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Technical Answers for Real World Problems(TARP)- SWE3999

Final Review

Project Report

Smart Gardening and Irrigation System Using IOT

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1. Abstract

Gardening is a common hobby for nature lovers. But the plants need continuous care. Sometimes, they may not get correct amount of water due to our carelessness. Like when the owner of the garden needs to go somewhere for a while due to business work or other things, the garden may remain unchecked and un watered for quite some time. The IOT can offer a solution to this problem for monitoring and watering via the smart gardening system. The garden can be modernized with recent technology which can be continuously monitored, so the plants could be provided watering and enough light according to need.

In our project, a smart gardening system and its monitoring using iot is designed. An IoT device built on Arduino UNO and sensors like Moisture sensor and LDR light sensor is made which updates the sensor readings to Thing Speak in particular amount of times. It Is an IoT platform for visualising data in different formats by connecting to an AP provided. The Wi-Fi module is serially connected to the Arduino to connect with internet.

The device is connected to a water pump. The water pump is automatically turned on/off based on the readings of the moisture sensor. We used different sensors to identify moisture and light intensity and can be monitored through internet which can be uploaded to cloud.

2. Introduction

"Cities usually think of trees just as aesthetic ornamentation," said lead study author 'Rob McDonald'. Research has already shown that trees are capable of both cooling and cleaning the air in urban spaces, But People won't worry about being responsible for maintaining them and to take care of them like watering daily. They often forget about it and the plant may even die. And some people don't know when to water their plants, if they over water their plants then the chances are the water may be leaked out or if it is sealed at bottom then due to excess watering yellowing leaves and new growth falling from your plant can be seen and also insects like mosquito's may grow in the still water.

Some small plants may even die due to this because if the soil is dense with water, it can limit the ability of the roots to breathe, they will then drown and begin to rot. Our main issue is to water them regularly and not overwatering. Many of us don't know how much and when to water which leads in excess watering and less watering. Hence smart gardening system should be implemented for small gardens and plants.

Human error may cause for more wastage of water where there is need of water for its run. For the smart gardening system , the IOT devices are used to ease of the effort of user and also reduce water consumption but tends to save more water and it makes sure the plant is not over watered. Though plant growth depends on soil nourishment but for now , in this project we are aiming for the water reduction in the consumption and proper watering to plants.The Arduino based system helps us to connect the sensors and the microcontroller and the cloud and then to the users. Arduino plays a major role for this device. For the IOT devices , the main reason for the automated working of IOT devices is the communication.

Communication is the vital role for the working of IOT devices. Proper communication should be efficient. The sensors help in the collecting information and interprets the values in

the form of datasets. For example, if we take example of the current project we are using here two main sensors i.e. moisture and light sensors. The moisture sensor values are updated periodically and if there is less water, watering is done automatically, the light sensor is used to detect the presence of light and to provide artificial light if needed. These values are interpreted in datasets and are sent to the Arduino board which sends the data to the cloud.

The Wireless Sensor Networks(WSN) have been adopted for the recent prototype for smart irrigation system. These prototypes aim at working of the smart irrigation system without any human error and not involving any human activities involved in it.

The cloud platform allows us to store the information and send information to the members who can access the cloud. Cloud can be accessed by the users and the users can communicate with the devices with the help of cloud. Distance doesn’t matter for this prototype since this device involves internet. Internet will help the users access the cloud and the users who are allowed to access the cloud can access it via the internet

Other than regulation of water supply to the fields one more thing that can be developed is the nutrient detection analysis in the soil. As we know that minerals and nutrients in the soil are required for the growth of crops and they play a vital role in plant growth and also in crop production and hence it is important to consider the condition of the soil as well for plants growth. This method is used for the most recent research in which a data mining clustering algorithm is used to detect disease analysis. On practical implementation on affected plants it had the ability to analyse disease like Bacterial Blight, Brown leaf spot etc.

With the help of image processing techniques, we can also analyse the sight of disease with the image captured and with the help of MATLAB code and with the help of image processing techniques we can analyse the disease area of the plants. On analysis, the system verifies the parameters such as Contrast, Correlation, Energy, Homogeneity, Mean, Standard Deviation and Entropy. The image is converted to three more clustered images containing Region of Interest (ROI). The above parameters detect the extent of disease

The project is built solely for the smart gardening process which works on ESP 8266 wi-fi module, Arduino Uno board and sensors and cloud server to save data. The sensors collect the values of from the area i.e. moisture and light sensors. The moisture sensor values are updated periodically and if there is less water, watering is done automatically, the light sensor is used to detect the presence of light and to provide artificial light if needed. These values are updated in datasets and are sent to the Arduino board which sends the data to the cloud.

The owner can access the cloud server and check the graphs which are formed from the collected datasets and can also share the details via the help of Thing Speak. The cloud server can be accessed via mobile or PC. The user can give commands which are received the 8266 module which works as a Wi-Fi module and helps in the communication between the Arduino and the water supply. Water will be sent to the plants on the basis of commands received and hence the whole smart gardening process works on this basis.

3. Literature Survey

The paper “GSM based solar automatic irrigation system using moisture, temperature and humidity sensors” proposes the irrigation system using Arduino mega which has more functions and features than Arduino UNO. In this system the moisture sensors sense the moisture and sends the data to Arduino, It determines weather watering is needed or not.

And the status of the water pump is intimidated through GSM module attached to the Arduino. the advantage of this system is that it runs on solar panels which erases the problems those arise due to insufficient load and other power related problems. It also incorporates humidity and temperature sensors which gathers additional information about the environment and intimidates the farmer if there is any abnormality

The paper titled “Smart irrigation: A Smart Drip Irrigation System Using Cloud, Android and Mining microcontroller” is used and it acts as the heart of the system, where the information

from all the nodes is collected. All the nodes collect the values of soil moisture from soil at respective places and if any values are less than the threshold value the drip system is turned on. In this system a local PC acts as central unit and stores the all the readings from the microcontroller in a database. And if user needs he can read the values from the PC using his Android mobile. and user can also get the future trends of the soil moisture applying data analytic techniques on the data collected. This is the advantage of this system.

IoT based smart irrigation monitoring and controlling system paper implements the smart irrigation monitoring with the help of atmega 328 microcontroller, ZigBee and cloud computing. The principle is that the moisture and other sensor readings are sent to the master node which in turn sends the data to the cloud. The cloud processes the data, depending on the crop raised the server detects the threshold value of the soil moisture and thus gives the direction to the microcontroller weather to the water the crops or not.

The DHT11 sensor measures the temperature and humidity and note the readings. The digital readings of temperature and moisture are sent to the Pi board which in turn pushes this data on to the cloud server. A solenoid valve is an electromechanical valve which is current controlled using a solenoid. It has a rating of 12V dc and has two openings. The USB Wi-Fi dongle is used to connect the Pi board to internet. The USB Wi-Fi dongle is used to plug into one of the USB port of the Pi board which can be configured to use any of the wireless networks in the surroundings.

A solenoid valve controls the watering. The opening or closing of the valve depends on the raspi input, as the valve is connected to one of the GPIO pins. The key feature of this project is the use of a server , which does the processing part. When the humidity and temperature readings cross the cut-off, a signal is sent back to the raspberry pi, which then opens the solenoid valve for a time of say, 10 seconds. The amount of water required per plant can been calculated, and the flow rate from the solenoid enables us to determine the amount of time for the valve to be open. The mobile technology enables the user to access the readings from anywhere, with an internet connection, thereby making the system ubiquitous.Each node consists of atmega 328 microcontroller, moisture, humidity and ambient sensors and these are connected to the master node via ZigBee protocol.

As we have seen the way soil moisture sensor and temperature sensor play a role in smart irrigation. In this paper it has been observed that smart irrigation with sprinkler irrigation is

also feasible. The smart network consists of an aggregated network with water sprinklers and sensors. For enabling communication, the sprinkler is controlled by microcontroller. The microcontroller communicates the sensor through Bluetooth. A smart sprinkler (SSP) is used here which is an integrated system of microcontroller , servomotor and sprinkler and Bluetooth. The SSP controls the sprinkler such that it sprinkles only in the region where irrigation has been requested by SDA. This kind of irrigation system reduces complexity and makes it more manageable.

One issue with smart irrigation is the availability of regulated power supply. In many remote villages there is a frequent problem of voltage fluctuation and power cuts which may disturb the working of the devices and the sensors. In this paper the regulated power supply is being provided with the help of photovoltaic cells. These photovoltaic cells absorb the light energy from the sun through sunlight. This solar energy is converted to electrical or any usable form of energy for the devices and power supply is provided. In this way, there is a regulated flow of power without fluctuations and thus maintains stability. It is therefore cost effective and reliable.

Arduino, here the PIC18F4550 microcontroller works as brain of this system. It is a 40 pin, high performance, enhanced flash, USB microcontroller with Nano Watt technology at an economical price. It operates irrigation pump in accordance with received decoded commands from GSM module and signals from different sensors. Two pins of the microcontroller are used for sensing water level. One pin as an output and another pin as an input to the microcontroller. The microcontroller is then programmed in such a way that an output pin remains high for all time 0and input pin waits for high signal. requires 3 phase power supply. If any of single phase fails during its normal operation motor gets heated up which may harm the motor winding. Hence, three phase detector circuit becomes necessary for irrigation motors. Working of PIC18F4550 microcontroller as the water level detector sensor and rain detector sensor reduces the need for a separate sensor. Inbuilt ADC of the microcontroller also reduces need for a external hardware circuitry. So proposed system is very cost effective and enhances agriculture productivity.

In the paper “smart irrigation with embedded system”, the smart irrigation is achieved with the help of Raspberry pi, Arduino and soil moisture sensor. The working principle is that the moisture sensors senses the data and sends it to Arduino the Arduino uses XBee module to communicate with other XBee module attached to the Rpi. The Rpi measures the moisture and

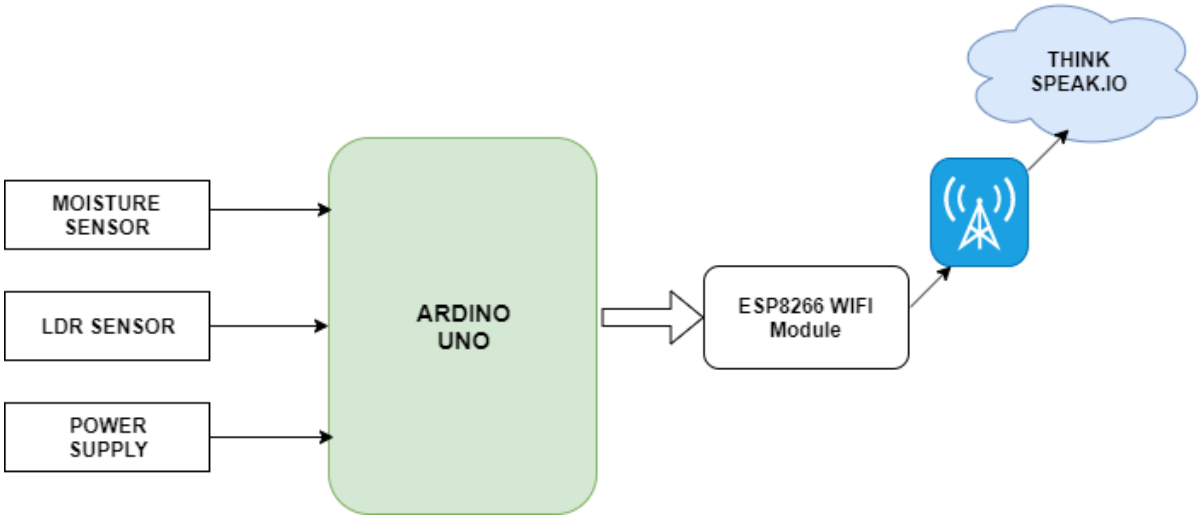
checks weather the soil requires watering or not. If it requires, the Raspberry pi sends the signal to the Relay which in turn sends the signal to the solenoid valve thus opening/ closing the valve depending on the signal. The Raspberry pi sends information to the cherry pi server and anyone who knows the IP address of the Raspberry pi can access the information about the field. This is the con of this system.

Survey Table

S.NO	TITLE	SENSOR	PROTOCOL	HARDWARE	PRO'S	CON'S	YEAR
1	Smart home gardening system using Raspberry pi	Moisture sensor	Wifi protocol	Arduino Uno Raspberry pi moisture sensor	The system is feasible and cost effective for optimizing water resources	Anyone who knows the IP address can access info.	2017
2	Design and Implementation of Smart Irrigation System	Soil moisture sensor	Zigbee wifi	Microcontroller Max 232 Sensors PC	Data mining concepts are applied to guess future trends	It access is limited to the surrounding of the PC.	2016
3	IOT based smart irriagation system and nutrient	Humidity And temperature	wifi	Raspberry pi Selnoid valve Usb wifi dongle sensors	It contains nutrient detection and disease analysis	It is costly to implement	2017
	detection and diseaseanalysis						
4	SISFAT: Smart Irrigation System with Flood Avoidance Technique	Flood avoidance sensor, Depth level sensor , Moisture sensor	wifi	Arduino UNO, Solar Panel, Sensors, Relay	Energy efficient since sunlight is used for regulation of energy	It may be costly installing the solar panels are costly	2017
5	IoT based smart irrigation monitoring and controlling system	Humidity, Temperature and moistur sensor	Zigbee	Atmega 328 microcontroller, sensors and relays	The decision of watering is taken in the cloud thus reducing the burden on microcontroller.	Access is limited to prefined area.	2017

6	Smart irrigation decision support based on fuzzy logic using wireless sensor network	Soil moistur and temperatur e sensors	Zigbee	sensors	It uses fuzzy logic to calculate the amount of time required to water the crops.	Constant regulation of power may not be possible in villages..	2017
7	GSM based solar automatic irrigation system using moisture, temperature and humidity sensors	Humidity, Temperatu re And soi moisture sensors	GSM	Arduino Mega Sensors Relays Photo voltaic cells	It runs on solar power so no issue of power.	It is costly to implement	2017
8	Smart Water Dripping System for Agriculture/Far ming	Temperatu re Sensor, Moisture Sensor , pH Sensor	WiFi	Sensors, Servo Motor, Power Supply , Water Pump	With the help of this system, one can control the amount of water given to the fields. This can help to control the excess water which is wasted.	A constant source of regulated power supply may be doubtful in case of remote villages.	2017
9	Novel, Low cost Remotely operated smart Irrigation system	Temperatu re Sensor(LM 35) , Water Level Detector Sensor, Rai Detector Sensor	GSM	Microcontroller, Relay, GSM module	This system assures protection of motor against fluctuating power supply, dry dun state, overheating of motor winding	Lacks drip irrigation method which helps to reduce water wastage	2015
10	ZigBee-based irrigation system for home gardens	Temperatu re Sensor, Moisture Sensor	zigbee	Sensors, Servo Motor, Power Supply , Water Pump	With the help of this system, one can control the amount of water given to the fields. This can help to control the excess water which is wasted.	A constant source of regulated power supply may be doubtful in case of remote villages.	2015

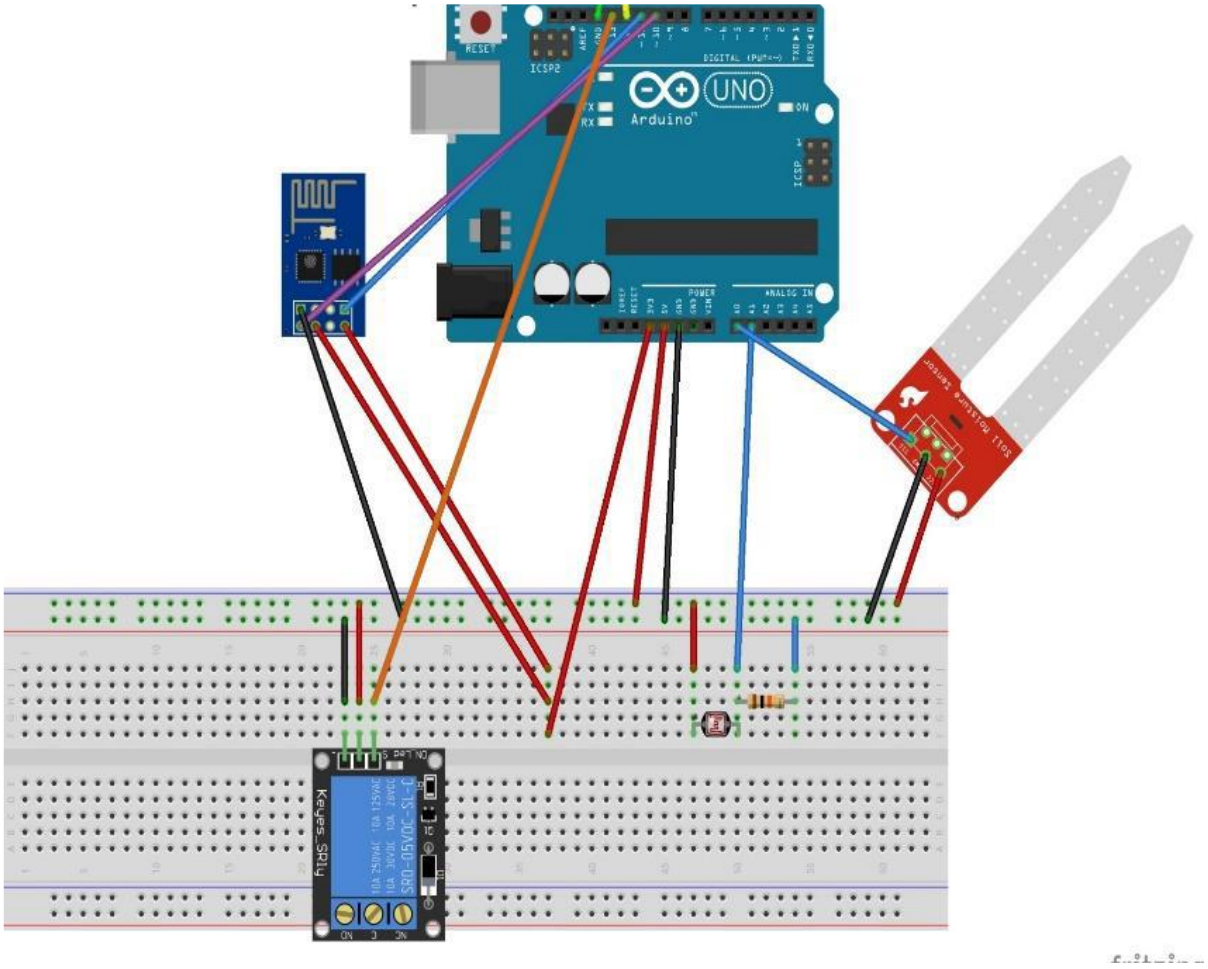
4. System Architecture



5. Proposed System

For general gardening system the solutions already available are, The Use of a consistent method of watering scheduling can often reduce energy use by 7% to 30%. Using an ET-based watering scheduling system can ensure you are not under or overwatering the crop. Use of sprinklers and Replace broken sprinkler heads as soon as possible. Buried pipelines rarely leak, unless they were not pumped out before winter. Maintain pumps regularly, including proper greasing and filling oil reservoirs every year. solar powered desalination plants will help in overcoming the water crisis. Drip irrigation, by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface. But for our solution We are using a moisture sensor to know when to water the plant. And a water-pump to water the plant. and wi-fi module to monitor the moisture levels and watering. We are going to use a microprocessor (Arduino) to manage this whole working model. And a power supply for the Arduino, motor-pump, wi-fi module. And the codes for Arduino and wi-fi module are uploaded and tested using the Arduino software. We can add the sprinkler setup as an extra to conserve more water. And the values will be updated online for monitoring purposes to the thing speak server so that we can later view it as a graphical data.

6. Design and Implementation

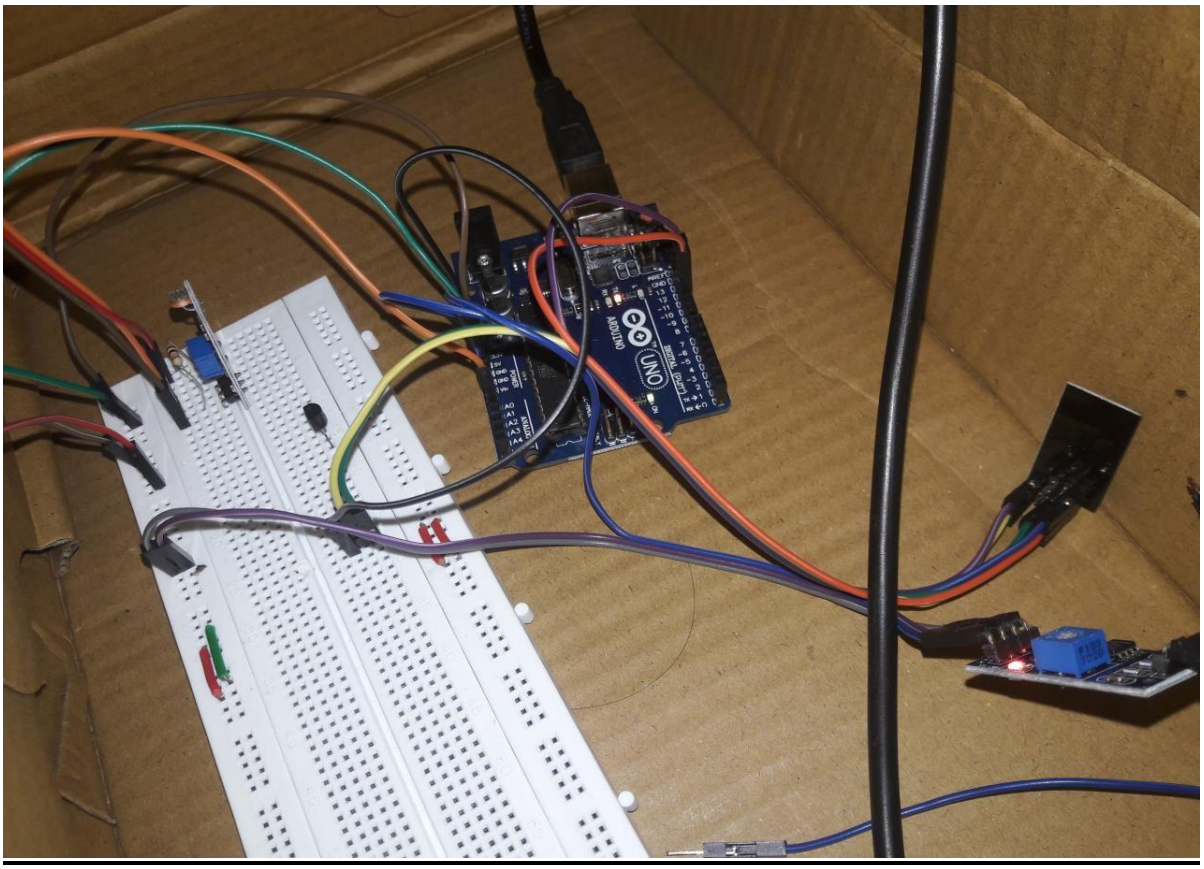


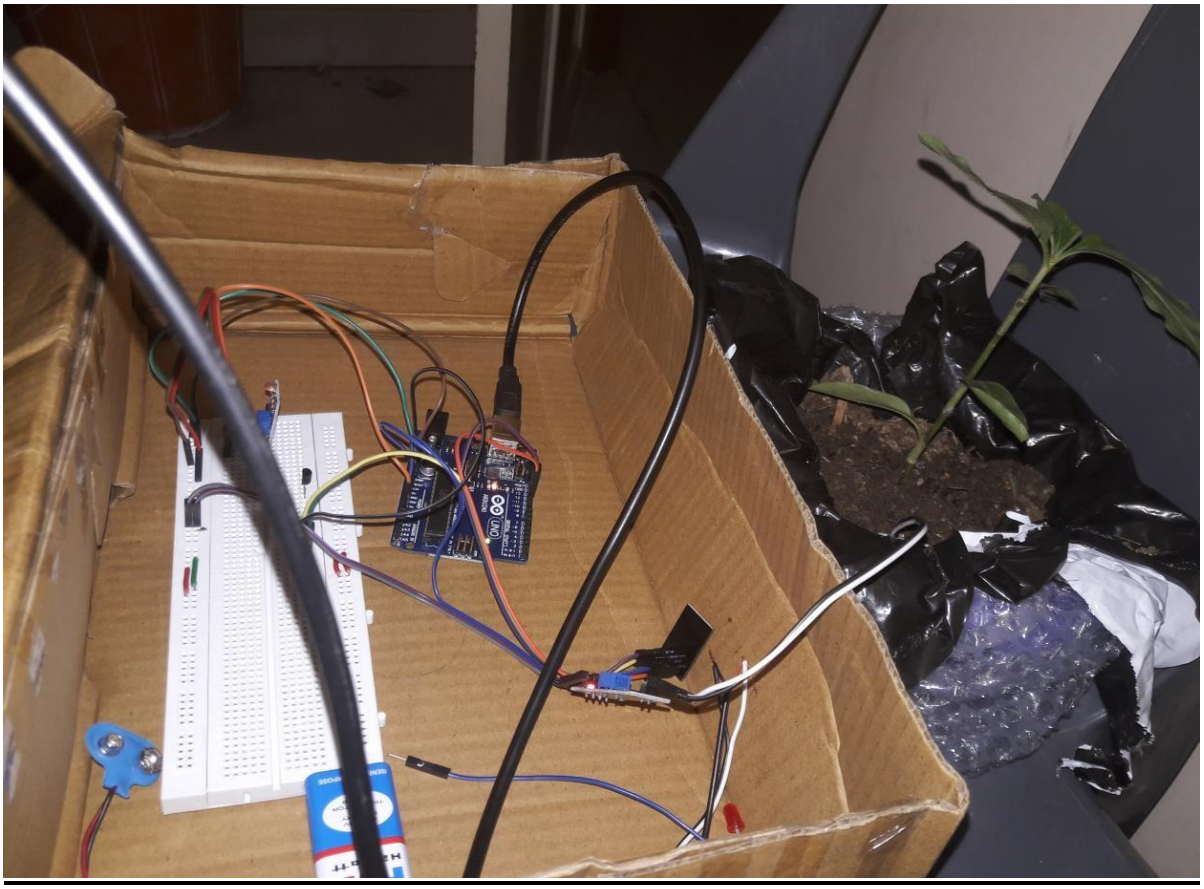
Like in the above diagram we successfully implemented a smart gardening system. In the implementation we are using the moisture sensor to detect the moisture values of the soil and according to that values we are going to water the plant until it reaches the normal values. The Wi-Fi module which is connected serially will update the sensor values to thing speak platform and we can access the data through web via our smart devices like our laptop and smartphone in the form of graphs and we can also access it in the form of a dashboard. The entire details of how the code works and how we did the project are in the ReadMe file.

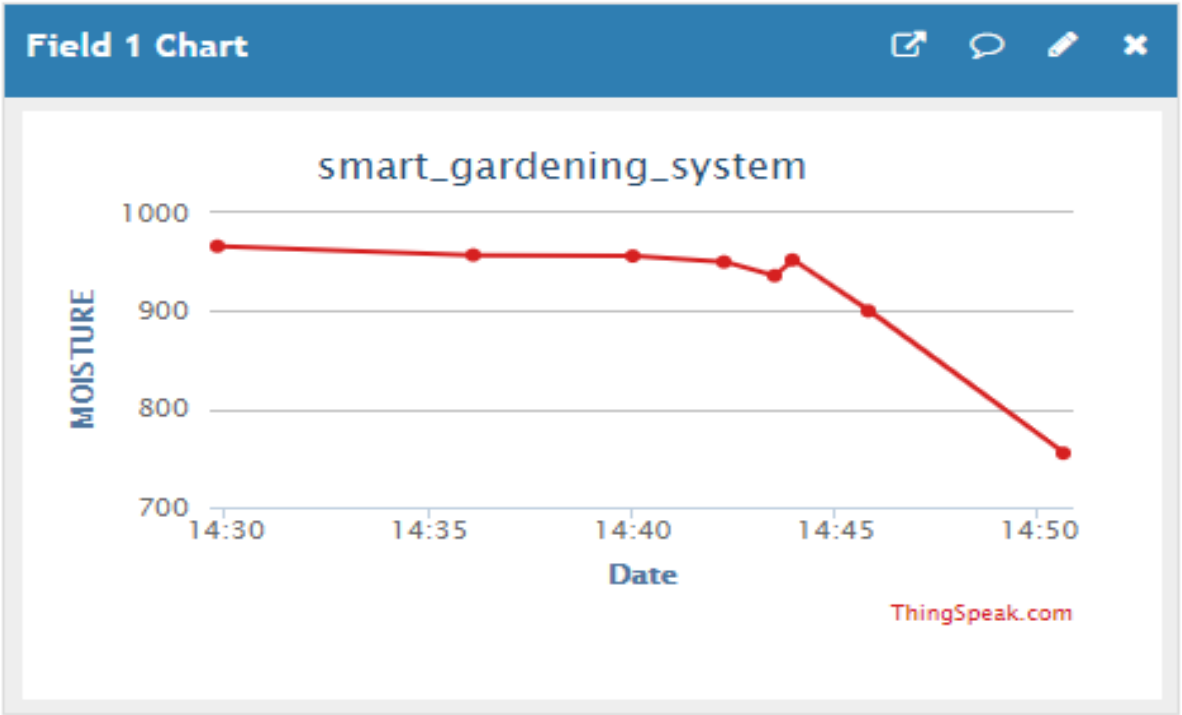
There we explained how we implemented the code and entire detail about the connections. In this project we can actually use a solenoid valve instead of water pump but due to cost efficiency we are using a water pump. The light sensor values will also be updated in the thing speak platform via the Wi-Fi module after we provide proper Wi-Fi connection.

7. Results and Discussion

In real scale example or the model, we can't give power from the batteries as it charges down. Instead we can use a solar panel which stores some power in batteries to supply at night times and using its own power at morning times or we can go with an Ac to dc converter and connect to our normal power supply. The next thing that concerns me is the water pump, as the water for our use come directly from the tank instead of using a water pump which is not going to be much useful in Real world application, we can go with a Solenoid valve to Allow/Stop the water flow. When it comes to real world application it should also be cost efficient so we are going to replace the Arduino with a microprocessor with basic functionalities. And the remaining components like Wi-Fi module and other sensors are not going to be changed in this system because they are already perfect.



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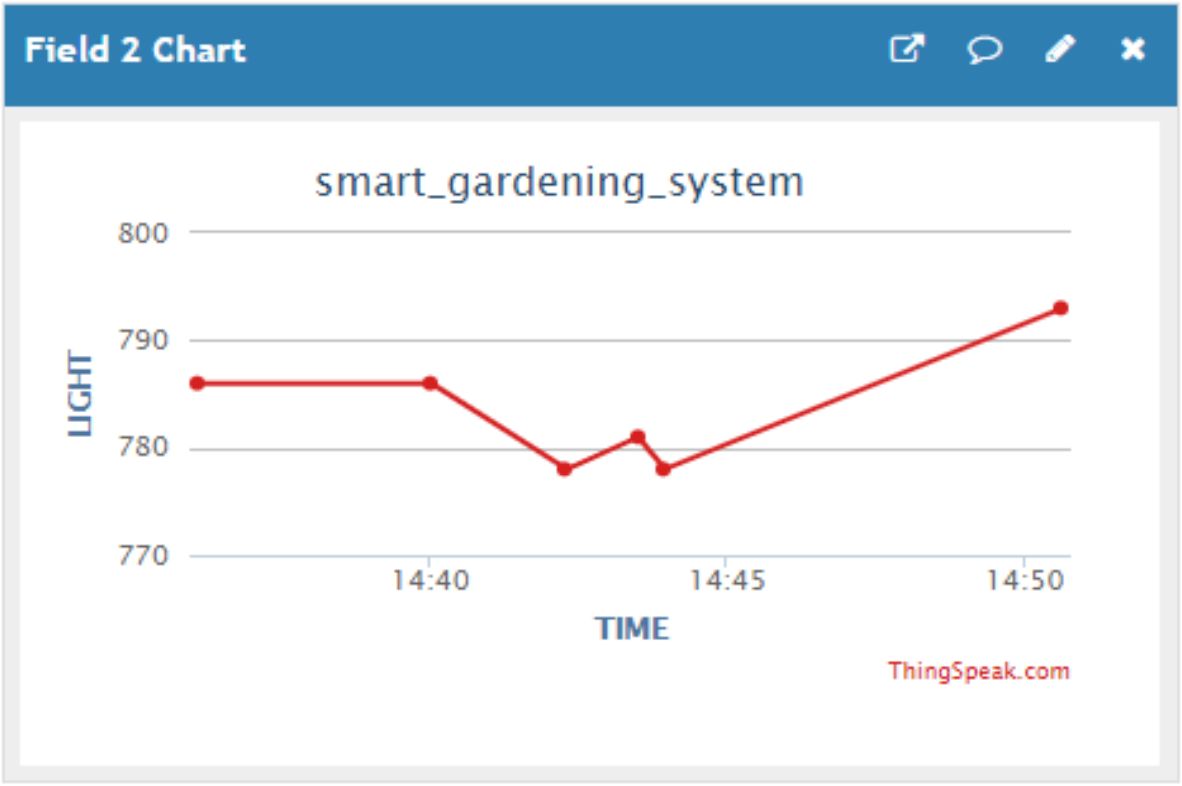

8. Conclusion

Successfully created a smart gardening system using the Arduino, moisture sensor, light sensor and began successfully monitoring the system using the Wi-Fi module and the thing speak website to upload the data. We are monitoring the soil moisture levels and the plant is watered automatically using the sensor levels via the code in Arduino. IN our system we can give an external input to turn on the artificial light or turn it off or we can keep it in a third state where the artificial light is automatically turned on if the sunlight is low via the detection by the LDR light sensor. In future we can replace the water pump with a simple solenoid valve if there are more no of plants. And we can implement it through more efficient sprinkling system so that we can save even more water and this system is eco-friendly