AN IoT BASED SMART IRRIGATION SYSTEM

[1]Priyadharsnee.K, [2]Dr.S.Rathi,
[1]PG Student,[2]Professor
Department of Computer Science and Engineering ,
Government College of Technology,Coimbatore,India
[1]priyadharsnee93@gmail.com

Abstract-The Internet of Things(IoT) is transforming the agriculture industry and enabling farmers to content with enormous challenges they face. Livestock monitoring, conservation monitoring and plant & soil monitoring are the challenges where IoT can be a solution. The innovative IoT applications address the issues in agriculture and increase the quality, quantity, sustainability and cost effectiveness of agricultural production. Today's large and local farms can leverage IoT to remotely monitor sensors that can detect soil moisture, crop growth and detect pest and control their smart connected harvesters and irrigation equipments.This project aims at monitoring the soil parameters like soil moisture, temperature and electrical conductivity and automates the irrigation process. Decision making is done through microcontroller. User is acknowledged about the field when there is any deviation from the expected values via text message. Along with soil parameters, plant pest detection is also included in this project. This ensures the complete system health.

Keywords: Automated irrigation, Moisture sensor, Temperature sensor, GSM

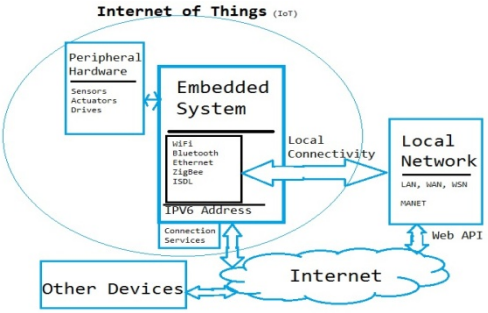
I.INTRODUCTION

Internet of Things represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various interesting purposes.Internet of Things is very quickly becoming a reality. We can see the proof of it around us. Our devices are getting smarter each day from smartphones to smart TV to smart car to Smart kitchen. Everything is now getting connected to Internet. Internet of Things (IoT) describes a network of physical objects that connect to each other through the internet. Objects, or 'things' can transfer information wirelessly without requiring human interaction. A 'thing' can be any object that can be assigned an IP address and provided with the ability to transfer data over a network.

A Thing, in the Internet of Things, can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low -- or any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network. These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices**.** Current market examples include smart thermostat systems and washer/dryers that utilize Wi-Fi for remote monitoring.

Internet of Things or IoT is an architecture that comprises specialized hardware boards, Software systems, web

APIs, protocols which together creates a seamless environment which allows smart embedded devices to be connected to internet such that sensory data can be accessed and control system can be



triggered over internet. Also devices could be connected to internet using various means like WiFi, Ethernet and so on. Furthermore devices may not needed to be connected to internet independently.

PROCESSING UNIT

Arduino , Raspberry Pi, Intel Edision, Intel Galileo , Netduino are the best IoT boards on which several applications can be executed. Every board has its own features, advantages and disadvantages over one another.

SENSING UNIT

Usually composed two sub units: sensors and analog-to-digital Converters (ADCs). The analog signal produced by the sensors are converted to digital signals by the ADC, and fed into the processing unit

IOT IN AGRICULTURE

Agriculture IoT helps in increasing crop productivity by way of managing and controlling the activities like

Crop water management - Adequate water supply is an essence for agriculture and the crops can be damaged in either of situation of excess of water supply or in shortage of water supply. In areas of drought condition, IoT can prove to be a great value as it manages the limited water supply smartly with least wastage of water resource**.**

Precision agriculture - The level of accuracy of temperature, moisture, pH of the soil affects the crop productivity to a greater extent. Higher the level of accuracy, lower would be the chances of crops being damaged.

II EXISTING SYSTEM

SMARTPHONE IRRIGATION SENSOR[1]An automated irrigation sensor was designed and implemented to use in agricultural crops. The sensor uses a smartphone to capture and process digital images of the soil nearby the root zone of the crop, and estimates optically the water contents. The sensor is confined in a chamber under controlled illumination and buried at the root level of the plants. An Android App was developed in the smartphone to operate directly the computing and connectivity components, such as the digital camera and the Wi-Fi network. The mobile App wakes up the smartphone, activating the device with user-defined parameters. Then, the built-in camera takes a picture of the soil through an antireflective glass window and an RGB to gray process is achieved to estimate the ratio between wet and dry area of the image. After the Wi-Fi connection is enabled, the ratio is transmitted via a router node to a gateway for control an irrigation water pump.

PREDICTING THE EXTENT OF WILDFIRES USING REMOTELY SENSED SOIL MOISTURE AND TEMPERATURE TRENDS [2]Recent climate trends evidence a rise of temperatures and an increase in the duration and intensity of droughts which is in turn leading to the occurrence of larger wildfires, which threaten the environment as well as human lives and beings. In this context, improved wildfires prediction tools are urgently needed. In this paper, the use of remotely sensed soil moisture data as a key variable in the climate-wildfires relationship is explored. The study is centered in the fires registered in the

Iberian Peninsula during the period 2010–2014. Their prior-to-occurrence surface moisture temperature conditions were analyzed using SMOS-derived soil moisture data and ERA-Interim land surface temperature reanalysis.

.

AUTOMATED IRRIGATION SYSTEM USING A WIRELESS SENSOR NETWORK AND GPRS MODULE[3]An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page

WIRELESS SENSOR NETWORK BASED AUTOMATED IRRIGATION AND CROP FIELD MONITORING SYSTEM[4] Wireless sensor Network based automated irrigation system for optimize water use for agricultural purpose. The system consists of distributed wireless sensor network of soil moisture, and temperature sensors placed in the crop field. To handle the sensor information Zigbee protocol used and control the water quantity programming using an algorithm with threshold values of the sensors to a microcontroller for irrigation system. The system has powered by solar panel and Cellular internet interface for data inspection. A wireless camera is fixed in crop field to monitor the disease area using image processing technique. The system is low cost and energy autonomy useful in water limited geographically isolated areas.

.

PROJECT HARITHA - AN AUTOMATED IRRIGATION SYSTEM FOR HOME GARDENS[5] The maintenance of even a small garden gets tedious at times in the urban scenario. A fully automated system which optimizes the use of energy and water resources is the need of the day. This lead to a design and implementation of a highly energy efficient, multimode control for an automated irrigation system. The system uses an in-situ soil moisture potential measurement and the programmed data to irrigate a desired area. The soil moisture content is monitored by a microcontroller-based data acquisition and distribution system. An integrated GSM module provides critical information to the user during system failure. The proposed microcontroller based system was programmed and tested for its performance.

THE DESIGN AND RESEARCH ON INTELLIGENT FERTIGATION SYSTEM[6]There exists a severe but normal problem that the crop fertilization is uneven such as over or too less fertilized and the concentration can’t be well controlled. As to this situation, an intelligent fertilization system is presented, which can realize automatic irrigation, fertilization, injecting fertilizer and mixing fertilizer. The paper introduces the system structure, design of piping system and computer control system, and three control algorithms: fertilization control algorithm, injecting fertilizer and mixing fertilizer control algorithm and system priority algorithm. The experimental result proves that this system has a good quality for EC and pH adjustment, steady performance and good practicability.

.

III. PROPOSED SYSTEM

An IoT based irrigation system is for efficient agricultural management system which enables farmers to contend

with challenges they face. There are many applications in IoT, which addresses the major problems like soil moisture detection, water conservation management, crop growth monitoring, etc., This project enables better and smarter irrigation through temperature, humidity and other sensors networked to communicate with the user. For farmers and growers, Internet of Things has provided extremely productive ways to cultivate soil with the use of cheap, easy-to-install sensors and an abundance of insightful data they offer.

SOIL MOISTURE: Soil moisture is the water that is held in the spaces between soil particles. The root zone soil moisture is the water that is available to the plants, which is generally considered to be in the upper 200 cm of soil. Moisture is fundamental importance to many hydrological, biological and biogeochemical process. The proposed system includes soil moisture measurement as the main module. Irrigation to the field and acknowledgement to the user are done based on the water content in the soil.

ELECTRICAL CONDUCTIVITY OF SOIL:

Electrical conductivity(EC) is a measurement of the dissolved material in an aqueous solution, which relates to the ability of the material to conduct electric current through it. EC is measured in units called Seimens per unit area. Higher the dissolved materials in the soil, higher the EC will be in it.

Similar to EC, pH of the soil measures the acidity of the soil based on hydrogen ion concentration in it. The pH of the soil ranges on a logarithmic scale from 1-14, where pH 1-6 are acidic, pH 7 is neutral, pH 8-14 are basic. The optimum pH range for most of the plants is between 5.5-7. Based on the pH value the soil nutrient level can be defined.

TEMPERATURE**:** Temperature is another parameter that is measured in this project. This value helps in conservation of water used for irrigation. Even though the soil moisture is less, if the temperature is not too high then the irrigation to the crop can be limited. This is because many plants can withstand low moisture conditions when the temperature is moderate

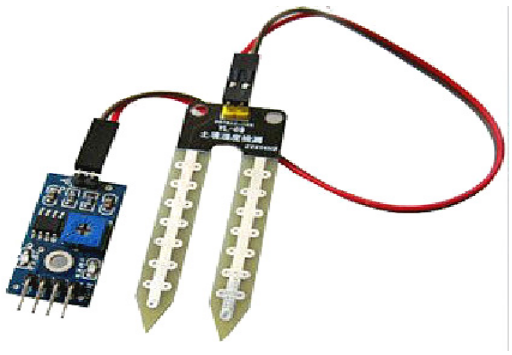
CONTROLLING UNIT: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. The board can be activated by sending a set of instructions to the microcontroller on the board. The Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing must be used for implementation.

The moisture and temperature sensed by the sensors are processed in the arduinouno microcontroller. When the values are beyond the threshold value, then the controller does the defined job.

MOISTURE SENSOR**:** Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity.

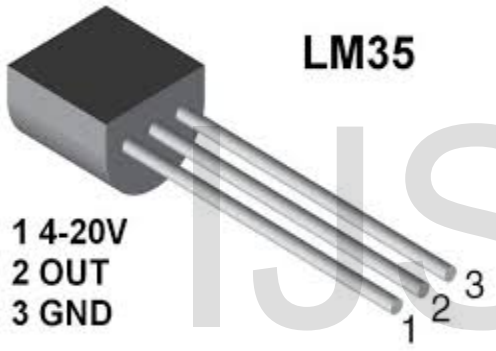
Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture.

Portable probe instruments can be used by farmers or gardeners.



soil moisture sensor

TEMPERATURE SENSOR:



LM35 Temperature sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air

GSM SIM 900 MODEM**:** The GSM standard has given birth to wireless services like General Packet Radio Service (GPRS) and Enhanced Data Rates for GSM Evolution (EDGE). Its end users were the first to take advantage of an inexpensive implementation of SMS (short message system), which is more popularly known as texting. GSM phones may be identified by the presence of a Subscriber Identity Module (SIM). This tiny object, which is about as wide as a finger, is a removable smart card that contains a user's subscription information, as well as some contact entries. This SIM card allows a user to switch from one GSM phone to another. One service that has grown enormously is the short message service. Developed as part of the GSM specification, it has also been incorporated into other cellular technologies. It can be thought of as being similar to the paging service but is far more comprehensive allowing bi-directional messaging, store and forward delivery, and it also allows alphanumeric messages of a reasonable length. This service has become particularly popular, initially with the young as it provided a simple, low fixed cost.

This project effectively uses the short message service provided by GSM to acknowledge the user about the field and crop condition.

PROJECT DESCRIPTION

An IoT based irrigation system aims to utilize the features of embedded system to make agriculture simple. Having sensors connected with controller, the system reads the soil moisture, temperature and electrical conductivity of the soil and

then the sensed data are processed in the controller.

The microcontroller is the decision maker of this system. It checks for moisture value and the temperature. initially the threshold moisture and temperature value must be defined. When the sensed moisture value goes above the threshold value, the controller checks for the temperature.Only if the sensed temperature value is higher than the threshold value, irrigation is done and the user is acknowledged. This is because all crops can withstand in the dry soil moisture condition if the temperature is moderate. This would conserve the water used for irrigation.

Sending SMS to the user about the field enables the user to remotely monitor the agriculture area. The SMS include the warning and suggestion to the affected system.

ADVANTAGE OF PROPOSED SYSTEM

- Simple and efficient
- Conserves water used for irrigation
- Accurate sensing
- Low maintenance cost
- Acknowledging user about the field

MODULES

- Parameter sensing
- Analysis and decision making
- User Acknowledgement

PARAMETER SENSING

This module deals with the sensing unit of the project, where the sensors like soil moisture sensor, temperature sensor and electrical conductivity sensor are placed in contact with the soil which is to be cultivated. These sensors are interfaced with the controlling unit via wired or wireless connections. The soil moisture sensor can measure the dryness of the soil with the maximum measure of 1023 units. This measure defines the complete dry soil. The temperature sensor can detect with the maximum of 150 degree Celsius. The EC value ranges from 1-14.

ANALYSIS AND DECISION MAKING

Based on the sensed values, decision is made by the microcontroller. As an initial step, the software for the controller must be configured. Before reading the analog inputs from the sensors, the threshold values for each parameter must be predefined. The moisture threshold value is set to 800 units in this project. The threshold temperature value is 24 degree Celsius. The EC value ranges from 5.5 to 6.5 units. These values are defined by complete analysis of the soil in prior.

The sensors are connected to the respective pins of the arduino microcontroller. The software implementations includes simple coding in C language. The controller first checks for the moisture value. When the moisture goes above 800, then it checks for the temperature. When the temperature is below the threshold value it means that plant can sustain for few more days without water. But if it goes above the threshold value, the plant must be irrigated.

USER ACKNOWLEDGEMENT

User acknowledgement is included as a module in this project. This enables the user/farmer to have complete awareness about the field and cultivation. This project is mainly useful for farmers who depend on labours to cultivate the land. They need not visit their land often. Instead they can use this smart project and get useful suggestions and warnings about the field.

GSM communication is used for sending the text message to the farmer's mobile phone. GSM SIM900 module is used in this project for acknowledging the user. Any GSM module type can be used based on our requirements. It uses AT commands for sending the message. It also

enables two way communication where the user can reply to the system.

When there is low moisture and high temperature, the GSM sends a message to the user about the condition and requests for irrigating the plant. When the EC value goes beyond the range, the fertilizers for improving the soil nutrient is also suggested in the text message.

IV. IMPLEMENTATION

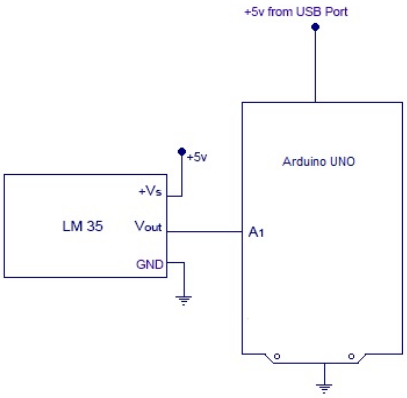
HARDWARE CONNECTIONS

The proposed system involves many sensors and controlling unit. They all must be integrated in such a way that the performance is not affected for any cause. Any wrong circuit connection may lead to failure of the entire system.

The soil moisture sensor and the Arduino uno board is interfaced as follows.Moisture sensor consists of four pins, Analog and digital pin, vcc and ground.

It operates at the voltage of 5V. The analog pin is interfaced with any of the analog input pins in the arduinouno board. The sensor is then placed in the soil for sensing the moisture content.

The temperature sensor LM35 is interfaced with the controller in the same way as the moisture sensor. LM35 has three pins, one for voltage, one for ground and other for analog input read. The voltage of 5V is required for its effective functioning. The following figure provides the circuit connection for the LM35 and Arduino interface.

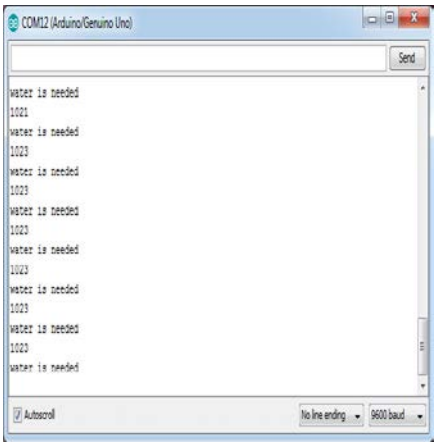


LM35 temperature sensor interfaced with Arduino

SOFTWARE IMPLEMENTATION

The software implementation requires the Arduino software IDE to be installed in the system. Microcontroller involves simple coding that can uploaded into the board for execution. Here is the screenshot of coding that was uploaded into the Arduino Uno board for soil moisture sensing.

The threshold moisture value is defined to be 800. When the sensed moisture is greater than 800, it means the moisture is low and the soil must be irrigated. When the sensed value is less than 800, it means the soil has enough water



Sensor value when soil is completely dry

V.CONCLUSION

This project presents the design of an IoT based automatic irrigation system. The proposed system can reduce the efforts of farmers and provides high yield. It also conserves water for irrigation by locating the sensor at the right position above the soil level. This work have shown that plants can still sustain at low moisture level when the temperature is moderate. Analysing more than one parameter has made this system an efficient one for managing the field.

VI.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.