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Research paper



Wireless network based smart irrigation system using IOT

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Abstract

The Internet of things generally as IoT is a concept of sharing the network between different network objects through internet connectivity. The main objective of this project is to help the agriculturists during the irrigation process. IoT plays a major role in the grazing fields. The Smart irrigation system minimizes the wastage of water and helps farmers for successful usage of the water and besides the crop development. In the proposed paper we are describing an efficient system of irrigation to minimize the consumption of water in the. This in turn grants a remote control mechanism to monitor the process of irrigation. This irrigation process is automated only if the moisture, Temperature levels of the field falls below the reference value. The notifications that are retrieved by the sensor are sent to farmers mobile at a given period of time. The farmers can get SMS about the condition of the soil (whether soil is dry or wet) based the dryness of the soil. The farmers can easily operate the motor and can easily monitor all the operation in the fields. This intelligent Irrigation system's efficiency is greater than 90% when compared with traditional method. Hence the designed system will provide the complete readings of the content of humidity in the soil and the timely records the temperature as well. This recorded data helps the farmers to inspect the proper functioning of the system and to supply the water into the field in the proper proportions.

Keywords: *Soil Moisture; Temperature; Humidity; Sensors; Internet of Things.*

1. Introduction

As India being an agricultural country and many people depend exclusively on agriculture, it is absolutely important to increase production of crop. [1] Now it's the time to get the rapid improvement of highly specialized greenhouse vegetables in the food production mechanism as the demand of food has been increasing. This method provides a major benefit and ease of production for the countries like India, where the major part of the economy is based on the irrigation. The above method gives maximum profit and also saves time and human effort. The climate conditions do not give much impact as the moisture level of the soil can be adjusted. The objective of this work is to control the flow of water to the fields through the mobile phone. These entire processes can be implemented using microcontrollers & sensors. The moisture sensor is used to detect the moisture in the soil. Those sensors are connected to the microcontrollers which are ARM-based and are also helpful in the data processing. ARM processors are widely used in the many kinds of electronic devices. As ARM being a RISC processor (Reduced Instruction Set Computer) it needs only fewer instructions while compared to other processors.. The smaller size of ARM processors is very effective in terms of power consumption and also reduces instruction complexity and increases the performance.

The primary goal of this project is to send a short messaging service (SMS) for farmers as regards the irrigation of divergent lands for on and off conditions [3]. This system further supports the mineral deposit management decision which helps to determine the execution time of the process. Automated irrigtion system contains an application which is automated with a devices present in the soil, and does not involve manual effort. [3] This expected system helps to control and, therefore, to minimize the workload of the farmer by irrigating the ground respecting water requirements. We added sensors to monitor humidity, temperature and content of moisture in the soil. As part of this system, we can apply water-soluble fertilizers along with drip irrigation [8]. Therefore the proposed system also reduces the use of water and fertilizers, since it applies fertilizers and water directly to the root area, which in turn saves the usage of fertilizers and water significantly.

2. Problem statement

The primary purpose of this work is to minimize the problems and disadvantages faced by all farmers in the agriculture sectors. There have been multiple problems that cause soil fertility and crop productivity to decrease. Another important problem faced by the farmers during irrigation is the availability of water for irrigation. In India there are many regions where sufficient amount of water is not available for the farmers during the cultivation of crop. This causes farmers to stop cultivation. Because of these issues, most the farmers are committing suicide. As there is huge increase in the population in every region of the country, probably there will be huge demand of food that is proportional to the agriculture. Now we can strengthen capital based on the theory that the "productivity of existing land does not decrease". The CSWI (crop water stress index) was existed everywhere before the past three decades. To tell us when to irrigated with drip irrigation CSWI was packaged with surrounding air temperatures.

Different types of communication mechanisms have been implemented to provide the communication between the elements in the network and network itself. Zigbee, WI-FI, Bluetooth, RF are the existing Communication technologies that are used in the sensor network. RF technology is chosen rather than other technologies because it provides the low cost and lower energy consumption. The smart internet-based irrigation program is the solution to all the problems mentioned above.

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3. Literature review

There is an in-numerous amount of analyses and development in the grazing path and it is growing together at great speed. Possible irrigation becomes a space for professional analysis within the IoT. [6] In the proposed system we are focusing specifically on the problem in the field of cultivation The problems includes controlling the amount of water supplied to the crop, monitoring soil moisture and soil pH value. Here, we are also considering the fertility of the soil. We can implement the soil moisture device within the soil to notice the humidity inside the ground. But as a primary measure we should always have a lot of information on the types of soil and also the amount of water required for this. With this in mind, we will induce these sensors. Nowadays, the most appropriate and the better method to irrigate the field are to use drip irrigation. [8] The above method is extremely convenient as it reduces water waste and increases soil fertility. Another major problem faced during the irrigation is soil erosion caused due to due to the traditional approach; there are many possibilities for soil erosion. Another appropriate parameter that will be projected for irrigation is the evapotranspiration rate of the plant. Shortened as ET, evaptranspiration, is the base transpiration speed of the plant that believes in humidity, temperature, plant density, wind, speed, etc.

4. Proposed system

The proposed system- "crop monitoring in wireless sensor networks" is useful for agricultural workers to maintain accuracy in agriculture. [5] The application helps to control the entire company in a remote location via IOT. [4] The application working in the sensor network consists of wide verity of nodes. The sensors nodes are fixed either at the root of the crop or inside the soil for varied purposes like collecting the values of the ambient and soil parameters. These parameters include light, humidity, soil moisture and temperature. The application that monitors crop contains two sensors: for example an image sensor and a compiler of environmental parameters. These sensors get information on the crop, soil condition, extract the readings of recorded soil moistures etc. and all this data is copied to the cloud storage connected to the database through wireless transmission. This information is stored in the primary database and then transferred to the Internet which is then received by the users. All the processing is done at the server side only. The Internet application is configured to analyze the received data and to check the humidity and temperature threshold. The process of decision making is done on the side server for automatic irrigation of the rig. If the recorded soil moisture is less than a specific threshold, the motor will be switched ON and if the threshold increases, the motor switches OFF. This approach can also be used in greenhouses where light intensity can be controlled and automated. The complete design of the system is shown in Fig. 1. In the given diagram we can clearly seen how the components of the system is interconnected to each other through wireless connection. All the required sensors are established and connected with the Arduino Microcontroller. [2] It is very important to maintain the proper security measures to the Databases which holds the record of the all the data such as the temperature, soil moisture and also the water level which are later given to the user through the SMS. There should be some Data Processing and Decision Making in the Databases and also automation in irrigation.

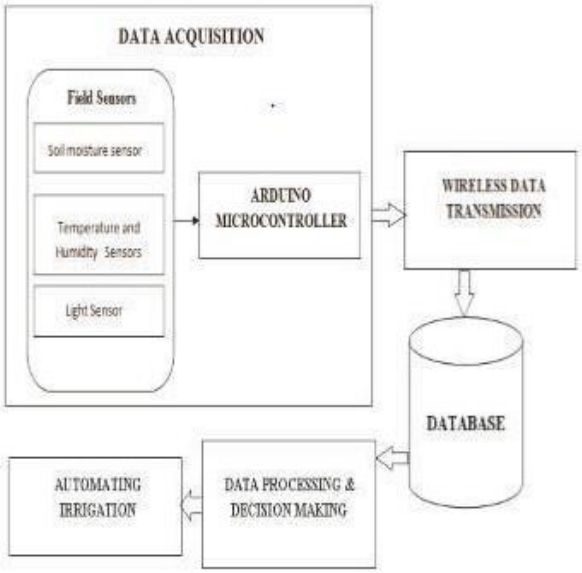

Fig. 1: System Design.

5. Working principle

The work profile is implementing an automatic irrigation system together with the detection of soil moisture using soil moisture sensor. The function of the entire model is as follows: The soil's moisture is measured with the help of the soil moisture sensor which is interposed inside the soil. The soil moisture device is useful for measuring soil conduction. As we all know, wet soil can have a larger conduction of dry soil, the comparator is it integrated in it. The voltage generated by the teeth and also the voltage of the threshold zone unit is compared. If the comparator's output is high, then we need to consider that the ground conditions are dry. The sensors send all its data to the microcontroller through which the sensors are connected.

The purpose of the microcontroller is to monitor the data received by the sensors (output of sensors) without interruption. If the amount of moisture recorded on the ground is greater than the edge, the microcontroller displays a message that mentions the constant data and the motor also switches off. Once the output obtained from the soil moisture device is recorded bit high, then it ends up by displaying the message as soil moisture is a smaller amount. Therefore, it shows the corresponding knowledge and also the output of the microcontroller in the alphanumeric screen, which is connected to the bottom of the semiconductor unit. [7] Every soil has different thresholds of soil moisture. Since the sensor continuously detects the soil moisture the motor is automatically turned on/off when the threshold is low or high. This system is also designed to avoid the risk occurring to the plants when the soil is not getting the corresponding threshold of moisture and if the soil is being wet frequently

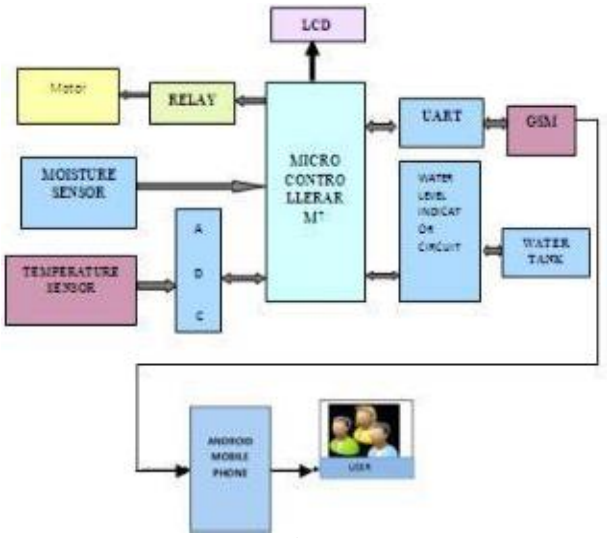

Fig. 2: Block Diagram of Irrigation Control System.

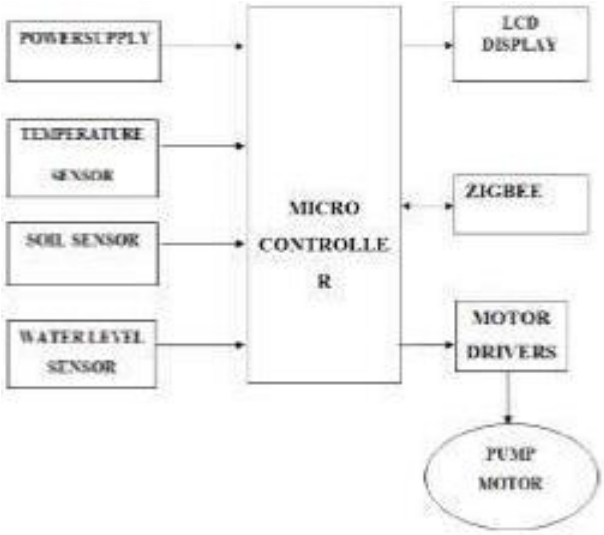

Fig. 3: Wireless Sensor Unit.

5.1. GSM module

[9] GSM/GPRS Modules are most popularly used in embedded systems as communication module .The GSM module is a device which is used in many of the IoT application [2]. It is like a modem which works on the sim card and only works after taking the subscription from that particular mobile operator. This Module provides the communication between a microcontroller and itself.



Fig. 4: GSM module.

5.2. Humidity / soil moisture sensor

The Soil Moisture Sensor's purpose is to measure the content of water in the soil [4]. This sensor serves widely in the sectors like Horticulture, Agricultural sciences, Biology and botany. This sensor regains its strength through capacitance in order to measure the content of water present in the soil. The farmer simply arranges this sensor in the soil. Once the sensor starts functioning it returns the volume of water present in that respective soil in the units of percentage. In both large and small scale modeling of agriculture, the working of the system depends on content of moisture in the soil. Crops always depend on the water moisture available near the roots rather than the precipitation occurrence. We use soil moisture sensor to accomplish the purpose of getting moisture information which is the key to the system. The Soil moisture sensor has two terminals which can be used to pass electrons using soil moisture as the medium. The moisture in the soil is determined by the ratio of the electrons and accordingly the motor is turned ON and OFF for the irrigation.

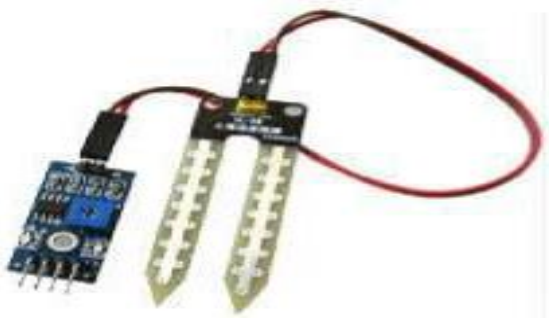

Fig. 5: Soil Moisture Sensor.

5.3. ZigBee module

In this current communication world, there are many high speed data communication standards available, but none of them were able to meet the communication standards of sensors and control devices. The communication standards which are at high data rate needs lower latency and low level of energy even at low-bandwidths.

So in-order to overcome the difficulties faces due to communication standards that are of high data rate we used the Zigbee technology in this system. [9] Zigbee technology consumes low power and is excellent in characteristics and also this serves as a key point to use Zigbee technology in most of the embedded systems. Zigbee Module comes under the 802.11 standards. The range in which the Zigbee module is operated lies in the range of 2.4GHz frequency bandwidth. Zigbee module can also be used for its one good property that is it has the power saving mechanism. It can be used for all the different classes of devices. Various transmission operations like broadcast can be done by using this and the standard topology used is multiple star topologies.



Fig. 6: Zigbee Module.

5.4. Motor

Motor is used to indicate the on/off state of pump when soil is wet/dry. It is controlled by microcontroller as programmed.

5.5. LCD

This is the first interfacing example for the Parallel Port. It is used to display the current statistic on the screen.

5.6. Power supply

Power supply of 12V is used for running this hardware system. Reference Voltage. It is the ideal defined voltage.

6. Advantages

- Improves growth.
- Saves water.
- Discourages weeds.
- Adaptable.
- Saves time.
- Reduces the manual effort for closing or opening valves time-to-time.
- This system adapts the new technologies and also facilitates the advanced irrigation system that reduces complex manual effort.
- This system can be operated at all the time to reduce the wastage of water.
- This system optimizes the consumption of energy by starting and stopping the irrigation process accordingly.

The system is absolutely effective in power consumption & the component used in the hardware. [6] This model is more helpful in minimizing the usage of water in the fields so that there is an availability of water every time for other purposes like electricity generation, our daily needs etc. By implementing this system in the countries which are rich in agricultural domain shows the major benefit. GSM technology helps user to control the motor remotely from any place within the range of the used components by simply sending SMS. This system mainly reduces the work of farmer since lot of manual work is being done by them in the farms now-a-days. Thus this model will give lots of relief to the farmers therefore it can reduce the effort of humans. Since the model is eco-friendly and it has various characteristics such as: The farmer can use this automatic system or he can operate the facilities manually by switching between the two modes.. Since there are different methods for each agriculture field all over the India therefore the system should be able to do the same work in everywhere. Since this model is convenient for all types of irrigation & to all climatic conditions.

7. Results and conclusion

This automatic irrigation system is proposed to introduce the technology of embedded systems into the agricultural sector. The designed system provides the readings of content of humidity present in the soil and also records the atmosphere's temperature. This system reduces the manual effort done by the farmers and makes the farmers work easy. It overrides continues monitoring of irrigation by the farmer with the automatic irrigation process. This makes the farmers to save effort, time and also produces more crops. As a result this system increases the economic condition of the farmers and gives comparatively more profit.

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