelessly water several plants from one central hub will be beneficial for those who may have plants in hard to reach areas where watering may be more conveniently done less often. This system will also benefit those people who may want to go out of town and not worry about asking someone to water their plants. See figure 1 for a system level design.

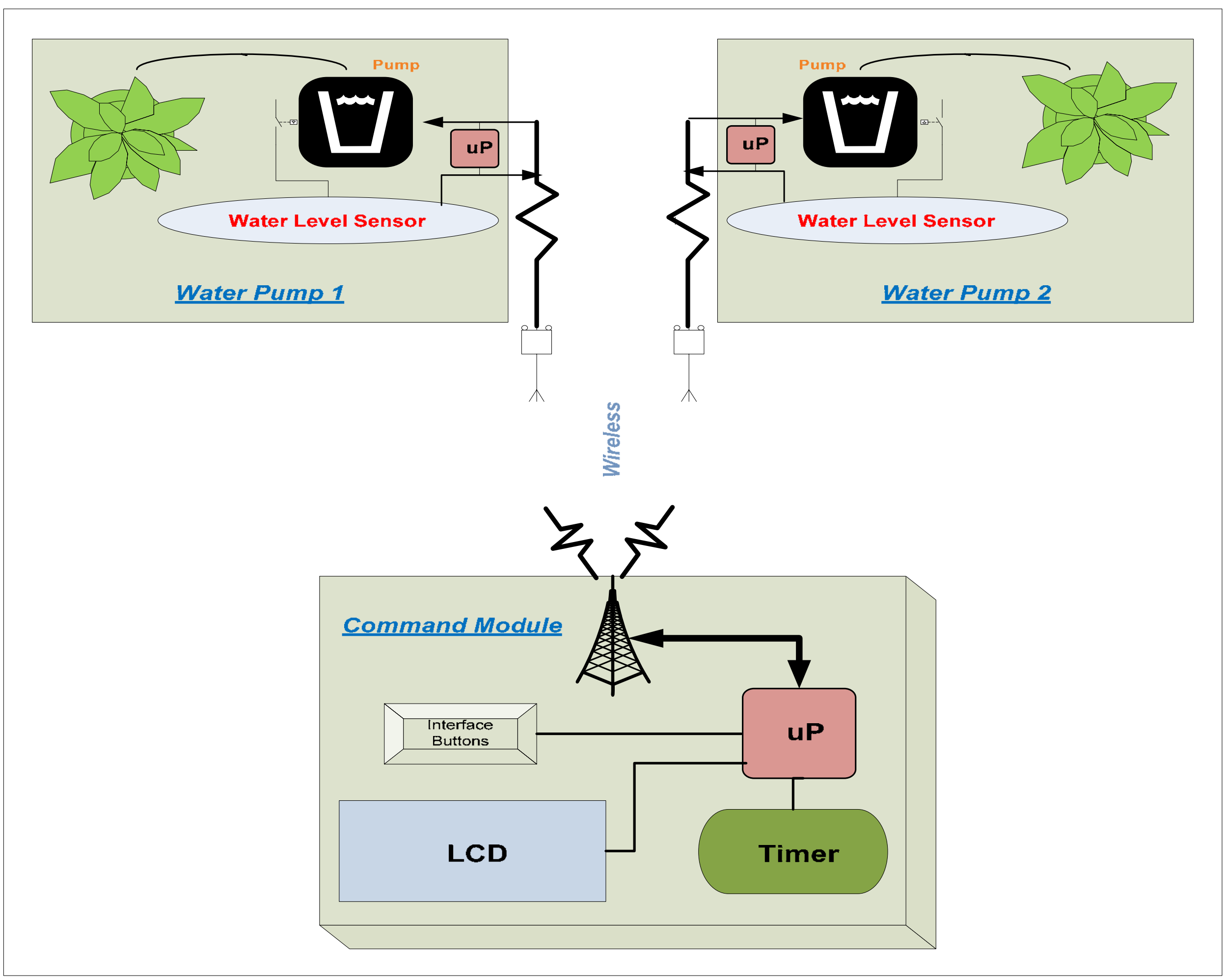

Figure 1

Features

The Plant Sitter will be marketable in the personal planting industry. It will allow users to go on vacation without worrying about asking someone to come over and water their plants. The Plant Sitter will also allow users to keep plants in hard to reach locations and allow the user several days before they must re-fill the reservoir.

The Plant Sitter will include:

- Wireless communication between a base controller and the battery powered plant feeders.
- The base controller will be wall powered and the wireless units will be able to conserve their batteries for long periods of time by putting their processors into sleep mode.
- The reservoir will hold enough water to water a plant once a day for four days. Since many plants require less water than this it should be an acceptable amount of time.
- In the remote units, there will be a water level sensor that will send information about the current water level back to the base controller.
- There will be an easy to use user interface featuring a keypad and LCD.
- The Plant Sitter will also feature a digital clock and will allow the user to program the current time and watering times according to the clock.

Technical Objectives

This team aims to design a system that can maintain a chronological list of commands that can be successfully sent wirelessly to several devices and effectively receive information back.

- First, the design of the central hub will require a timer to interface with a microprocessor to keep a system clock. The processor will constantly check the clock and determine when the tasks are to be done.

- The central microprocessor will also have to be interfaced with an LCD and keypad to set the initial clock, program time intervals, inquire on the status of the water-level sensors, and view all the settings and information needed to be displayed by the hub. This will require the processor to run a program to allow these functions.
- The central hub will have to perform its tasks using a wireless transceiver which will communicate with the remote transceivers (for demonstration purposes, there will only be two remote devices).
- Each remote device must also contain a microprocessor to interface with the transceivers for data communication.
- The remote microprocessors must be able to control the water pumps and check the status of the water levels on command. The pumps will turn on for a pre-set amount of time that will depend on the size of the plants. The processors will return the status of the water-level sensors when queried by the central hub. All these tasks will also require the microprocessors to send confirmations when data is successfully transmitted.

Components

In order for the Plant Sitter to complete its objectives, we will need a combination of several controllers and a wireless chips. Other items that are needed are water level sensors, small water pumps, and a DS1307 timer chip.

Controller	Wireless Chip	Cost	Programming	Configuration	Choice
Pic18f458	Nordic	$65	Easy	Hard	
Atmega32	Xbee Pro	$130	Medium	Easy	
Ez430	RF2500	$70	Medium	Medium	X

Table 1

Microcontroller and Wireless chip combination

Our microcontroller decision was based on ease of use with wireless communication and low power consumption. Our first intention was to go with a PIC processor and a Nordic wireless transmitter. After some research, the Ez430 wireless development kit with the Texas Instruments MSP430 was found to be a much better choice. The Ez430 provides a low-power solution with wireless capability in a single package. With everything included, the TI microcontroller was also the cheaper choice. Our project will require 3 of these target boards to communicate from the central controller to the two remote water pumps.

Physical Design

The physical design of the Plant Sitter will include a master communication hub with a user interface and two wireless slaves. The slaves will have the ability to detect the amount of water in a reservoir and pump water from the reservoir to the plant. This design scheme was chosen over the option of having just one wireless slave device because we wanted to show that having two or more slaves is a possibility.

Timer and Alarms

The timer will consist of a DS1307 chip from Dallas Semiconductor. This chip communicates through an I2C interface. The clock and data lines will require pull-up resistors and the chip will operate off of a 32kHz external crystal. The DS1307 chip offers the ability to keep track of years, months, days of the month, days of the week, hours, minutes, and seconds. It can keep 24 hour time or 12 hour time using am and pm.

Water level sensor and water pumps

Aquahub.com sells a float switch that is normally used to tell if the water level of a tank has decreased a certain amount. We plan to fully submerge the float switch to allow our system the ability to detect when the reservoir has a minimal amount of water left in it. The wireless slaves will poll the water level sensor after each operation of the pump and decide if more water is needed in the reservoir. The pump will operate when a signal comes from the master device.

In figure 2, the float switch operates by using a magnet, the magnet moves vertically with the level of the water and as the water level goes low enough, the switch closes. The dashed line represents the water level and if this switch was at the bottom of a reservoir it would detect when the water is low.

We are also considering the idea of using a two stage Darlington switch to detect whether or not there is water in the reservoir. The sensor circuit is illustrated in Figure 3, since there are ions in tap water, this active low switch will produce a voltage when the water level is low.

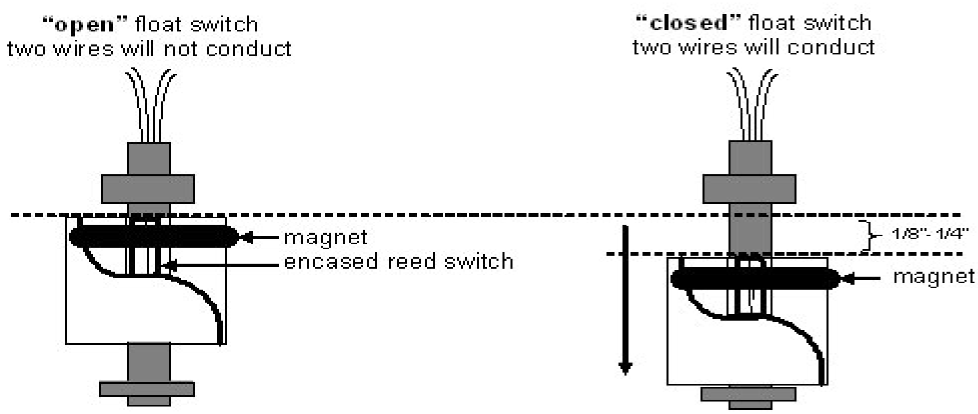

Figure 2

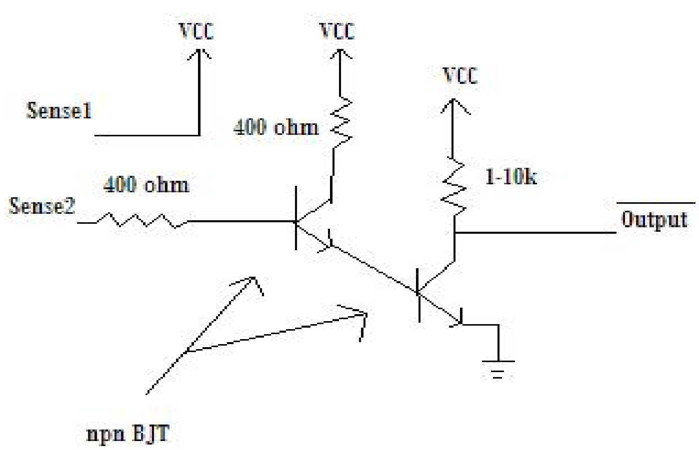

Figure 3

Software Flow Chart

The interaction between devices in software is roughly described below in Figure 4. The Master device will signal to the slave devices when it is time to water the plants. The slaves will water the plants and then check the water level. If the water level is low, the slaves will notify the master and the master will display a low water warning on the LCD.

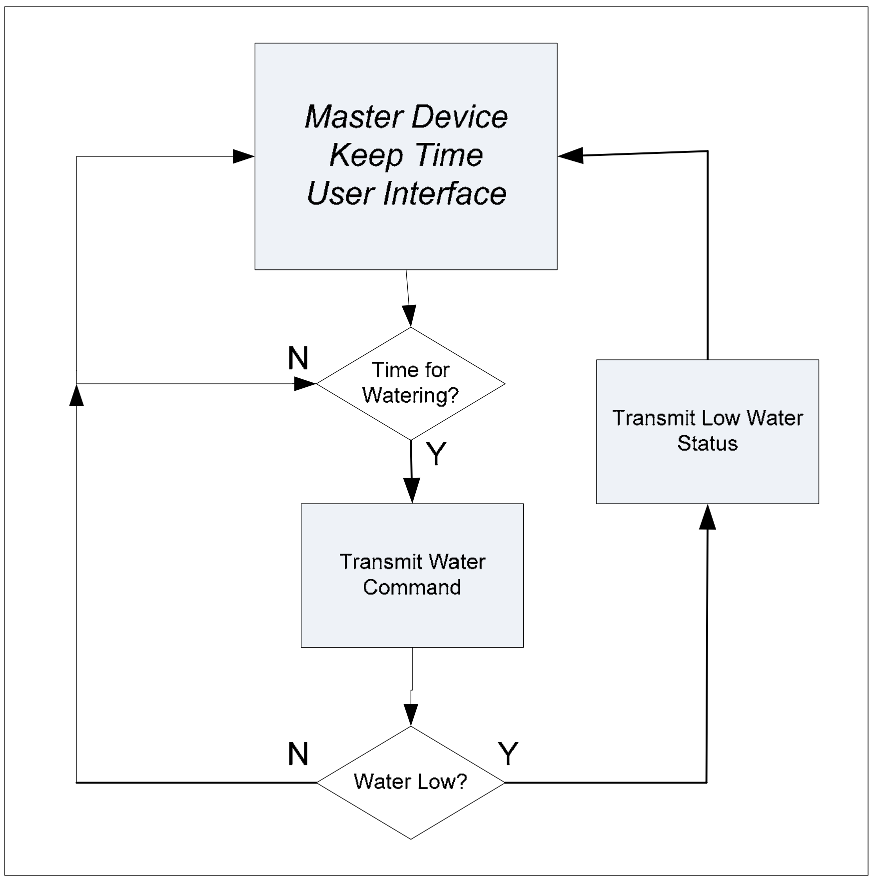

Figure 4

Division of Labor

The labor for the project is divided as shown in Table 2. Some tasks require cooperative work from both team members.

Task	*Member*
Main Timer	Adam
Ez430 Bring-Up	Christian
User Interface	Adam
Water Pumps and Sensors	Christian
Remote HW/SW	Christian
Wireless Communication	Adam
Prototype Testing	Christian
Board Design	Adam and Christian
Populating Boards	Adam and Christian
Final Board Testing	Adam and Christian
Presentation/Aesthetics	Adam and Christian

Table 2

Gantt Chart

The proposed schedule for our project is shown in the Gantt chart below. We aim to complete the tasks listed by the deadlines shown. Some jobs contain several subtasks which are also shown in the figure.