Automated Greenhouse Watering and Heating System for the Schenectady ARC

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Introduction

The Schenectady ARC aims to provide people with developmental disabilities the resources, services, and support that enable them to advocate and participate within their communities. The purpose of the project is to implement a water delivery and heating system tailored to the ARC's greenhouse in terms of use, cost, and intuitive operation for people with disabilities. This project was worked on by previous students, and we focused on developing a wireless sensor system.

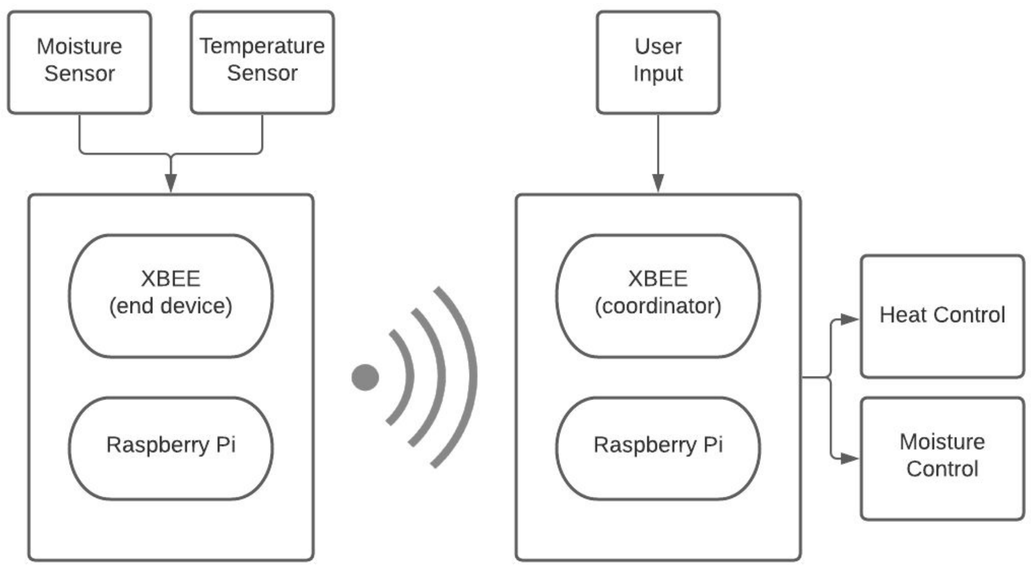

Figure 1. Wireless Sensor Block-diagram

There are two remote units; the wireless sensor module on the left and the main controller on the right.

The wireless sensor module will be placed at the seedling beds and it consists of a Raspberry Pi 3 B+, an XBee, a moisture and a temperature sensor. The main controller includes an Xbee radio module, a Raspberry Pi 3B+ and a touch screen. The wireless sensor module will read data from the sensors and transmit it wirelessly to the main controller. Then it computes the readings from the two sensors and displays the temperature and moisture accordingly.

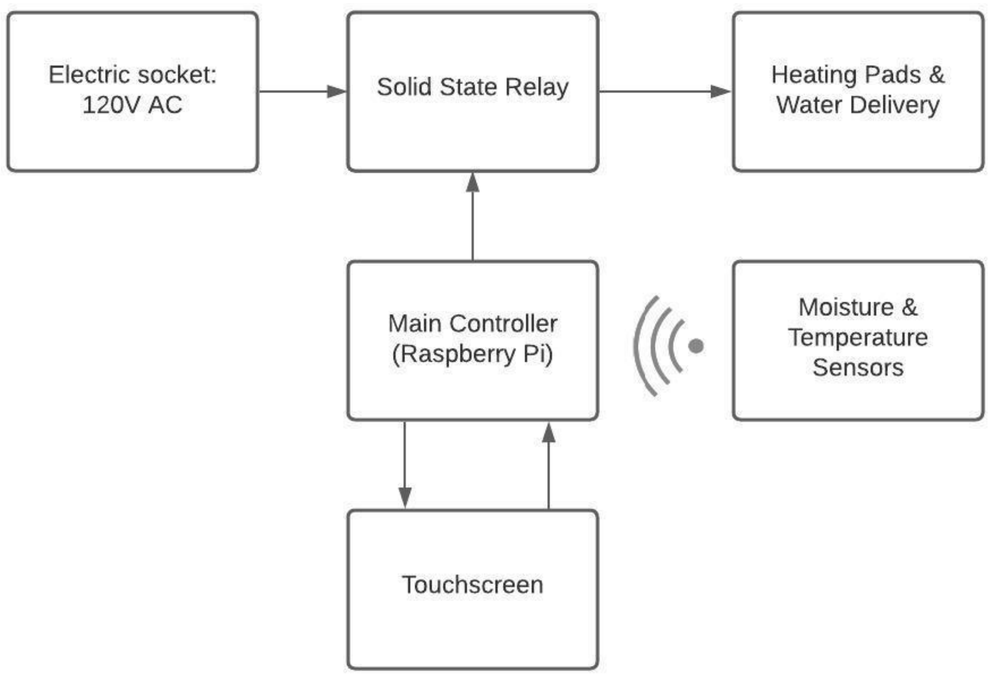

Figure 2. Top Level Design of System

The project consists of an electric socket, a 120V AC power supply, one solid state relay which acts like a switch for each heating pad and another one that controls each solenoid for the water delivery system, a wireless sensor module which provides moisture and temperature readings, a main controller which controls the touch screen to display the data using a Raspberry Pi. The system we created is a wireless sensor system that reads and transmits the moisture and temperature data wirelessly to control the watering and heating system at the ARC greenhouse.

Components

XBEE Module: Responsible for transmitting and receiving sensors data wirelessly between main controller and remote sensor unit. The communication is completely wireless, allowing us to build a waterproof system.

Capacitive Moisture sensor: Responsible for measuring moisture of the seeding beds. The collected data should be sent to the system to control water in real-time and regulate the water misters accordingly.

Temperature sensor: Responsible for measuring the temperature. Temperature will be delivered through heating pads that are placed under the seedling beds.

Raspberry Pi: Responsible for calculating moisture and temperature value and running graphic user interface. The raspberry pi are used for both wireless sensor module and coordinator with touchscreens.

The XBee network consists of one coordinator and multiple end devices. We established the network by using the XBee python library. The network consists of one coordinator and several end devices. All the XBees are on the same channel and every end device has two-way communication enabled with the coordinator.

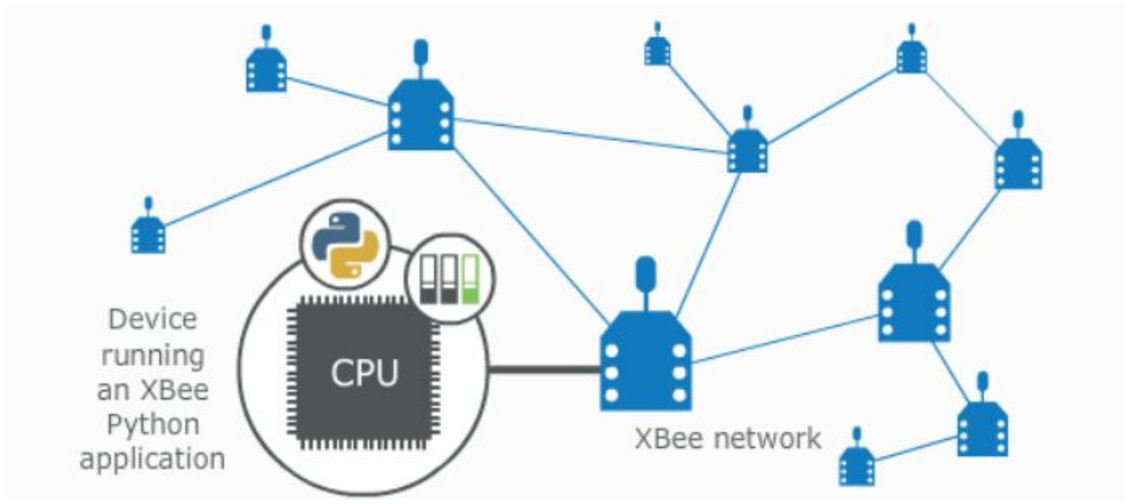

Figure 3. XBee Network

Modular: the remote sensor unit should be identical

Low Cost: approximately $80 per module

Dynamic: the XBEE module can transmit and receive data within 200 ft

Untethered: no external wires needed

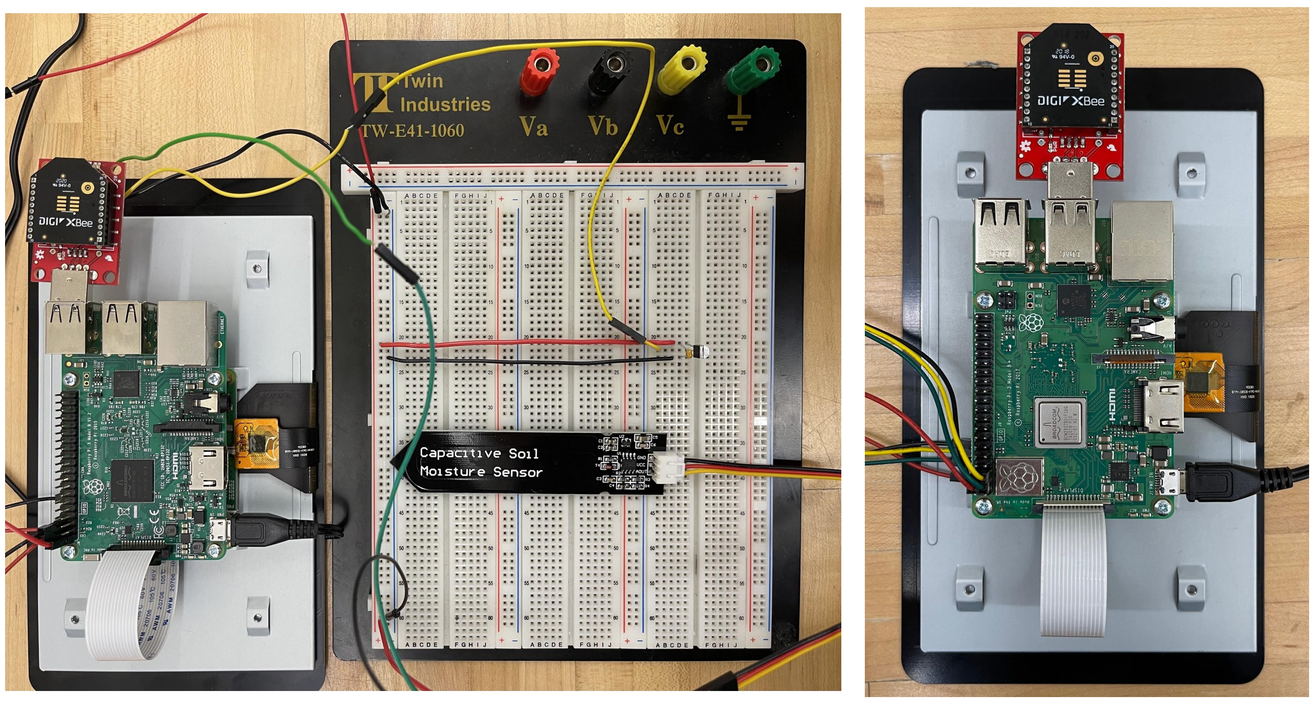

Figure 4. Remote Sensor Unit (left) and Main Controller (right)