A sensor based smart irrigation system using IOT

Harwant Singh Arri
Assistant Professor
Department of computer Science & Engineering
Lovely Professional University

Dhiraj Kapila
Assistant Professor
Department of computer Science & Engineering
Lovely Professional University.

Abstract

Currently used sprinkler systems are designed to turn on and off at specified times, for specified lengths of time during the day without any consideration for the field moisture content, some are programmed to adjust to general climatic changes in the calendar year and some are even based on yearly evapotranspiration rates. This has led to problems of 'overwatering' and 'underwatering'. This paper looked at designing a structure for a smart irrigation sprinkler system using IOT for implementation. Data was collected and analysed for cabbage grown in loam and clay and a simulation performed using a IOT based structure for making of watering times. It was found that the watering timetable of a human could be imitated through the use of IOT and could be more efficient than some more complicated irrigation schedules developed.

1. Introduction

The starting of summer is a good time to strengthen the productivity of your urban irrigation system or setting up an electronically controlled irrigation system that is water efficient. Today there are lots of "smart" techniques available that make it possible you to preserve beautiful landscapes while enhancing water efficiency.

Various Smart Irrigation Technologies

A) Weather-Based Controllers

Weather-based controllers or Climate-based controllers adjust the irrigation schedules depending on weather patterns. These climatically-based systems retrieve current weather data and some even factors in your precise landscape (such as crop types, moisture in soil, slopes, etc.) to change an irrigation play-time, so that the crop field always obtains the adequate quantity of water. There is a huge choice of products in this type with numerous climate input choices and field specific adjustment factors. Water savings can be considerable and another big benefit is the usability of these "self-adjusting controllers".

B) Sensor-Based Controllers

Sensor-based controllers relies on sensors of soil moisture positioned under the field in the root zones of gardens and fields to predict how long to water. Soils might be preserved amid lesser and higher moisture level mark for optimum crop health. Otherwise, a modest decision is to carry on with the on-going irrigation method to run depends on the soil moisture. Climate-based and electronic senor-based control inventions are offered as separate controllers or add-on equipment's to prevailing controllers. Respectively has been publicized to lessen irrigation water use up to seventy percent without surrendering the superiority of your land.

C) IOT Based Irrigation System

IoT innovation is useful, and makes farming simpler. Not only it will immediately perform water irrgation depends upon the soil's moisture level, it would also submit the information to ThingSpeak Server to supervise the soil health. The System will involve a “water pump” that would be employed to sprinkle water on the field depends upon the land ecological condition such as “Moisture, Temperature and Humidity”.

D) Smarter Sprinklers

The biggest benefit of converting to a smart irrigation scheme is the considerable amount of water savings. All such savings can be doubled by dipping obsolete sprinkler systems all over twenty percent and using nozzles that can instead spray spinning water streams in numerous different trajectories. These “Smarter Sprinklers’ goes a long way in guaranteeing uniform circulation of water to every area of the field and offers considerable huge resistance to fluctuations in different weather circumstances.

The water that these revolving-head sprinklers release is often drenched in by the soil, thereby reducing runoffs and other types of waste. Rain sensors have also gained widespread adoption amongst crop cultivators in various countries aroud the world. Such sensors double up as "shutdown tools, " transmitting signals at the time or just afther the heavy rainfall to avoid automatic sprinklers run.

Rain/Freeze Sensors

Rain sensors prohibit irrigation systems from operating during the starting the heavy rainfall and the time when irrigation is needless just after right rain occurrences. Rain / freeze sensors add the ability to prevent irrigation whenever temperatures reach freezing to avoid ice in landscapes and in hardscapes. These devices can reduce irrigation water usage up to 35 percent and help extend irrigation system life. Sprinkler systems should never run in the rain, and rain sensors can put an end to those wasteful and embarrassing situations.

2. Overview of Smart Irrigation Water Sprinkler using IOT and Arduino Uno.

Water is becoming increasingly rare and valuable with the global population reaching 8eight billion. The nearly 70 percent of water usage worldwide is employed for irrigation. It's no surprise that much of the water release are lost here too. Nearly half of the water we employ on irrigation is misused because of unproductive irrigation approaches.

Nowadays utilized sprinkler systems are built to switch on and off at designated times, for stated lengths of time throughout the day deprived of any deliberation for the landscape moisture content, few are automated to regulate to over-all climatic fluctuations throughout the current year and few are often based on annual evapotranspiration rates. This has led to problems of ‘overwatering’ and ‘underwatering’. This paper looked at designing a structure for a smart irrigation sprinkler system using IoT technology for implementation. The word "IoT" referring to the "internet of things", can be interpreted as the interconnectedness in the open internet substructure amid the personally distinguishable embedded computing apparatuses. The ‘IoT’ links numerous computing systems and transportations by employing the usages of Internet as well as Electronic Sensors. In the agriculture land, sensors are deployed like soil moisture. The data gathered from these electronic sensors is further transferred to data server with the usage of Android device. The device is triggered in the control section using the program, and this is done with the switch ON /switch OFF buttons in the implementation.

Correct use of irrigation is an essential factor in the appropriate usage of the irrigation method, meanwhile the prime motive is the lacking of ground water because of shortage of rainfall and lack of natural water use. That is reason we apply that automated watering method for “plants and soil moisture”, that is extremely advantageous to every kind of weather circumstance. The proposed system is a grouping of hardware and software parts. The hardware part comprised of embedded system such as Arduino board and software part is the mobile Application designed using android and java.

Fig 1. Arduino Uno Board

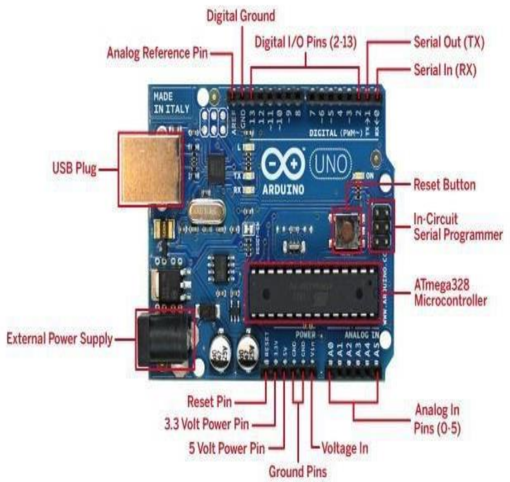

Fig 2. Arduino Uno Pin Configuration

Moisture Sensing Unit of Proposed System

Soil moisture is an important element of irrigation regulation. Soil moisture plays an essential role both in the irrigation fields and in the plants ' garden. The soil humidity sensor is a device used to determine the water volume in the soil. The sensors do not measure the volumetric water content directly using certain different soil laws such as di-electricity, electricity resistance, otherwise neutron contact and humidity substitution. The FC-28 soil moisture sensor contains 4 pins. The A0 pin is an analog output for energy needs, the D0 is a digital output and the GND pin is for land use. The LM393 comparator will measure this value, which also includes a potentiometer that calculates the minimum value. The LED should turn on / off according to the threshold value. The sensor has the capacitor to set the moisture level of the target. If the sensor is moisture than the stated threshold, the electronic quality is lower and the output displays a LED. The sensor is very easy to use. Low moisture is still available if the soil moisture is below the specified level. The digital throughput can be attached to a microcontroller for detecting the moisture level, the electronic output increases and an LED shows the throughput. Whenever the soil moisture is below the specific threshold, the throughput stays low.. To sense the level of moisture the digital throughput can be attached to an embedded microcontroller.

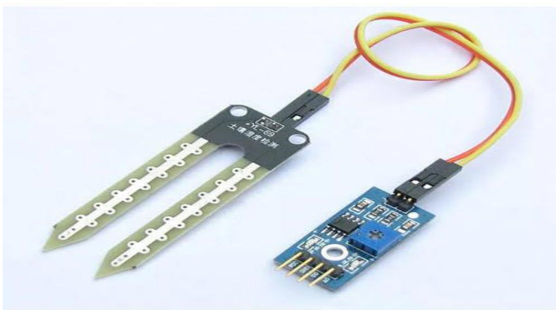

Fig 3: Soil Moisture Sensor

3. IOT Unit of Proposed System

This section comprises of a mobile application designed using android technology which shows the present water sprinkler status i.e. switch on or switch off and a control hyperlink button which forwards the app user to a thingspeak.com webpage which realistically represents the sensor data.

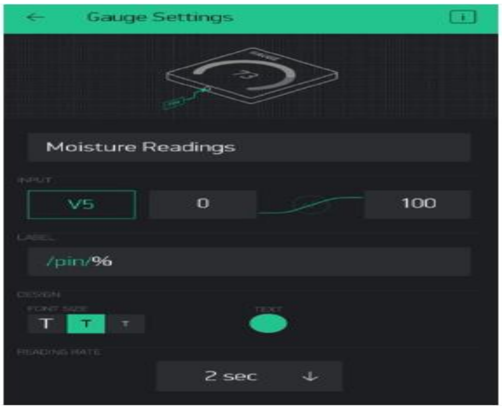

Fig 4. Andriod App page shares sprinkler & soil moisture values.

4. Design and Control Unit of Proposed System

For all popular hardware platforms-allows server and process communication with all incoming and outgoing commands. We can build this Smart Irrigation System through IoT by using all sensors and hardware components It can be applied to turn the engine on / off to save water and convenience on our needs. ESP8266, ESP32, Node MCU, particulate matter, raspberry tar and other mobile microcomputers over the internet. Both supported by Bluetooth and BLE.

"BLYNK Android App " is used to tracking soil moisture and humidity sensor observations, as well as DC Pump status. Mainly by making our individual account and must configure the hardware of the project. There are numerous widgets available in "BLYNK Android App " and we have used only few of them. They are

a) **LED widget**: This widget is an indicator for DC Pump.

b) **Email widget**: for transferring the electronic mail announcement to the handler of the DC Pump.

c) **Gauge widget**: for showing the soil moisture readings.

The "BLYNK Android App " console is for tracking the soil moisture and the sensor values in the land and values are updated occasionally and the handler can see the reading from anywhere. The DC pump reveals that whether the pump is Switched ON or Switched OFF which is showed by the attached green light emitting diode on the second side of the app console. This project is used for main automation purpose.

Fig 5. Moisture Status

So the component used should not be easily damaged or breached. Also the communication is wireless, due to which data transmitted over the network can be interrupted, so the network needs to be uninterrupted. And the sensors that have been installed to the device should have the minimum error correction so the values should be accurate.

The system mainly consists of hardware components that are responsible for detecting and receiving and responding to various commands. Various Sensors are used so as to make automated controls. Wireless Network is used for connecting various nodes to internet. For basic visual representation of the automated control and sharing data between different nodes as been clearly mentioned in the following flow chart diagram. The GUI is made for all three-sensor nodes and you can access it by domain of the system.

The coding is done in Arduino software and the scripting of the web application is done in Visual studio code and mobile app is implemented in android..

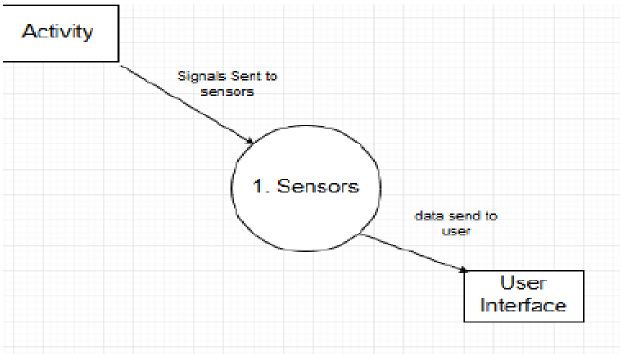

Fig 6. Proposed Model of Project

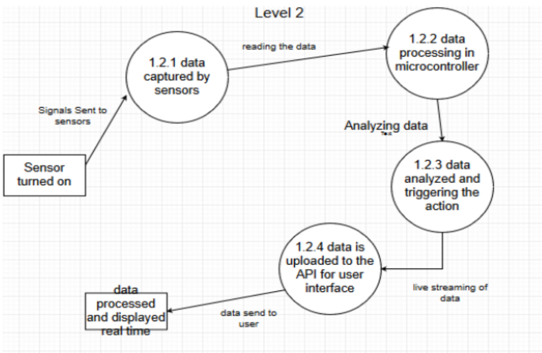

Fig 7. Working Model of Proposed System

5. Methodology of Proposed System

"Water Sprinkler" control has accomplished by deciding a beginning value at which watering must start itself. Whenever the soil moisture sensors spot moisture content earlier the beginning then the water sprinklers should started until the soil is entirely moist. Figure 5 shows the flow chart of the system

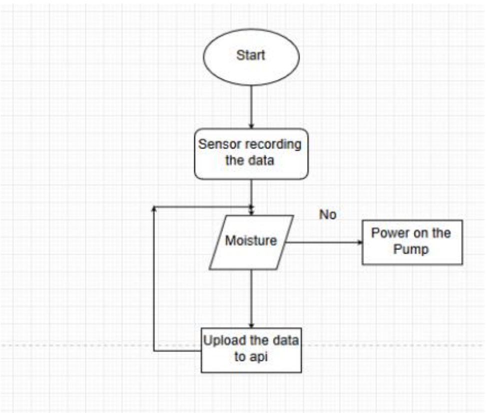

Fig 8. Flow chart of Proposed Project

It uses capacity primarily to measure soil water content (dielectric permittivity). This system can be controlled through the incorporation of this sensor in the Earth and a percentage status of the water content in the Earth can be shown. Connect the "Arduino Board" into your device's USB port and verify that the Arduino board's LED power gauge reflects with red color. Typical "Arduino Boards", the LED power reflector placed adjacent to the RESET button. An orange color light emitting diode close to the center of the board must show ON and OFF signal whenever the "Arduino Board" is switched on with the power. The "Arduino Board" originated from the workshop embedded with software to light up the light emitting diode as a general check which revels that board is in fine condition. Plug all the connection into ESP8266, check whether the light blinks or not while plugging into the USB or power sources. Open your laptop and go to connections list if the WI-FI module is coming up then it is working fine. After compiling the code on the Arduino IDE, connect the various sensors and wi-fi modules one by one to upload their respective codes. As the modules have their own microcontrollers so they need to programmed. After Uploading the code ,unplug them and provide the power sources using the batter of 9V or USB through laptop and test the hardware connections by sending small data. Testing each and every sensor individually and mapping its output so as to get accurate results at the time of implementation.

6. Result and Discussion

The working of this system consisting the software part(coding). We have done the coding of all two major nodes that are Arduino and NodeMCU. Which shows that how both the nodes communicate with each other. The hardware and software requirements of this particular system contains Soil Moisture Sensor, Wi-Fi module ESP8266, Android Application and MYSQL, etc. The readings attained from sensors permit the arrangement to make the water sprinkler switch on and switch off. The below graph reveals that moisture content of over watering soil possess much time period to lessen by ten percent as related to the moisture content of soil that is originally seventy nine percent moist. Hence, the graph curve for sensor endlessly falling curve as the moisture diminishes as time goes away.

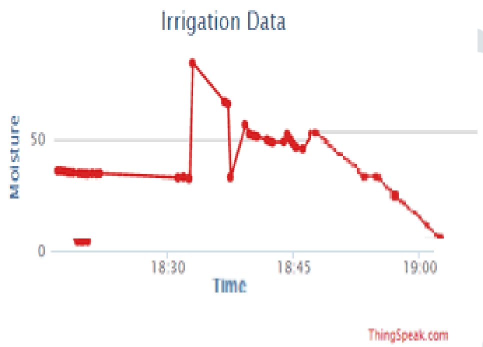

Fig 9. Soil Moisture Status Curve

7. Conclusion

In the agriculture field, the electronic sensors are utilized like soil moisture. The data obtained from the electronic sensors is transferred to the database folder through the Android device. In the control section, the proposed system is stimulated employing the application, this is terminated by enabling the switch ON or switch OFF controls in the android application. Also, the system is automatically triggered depends on the soil moisture content. In the used android application, there is a control switch to turn off the irrigation stream if the system arrangement fails. Other factors like the soil moisture sensor determines the verge price and the level of the water in the soil. From the previously mentioned information, lastly, we have accomplished that the hardware parts of this proposed system interfaces with all the sensors. The system is powered by a power source, and the system has been checked for watering an agriculture field.

8. Future Scope of Proposed System

The proposed system is a probable solution to the issues occurred in the prevailing manual and unwieldly process of watering by allowing effectual consumption of water resources and implement it as a large-scale project so as to conserve energy.

9. References

[1] Joaquin Gutierrez Jaguey et al., "Smartphone irrigation sensor", Sensors Journal, vol. 15, NO. 9, September- 2015.

[2] David Chaparro, MerceVall-llossera, Maria Piles, Adriano Camps, Christoph R¨udiger and Ramon Riera-Tatch, "Predicting the Extent of Wildfires Using Remotely Sensed Soil Moisture and Temperature Trends", IEEE journal of selected topics in applied earth observations and remote sensing, VOL. 9, NO. 6, June 2016.

[3] Joaquín gutiérrez et al., "Automated irrigation system using a wireless sensor network and gprs module", ieeetransactions on instrumentation and measurement, vol. 63, no.1, january 2014.

[4] G.nisha, J.megala, "wireless sensor network based automated irrigation and crop field monitoring system", sixth international conference on advanced computing (icoac), 2014.

[5] Aravind Anil et al., "Project HARITHA - An Automated Irrigation System for Home Gardens", 2012

[6] JunjinRuan, Peng Liao, Chen Dong., "The Design and Research on IntelligentFertigation System", 2015 7th International Conference on Intelligent Human-Machine Systems and Cybernetics.

[7] Santoshkumar and Udaykumar R.Y, "Development of WSN System for Precision Agriculture", IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication SystemsICIIECS'15

[8] Nelson Sales and Artur Arsenio," Wireless Sensor and Actuator System for Smart Irrigation on the Cloud", In Agricultural Communications Documentation Center, 2015

[9] SabrineKhrij , Dhouha El Houssaini, Mohamed WassimJmal, Christian Viehweger, Mohamed Abid, OlfaKanoun, "Precision irrigation based on wireless sensor network", IET Science, Measurement and Technology,Jan 2014.

[10] Dr. Narayan G. Hegde, "Water Scarcity and Security in India", BAIF Development ReseachFoundation, Pune.

[11] Marvin T. Batte, "Changing computer use in agriculture: evidence from Ohio", Computers and Electronics in Agriculture, Elsevier science publishers, vol. 47, 1–13, 2005

[12] Csótó, Magyar, "Information flow in agriculture – through new channels for improved effectiveness", Journal of Agricultural Informatics 1 (2), 25–34, 2010

[13] Jin Shen, Song Jingling, Han Qiuyan and Yang Yan, "A Remote Measurement and Control System for Greenhouse Based on GSM-SMS", Electronic Measurement andInstruments, 2007. ICEMI '07. 8th International Conference

[14] Indu Gautam and S.R.N Reddy, "Innovative GSM based Remote Controlled Embedded System for Irrigation", International Journal of Computer Applications Vol. 47 – No.13, June 2012

[15] R.Suresh, S.Gopinath, K.Govindaraju, T.Devika, N.SuthanthiraVanitha, "GSM based Automated IrrigationControl using Raingun Irrigation System", InternationalJournal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 2, February 2014.

[16] Karan Kansara, Vishal Zaveri, Shreyans Shah, Sandip Delwadkar, and Kaushal Jani "Sensor based Automated Irrigation System with IOT: A Technical Review",(IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (6) , 2015, 5331-5333

[17] Sumeet. S. Bedekar, Monoj. A. Mechkul, and Sonali. R. Deshpande "IoT based Automated Irrigation System", IJSRD - International Journal for Scientific Research& Development| Vol. 3, Issue 04, 2015 | ISSN (online): 2321-0613