Project Report on

Sensoponics

Automated Smart monitoring and Irrigation System
using Arduino Uno

Abstract

‘Water’ is one of the natures precious gifts to mankind. all living things consist mostly of water e.g. the human body is of two third of water. water is the most essential component of life and is vital for sustenance, so as it is most vital component for upgrading agricultural productivity and therefor utilization of water in most efficient manner is the key concept we must follow to improve the farming/gardening in the nation. Sensoponics helps the farmers/gardeners to distribute water to crops/plants by providing them with water when they need the water, this helps to prevent wastage of water and soil degradation. in this project we will develop an automated smart monitoring and irrigation system that helps farmers/gardeners to know the status of their crops/plants from home or by residing in any part of the world. This system helps farmer/gardeners to irrigate the land in very efficient manner based on soil humidity, atmospheric temperature & humidity and water consumption of plant. water excess irrigation not only reduces plant production but also damages soil fertility and cause ecological hazards like water wasting and soil degradation. the smart system not only provides comfort but also reduce energy conservation, efficiency and time saving. Now a day’s farmers are not financially stable to use industry graded automation and control machine which are high in cost. so, in this project we will implement a concept of IoT (Internet of Things) to read the data from sensors using Arduino Uno and send it to ThingSpeak, an opensource cloud to store and analyze the data of sensors.

Keywords – Water Management, Sensoponics, Soil degradation, Thingsspeek; Internet of things (IoT); Arduino; Soil Moisture Sensor; Water Motor; Temperature & Humidity Sensor;

TABLE OF CONTENT

CHAPTER 1
Introduction

The importance of building an automation system for an office home or field is increasing day-by-day. Automation makes an efficient use of the electricity, water and reduces much of the wastage. Sensoponics makes an efficient use of water for the growth of plants.

Scope of Project

Heart of Sensoponics is Arduino Uno micro controller. Arduino Uno has dedicated general purpose input output pins (GPIO pins). The advantages of the system are in three folds

- Saving energy and resources, so that it can be utilized in appropriate way
- Farmers would be able to spread the proper quantity of water at the proper time by automating farm or nursery irrigation
- Avoiding irrigation at the incorrect time of day, reduce runoff from overwatering saturated soils which will enhance crop/plant's performance.

Literature Review

This project is not the first of it's kind there are various paper published which can be relate to this project not entirely but with some of the modules. As many researchers found that the agricultural area and its productivity are decreasing day by day there are many researchers proposed a solution for the problem and some of them are

Chandankumar Sahu et al. proposed a system on "A Low Cost Smart Irrigation Control System". It includes several wireless sensors. Each sensor is integrated with a wireless networking device and the data received by the "ATMEGA-318" microcontroller which is on the "ARDUINO-UNO" development board. The Raspberry pi is used to send various types of data like text messages and images through internet communication to the microcontroller process [1].

K S. Nemali et al. Proposed irrigation systems which are also automated through information on volumetric water content of the soil using dielectric moisture sensors. It is used to control actuators and save water. [2].

Kapoor, Ayush, et al. Proposed "Implementation of IoT (Internet of Things) and Image processing in smart agriculture”. It combines Image processing techniques and Internet of things to smartly monitor the growth of plant. [3].

Supraha Jadhv et al. proposed, automated irrigation system using wireless sensor network and raspberry pi that control the activities of drip irrigation system efficiently [4].

Product Scenarios

In this project we use Arduino Uno (Figure 1.1) a microcontroller which was release in September 24, 2010. Price in between ₹1200 to ₹1500 from official websites but with local manufactures similar microcontroller (not from Arduino) can be available from ₹400 to ₹500 which can reduce the cost of the device to the grater extend.

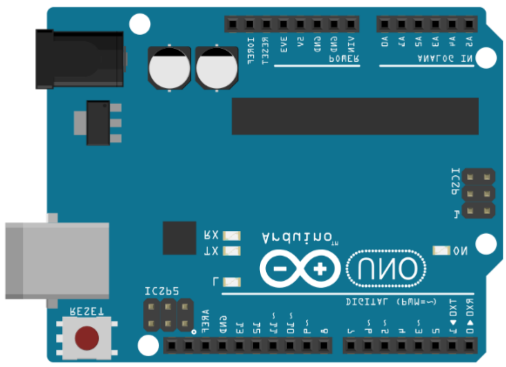

Figure 1.1

The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pins and 14 digital I/O pins that allows the user to attach various extension boards.

Arduino Uno the most official board from Arduino consist of 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB of flash RAM the in-depth details of the microcontroller is listed in Table 1.1, since the microcontroller is open source board the value of individual components can vary.

✓	Microcontroller	: ATmega328P
✓	Operating Voltage	: 5V
✓	Input Voltage (recommended)	: 7-12V
✓	Input Voltage (limit)	: 6-20V
✓	Digital I/O Pins	: 14
✓	Analog I/O Pins	: 6
✓	DC current per I/O pins	: 20 mA
✓	DC current for 3.3V pin	: 50 mA
✓	Flash Memory	: 32KB(Atmega328P) out of which 0.5 KB used by bootloader
✓	SRAM	: 2KB (Atmega328P)
✓	Clock Speed	: 16 MHz
✓	weight	: 25 g

Table 1.2

The proposed system consists of various processes and module but can be mainly categorized in 4 Architectural modules.

1. Offline Module
2. Cloud Module
3. Local Server Module
4. Event Triggered Module

Overview of the Next Chapter

In the next chapter we will discuss about the requirements of the proposed system that includes Functional and Non-Functional Requirements and the Use Case Scenario of the proposed system.

CHAPTER 2
Requirement Analysis

Software requirement is a functional or non-functional need to be implemented in the system. Functional means providing service to the user.

Functional Requirements

Functional requirements essentially specify what the system should do and, in our project, the functional requirements are

1. The project should monitor the soil moisture in real time.
2. The project should provide the plant with proper amount of light.
3. The project should be able to send the data to the cloud in real time.
4. The project should be able to fetch the data from cloud in real time.

Non-Functional Requirements

Non-Functional requirements essentially specify how the system should response on a scenario, in our project, the non-functional requirements are

1. In the proposed model the water submersible should only activate when the moisture level was very low.
2. The water submersible should only start if the model senses the availability of water in water tank.
3. The propose model will also work if the internet connectivity is not there just the local server and cloud cannot work in this case.
4. Whatever the case the proposed model will complete a cycle that consist of
    - Read the sensory data
    - Upload the sensory data to cloud
    - Store it locally (optional may skip)
    - Trigger the SMS (optional may skip)

That completes the functional and non-functional requirements of the proposed model but how the project should work i.e. what are the in and outs of the project to understand this we must analyze the use cases.

Use Cases

A use case is a methodology which helps in system analysis to clarify, identify and organize system requirements. It is generally made up od a set of possible sequences of interactions between system and users in a environment.

The use case for the proposed system can be analyzes with the Use case diagram in figure 2.1

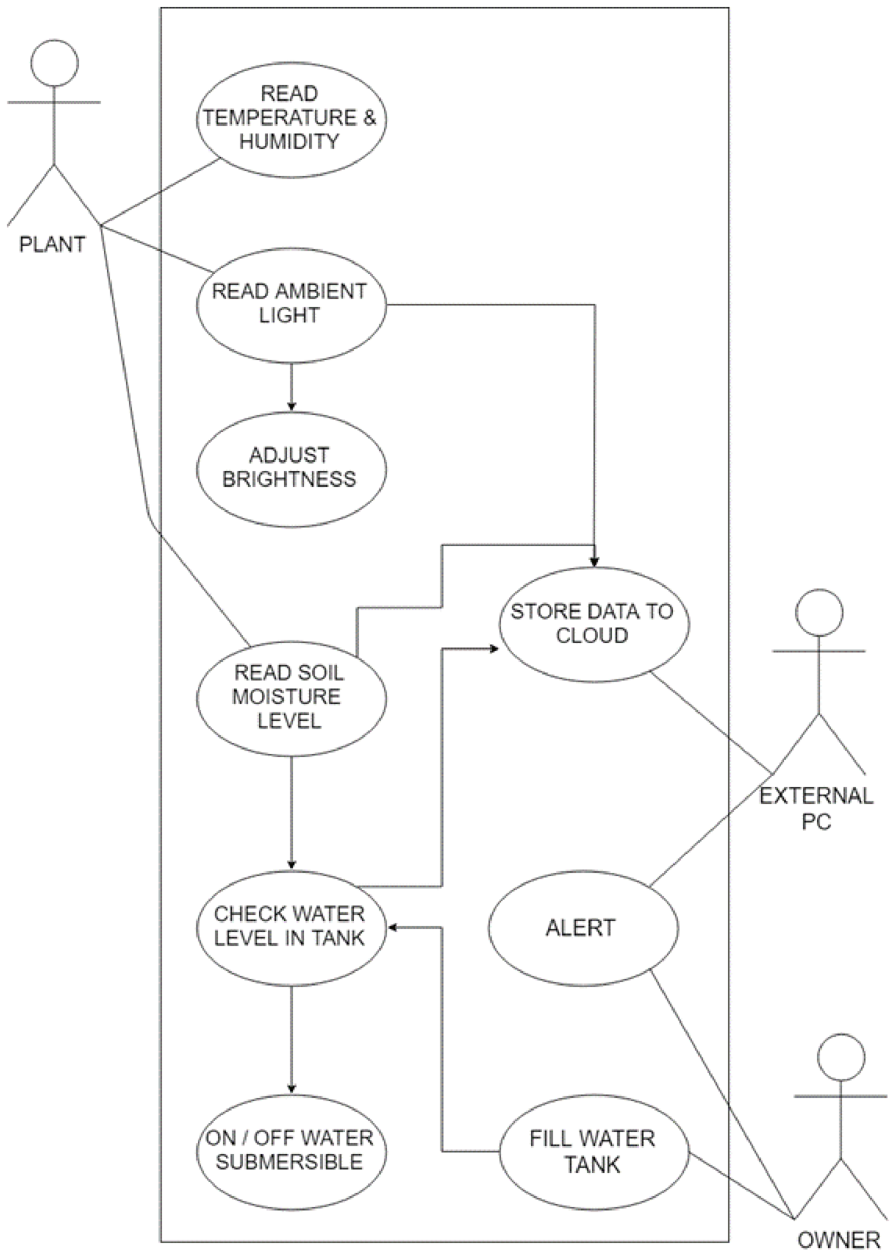

Figure 2.1

We can see in the use case diagram that the interaction of the owner and plant in very minimal i.e. that the owner just have to fill the water tank and get the alert for it and the other entirety i.e. the external PC was there just to create a local server to store the sensory data locally and all the relevant values were taken from the plant by the system.

CHAPTER 3
System Design

In this chapter we will discuss about the designing methodologies of the proposed system that includes the goal of the design system architecture and other methodologies that are relevant to the project.

Design Goal

The design of the proposed system is not very complex it only provides the proper placements of every sensors and actuators along with there connectivity to other modules and microcontroller.

The design goal is defined in three folds

1. The design should be well organized for sensors and actuators.
2. It should be simple and appealing.
3. It should achieve the basic goal i.e. Automated Smart monitoring and Irrigation.

System Architecture

The system architecture describes the basic working of the module, as we have discussed briefly about the 4 architectural module in chapter 1 now, we will discuss them in-depth.

1. **Offline Module:** The Offline Model is just the connection of Sensors and Actuators with the microcontroller as shown in Figure 3.1

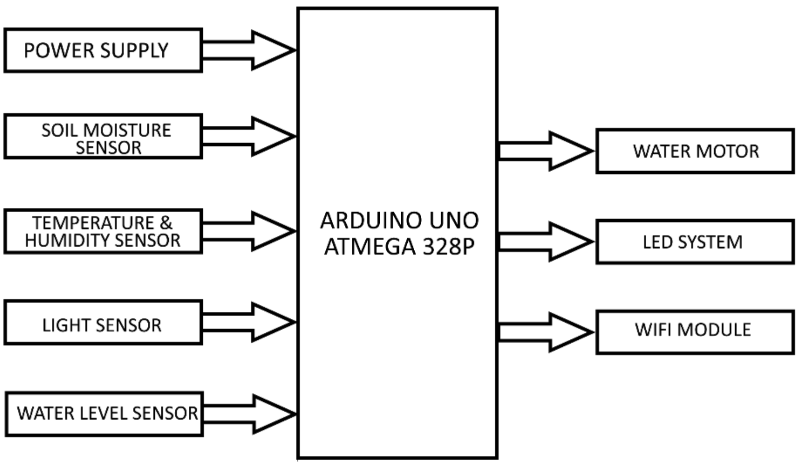

Figure 3.1

In Figure 3.1 it generally describes the in and out of the basic model i.e. what are the inputs to microcontroller and what are the outputs by microcontroller.

2. **Cloud Module:** The Cloud Model is the connection of Offline model with in Cloud as shown in Figure 3.2

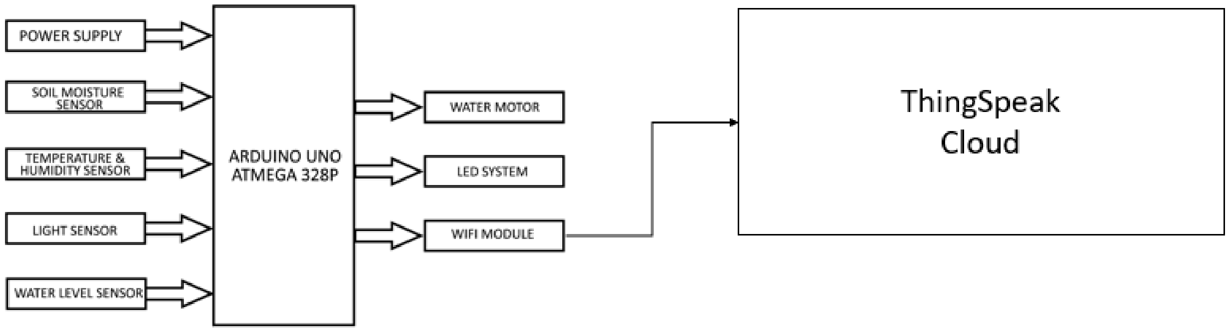

Figure 3.2

3. **Local Server Module:** The Local Server Model is the connection of Cloud Model with Local Server to store data locally as shown in Figure 3.3

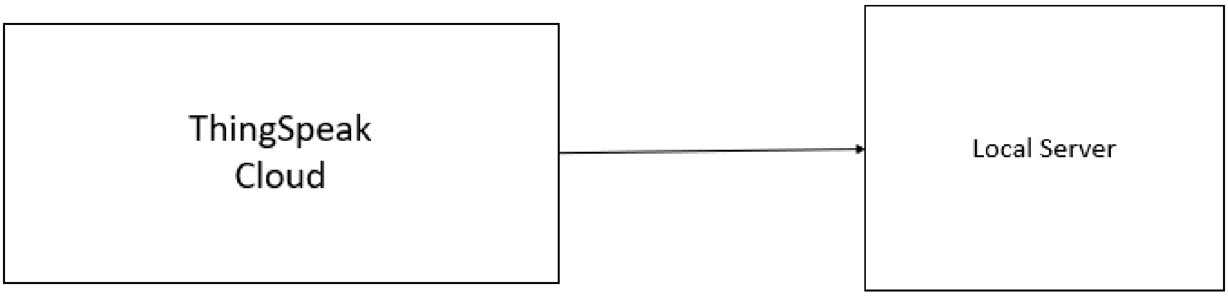

Figure 3.3

4. **Event Triggered Module:** The Event Triggered Model is the Manipulation of the data stored locally to trigger the solution for an event and in our project, it is SMS for water tank Refilling shown in Figure 3.4 this module is generally the optional module.

Figure 3.4

As we have discussed the design goal and the architectural module of the proposed model I now comes the detailed workflow of the proposed model i.e. how the model should work using different modules. As Figure 3.5 describes the detailed workflow of the proposed system.

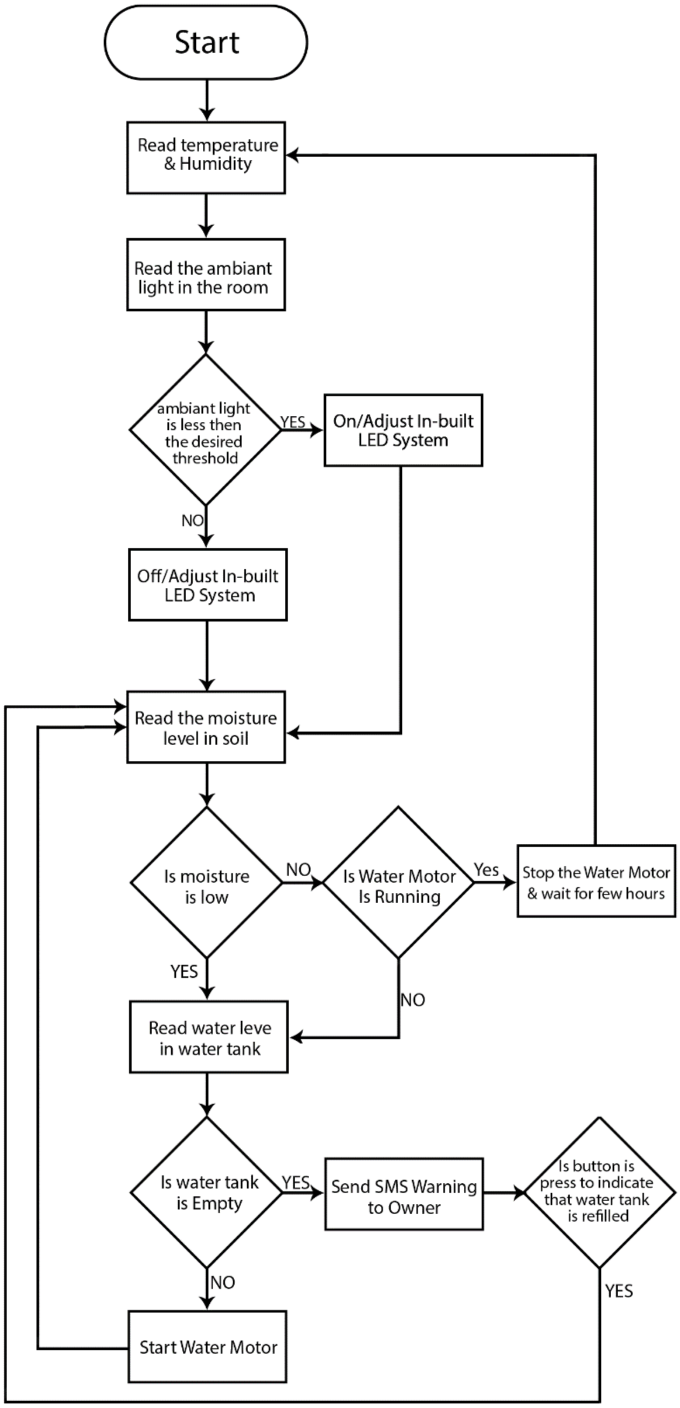

Figure 3.5

CHAPTER 4
Work Done

Theoretical concepts can only be helpful if it can be implemented in real life, to do so we must implement all the concepts, Architectural design and methodologies. So in this chapter we will discuss about the implementation of all the things we have discussed in previous chapters.

Development Environment

As we have discussed in chapter 1 that the heart of the project is Arduino Uno. To work with Arduino Uno, one must have a good knowledge of ‘C’ language as the Arduino IDE works with ‘C’ language only, it is easy to use and also have some predefined programs to check the sensory data.

Arduino IDE only helps microcontroller to work as we desire but, there should be sensors and actuators also which can follow the command of microcontroller to fulfill our goal.

In figure 4.1 we can see the connectivity of the various sensors and actuators with the microcontroller

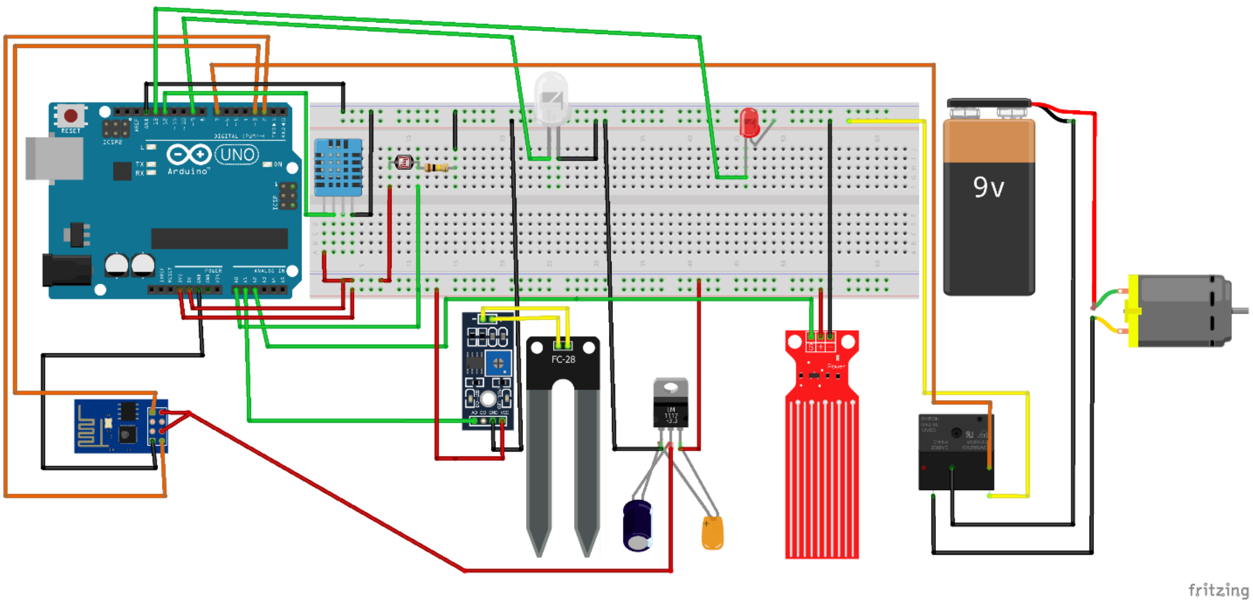

Figure 4.1

Result and Discussion

After successfully implementing the code in Arduino now we have turned up to our cloud storage ThingSpeak. As we can see ion Figure 4.2 that now our proposed model can register the various sensory data to the cloud

Figure 4.2

Similarly for the local host to store the data we have created a python script which runs every time and store data locally as well as trigger message when require Figure 4.3.

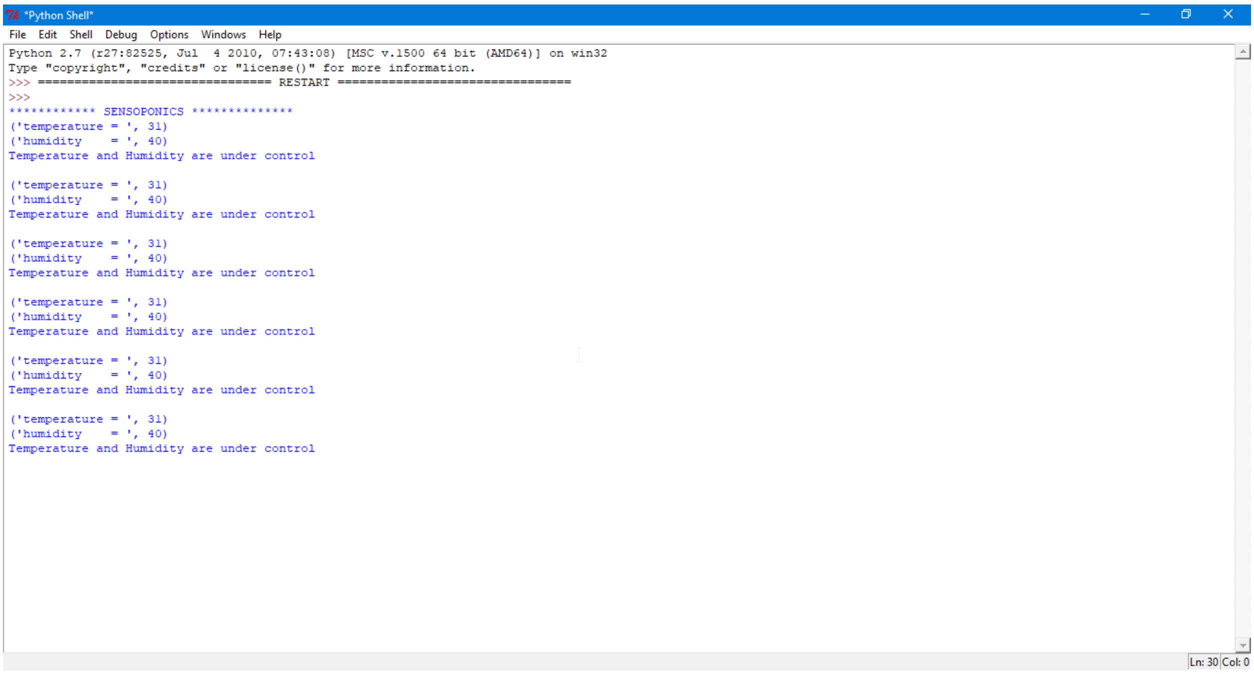

Figure 4.3

The final model should look like Figure 4.4

Figure 4.4

Reference

[1]Sahu, Chandan Kumar, and Pramitee Behera. "A low cost smart irrigation control system." *Electronics and Communication Systems (ICECS), 2015 2nd International Conference on*. IEEE, 2015.

[2]Nemali, Krishna S., and Marc W. van Iersel. "An automated system for controlling drought stress and irrigation in potted plants." *Scientia Horticulturae* 110.3 (2006): 292-297.

[3]Kapoor, Ayush, et al. "Implementation of IoT (Internet of Things) and Image processing in smart agriculture." *Computation System and Information Technology for Sustainable Solutions (CSITSS), International Conference on*. IEEE, 2016.

[4]Ansari, M. N. "List of Recently Published Quality Research Papers." *Imperial Journal of Interdisciplinary Research* 3.8 (2017).