Smart Irrigation using Internet of Things in Farming

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Abstract— Agriculture plays a vital role in the development of an agricultural country. Issues concerning agriculture have been always blocking the development of the country. Usually farmer needs to check soil moisture level of the land, he has to keep a watch on weather. This paper will help to irrigate the farmland in a hasty manner with the help of smart phone in which farmers will get an android application which will notify soil moisture level, temperature, humidity of the farm and also will help farmer control the irrigation of the farmland. A system hardware consist of Arduino Uno, temperature sensor, soil moisture sensor, so that system can sense soil moisture levels and temperature with the help of sensors and then will analyze it. Analyzed data will be display on android application as a result and actions can be taken.
Key words: Arduino Uno, Android, Irrigation, Soil Moisture

I. INTRODUCTION

Agriculture is the unquestionably the largest livelihood provider in India. With rising population, there is a need for increased agricultural production. In order to support greater Production in farms, the requirement of the amount of fresh water used in irrigation also rises. Currently, agriculture accounts 83% of the total water consumption in India. Unplanned use of water inadvertently results in wastage of water. This suggests that there is an urgent need to develop systems that prevent water wastage without imposing pressure on farmers.

Over the past 15 years, farmers started using computers and software systems to organize their financial data and keep track of their transactions with third parties and also monitor their crops more effectively. In the Internet era, where information plays a key role in people's lives, agriculture is rapidly becoming a very data intensive industry where farmers need to collect and evaluate a huge amount of information from a diverse number of devices (eg., sensors, faming machinery etc.) in order to become more efficient in production and communicating appropriate information.

With the advent of open source Arduino boards along with cheap moisture sensors, it is viable to create devices that can monitor the soil moisture content and accordingly irrigating the fields or the landscape as a when needed. The proposed system makes use of microcontroller ATMEGA328P on arduino Uno platform and IOT which enable farmers to remotely monitor the status of sprinklers installed on the farm by knowing the sensor values thereby, making the farmers' work much easier as they can concentrate on other farm activities

II. LITERATURE SURVEY

In [1] A Remote Measurement and Control System for Greenhouse Based on GSM-SMS the proposed system introduced a GSM-SMS remote measurement and control system for greenhouse based on PC-based database system connected with base station. Base station is developed by using a microcontroller, GSM module, sensors and actuators. In practical operation, the central station receives and sends messages through GSM module. Criterion value of parameters to be measured in every base station is set by central station, and then in base stations parameters including the air temperature, the air humidity.

Indu et al. [2] mainly focuses on reviews in the field of remote monitoring and control, the technology used and their potential advantages. The paper proposes an innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system sets the irrigation time depending on the temperature and humidity reading from sensors and type of crop and can automatically irrigate the field when unattended. Information is exchanged between far end and designed system via SMS on GSM network. A Bluetooth module is also interfaced with the main microcontroller chip which eliminates the SMS charges when the user is within the limited range of few meters to the designated system. The system informs users about many conditions like status of electricity, dry running motor, increased temperature, water content in soil and smoke via SMS on GSM network or by Bluetooth.

In , R.Suresh et al. [3] mentioned about using automatic microcontroller based rain gun irrigation system in which the irrigation will take place only when there will be intense requirement of water that save a large quantity of water. These systems bring a change to management of field resource where they developed a software stack called Android is used for devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system. These system covered lower range of agriculture land and not economically affordable.

In [4] IOT SMS alarm system based on SIM900A , an IOT alarm system based on SIM900A module of SIMCOM Company was designed for greenhouse. The system can gather environmental parameters such as air temperature and air humidity. Meanwhile, with the use of AT command, this system can also realize SMS automatic sending and receiving, environmental parameters overrun alarm and insufficient balance alarm. Through the system setting, the alarm message can be sent to the user-specified mobile phone automatically no matter what the users' location is. This system as a typical application of IOT in the agriculture has got some satisfactory results in the actual operation

III. HARDWARE

A. Arduino

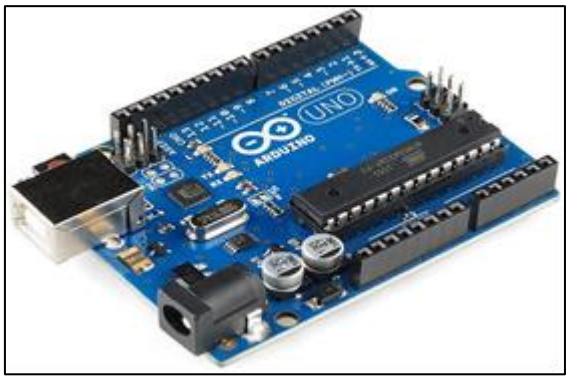

Fig. 1: Arduino Uno Module

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards and other circuits. The boards feature serial communications interfaces, including USB on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

B. Soil Moisture Sensor

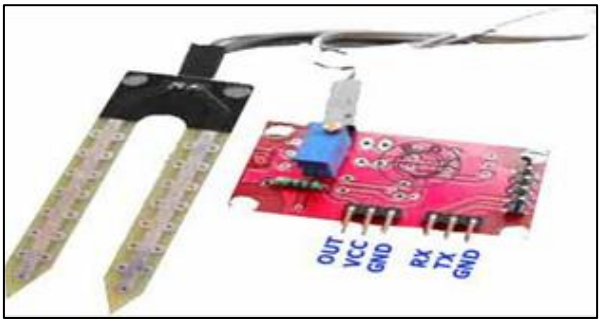

Fig. 2: Soil Moisture Sensor

This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, and else the output is at low level. By using this sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique. Module triple output mode, digital output is simple, analog output more accurate, serial output with exact readings.

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons.

Soil moisture content may be determined via its effect on dielectric constant by measuring the capacitance between two electrodes implanted in the soil. Where soil moisture is predominantly in the form of free water (e.g., in sandy soils)

C. DHT 11 Temperature & Humidity Sensor

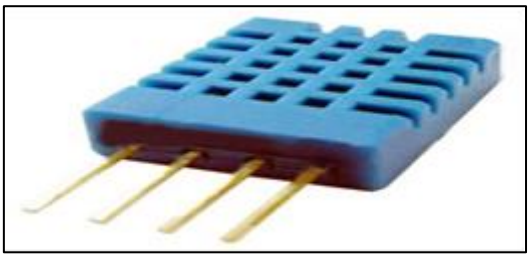

Fig. 3: Temperature & Humidity Sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

IV. SYSTEM DESIGN

A. Wireless Sensor Units (WSUs)

Each WSU has one soil-moisture and one soil-temperature sensor inputs. The node takes the soil moisture and temperature data periodically after every minute. The interfaces of WSU consist of: Sensor Interface, power relay interface. These interfaces work in on board designed using Atmega328 microcontroller. The Sensor Inter- face receives data from the temperature sensor and soil-moisture sensor, the both sensor signals in Volts are read via Analog Input pin. We can convert the temperature value in Volt into degree Celsius and moisture into percentage. As per the soil data WSU itself control the irrigation automatically. If the signal came from coordinator node to make the irrigation ON/OFF controller take the action as per coordinator signal in manual mode.

B. Data Gateway (Coordinator)

It is the central base station of the irrigation system. The data from multiple WSUs is revived wirelessly, identified each

WSU data, separate it and stored in data base in tabular form. The database is created on the server by using the Thingspeak application. One its own server can serve HTML files over HTTP, and with additional modules can serve dynamic web pages using scripting languages such as PHP. It can sends the signal to WSU to make the irrigation ON/OFF in manual mode

C. Communication Module

WSN was selected for this battery operated sensor network because of its low cost, low power consumption, and greater useful range in comparison with other wireless technologies. The devices operate in industrial, scientific, and medical 2.4-GHz radio band and allow the operation in a so called mesh networking architecture. From a wide range of commercial Zigbee devices, the Xbee-PRO is an appropriate original equipment manufacturer module to establish communication between at WSU and the Gateway because of its long-range operation and reliability of the sensor networking architecture. The Xbee-PRO is an RF modem with integrated chip antenna, 20-pins, and 13 general purpose input/output (GPIO) ports available of which four are ADC. It can operate up to a distance of 1500 m in outdoor line-of-sight with 170 mA of TX peak current and 45 mA for RX current at 3.3 V and power-down current of 3.5 A. The XBee radio modem of each WSU is powered at 3.3 V through a voltage regulator and interfaced to the host microcontroller through its serial port, a logic-level asynchronous serial, and voltage compatible UART configured at 9600 baud rate, no - parity, 1 - start bit, 1 - stop bit, 8 - data bits. The WSUs were configured such as end devices to deploy a networking topology point-to-point based on a coordinator that was implemented by the XBee radio modem of the Gateway. The least significant byte of the unique 64-bit address is used to label the information of the soil moisture and temperature for each WSU in the network. This byte is registered in the Gateway as the identifier (ID) associated to each WSU.

D. Android Application

In existing irrigation system we saw that user has to present at the field to know the status of irrigation and soil data. To over- come to existing system graphical user interface is developed to monitor the current status of irrigation system. This application permits the user to see the status of the sensors and irrigation remotely by using any Internet access devices. This feature of the system is allowed an authorized user to control the water scheduling in data gateway according to crop and season. All the information is stored in the database.

V. CONCLUSION & FUTURE SCOPE

Thus the AUTOMATIC IRRIGATION SYSTEM has been designed and tested successfully. The automation of an irrigation system will reduce the gap between requirement and consumed energy and further conserves the resources thereby reducing the wastage of resource. Soil moisture and temperature sensor gives the best combination conditions for irrigation. Using this system a farmer can save his precious time and can get more crop yield.

In the present era, the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals. Moreover in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence we require an automatic system that will precisely monitor and control the water requirements in the field. Installing plant irrigation system saves time and ensures judicious usage of water. Moreover this architecture uses microcontroller which promises an increase in system life by reducing power consumption. The system components are readily available, relatively affordable and they operate quite reliably. This system will not only conserves the natural resources but also will give a splendid boost to the production of crops which is one of the main aim of developing this system. Hence will have grate saving of irrigation water, stronger, healthier plants and stable and high yields

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