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Internet of Things (IOT) based Automatic Irrigation System using Wireless Sensor Network (WSN)

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Abstract:
A resource that all living species need is Water. It is therefore very precious and for enhancing agricultural productivity it is the critical input. Therefore expansion, of irrigation has been a key strategy in the development of agriculture in country. Today, farmers have several issues in agriculture due to lack of rains and scarcity of water. The main motto of this paper is to save time, money and power of farmer with an automatic irrigation system. Manual intervention is required for the traditional farmland techniques. Human intervention can be minimized with the automated technology of irrigation. By using soil moisture sensor levels of soil moisture/humidity can be checked. Whenever there is a change in humidity/moisture in the soil this sensor senses the change and an interrupt signal is passed to the micro-controller and depending on this the irrigation system works. The automated irrigation system provides a web interface to the user so that the user can monitor and control the system remotely i.e., can make the irrigation system ON and OFF remotely.

Keywords:
Wireless Sensor Network; IoT; irrigation.

Introduction:
Agriculture Sector is the major source of income for the economy of a nation and 70% of farmers and common people depend on the Agriculture.

Artificial application of water to the soil for assisting in growing crops is known as Irrigation. For agriculture productivity process it is critical input and pivotal in agricultural, social and economic growth of the nation [1]. Most of the irrigation systems are operated manually. These antiquated techniques are replaced with semi-automated and automated techniques. Ditch irrigation, drip irrigation, terraced irrigation and sprinkler system are the available traditional techniques. Based on increased demand for higher agricultural productivity, poor performance and decreased availability of water for agriculture the global scenario of irrigation is categorized. By using an automated system for irrigation the above problems can be rectified.

The systems require more human intervention and are time consuming. So a modern technology is required to resolve the problem and should support for better Irrigation Management. For this we can have a system which is “Internet of Things (IoT) based Automatic Irrigation System using Wireless Sensor Network (WSN)”. WSN has the ability of communication, computation and sensing. A bridge between the real physical world and virtual worlds can be provided with WSN. It has a wide range of applications in home automation, civil infrastructure, science, security and agriculture.

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A. Need of Automatic Irrigation System:

- It is easy and simple to install and configure.
- It saves energy and resources, so that they can be utilized in a proper way.
- By automating farm farmers would be able to smear the right amount of water at the right time.
- Avoiding irrigation at the wrong time of the day, reduce runoff from overwatering saturated soils which will improve crop performance.
- Automated Irrigation System makes the motor ON and OFF.
- Motors can be automated easily by using controller and no need of labor to turn the motor ON and OFF.
- Elimination of human error in adjusting available soil moisture levels.
- It is time saving.

Internet of Things (IoT):

The internet of things collect and exchange data which is a network of vehicles, buildings, physical devices and other items embedded with sensors, electronics, software and network connectivity [2] . IoT creates opportunity for more direct integration of the physical world into computer based systems which results in accuracy, efficiency and economic benefit. An IP address is used as a unique identifier by devices for integration with the internet.

Applications of IoT include Environmental Monitoring – monitors soil and atmospheric conditions with sensors for environment protection. Transportation – includes smart traffic control, smart parking. Infrastructure management – monitors and controls the infrastructures such as railway tracks, Medical and Health Care Systems – emergency notification systems and remote health monitoring can be enabled.

Block diagram

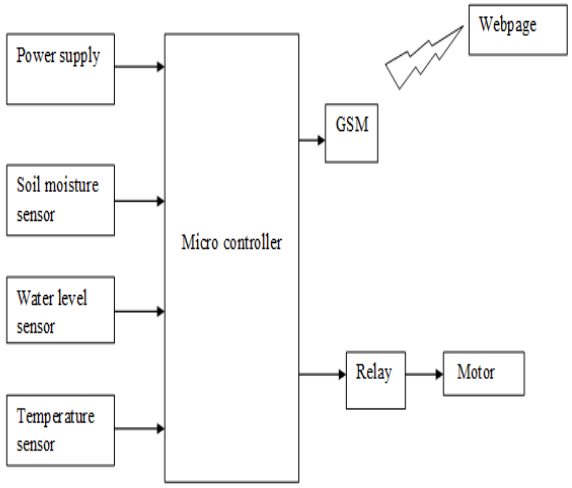

Fig1: Block Diagram of Automatic Irrigation

1) Micro-controller:

In this ATMEGA8 is used as a micro-controller. The automated irrigation system is controlled using ATMEGA8. The Irrigation system is programmed via micro-controller to give interrupt signal to the irrigation system depending on the soil moisture levels.

2) Power Supply:

A power supply is a device that supplies electric power to electric load. The term is most commonly applied to electric power converts that one form of electrical energy to another, it may also refer to devices which converts other form of energy (chemical, mechanical, solar) to electrical energy [3] . The output voltage or current to a specific value can be controlled by a regulated power supply; the controlled value is held nearly constant despite variations in either voltage supplied or load current by the power supply's energy source.

3) Sensors:

a) Soil Moisture Sensor

It is an electrical resistance sensor. The sensor is made up of two electrodes. Soil moisture sensor reads the moisture content which is present around it.

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A current is passed across the electrodes through the soil and the resistance will be low and thus more current is passed through. The sensor module outputs a high level of resistance when the soil moisture is low. It has both digital and analog outputs. Digital output is simple to use, but it is not as accurate as analog output.

b) Water level sensor

Level of substances that can flow can be detected by using level sensors. Substances include granular material, slurries, powders and liquids. Level measurements can be done inside containers or it can be the level of a lake or river. These measurements can be used to determine the flow of water in open channels or the amount of materials in a close container.

c) Temperature sensor

Here LM35 is used as a temperature sensor. It is an integrated circuit sensor which can be used to measure temperature with an electrical output proportional to the temperature. LM35 generates a higher output voltage. It is used to measure the surrounding temperature.

4) Relay:

Relay is an electrically operated switch. These are used where there is necessary to control several circuits by one signal or by a low power signal. A relay which can handle the high power required to directly control an electric motor or other loads is called as contactor. To perform logical operations these were used in early computers and telephone exchanges.

5) GSM:

For digital cellular communication GSM is a globally accepted standard. It is based on Time Division Multiple Access (TDMA) technique and a second generation cellular standard developed for data delivery and to cater voice services using digital modulation.

Specifications of GSM are:

Frequency bands:

GSM 900:

- 890 - 915 MHz: Uplink
- 935 – 960 MHz: Downlink

GSM 1800:

- 1710 – 1885 MHz: Uplink
- 1805 – 1880 MHz: Downlink

- Carrier Bandwidth: 200KHz
- Channels/carrier : 8
- Modulation data rate: 270.833Kbs

6) Web Page:

A web page is a web document that is suitable for the web browser and World Wide Web. The language used here is PHP. It is a server side scripting language designed for web development. PHP code may be embedded into HTML code or it can also be used in combination with various web frameworks, web content management, web template systems. In the web server PHP code is processed by PHP interpreter. In web page the values regarding soil moisture and temperature are displayed. By web page user can make the irrigation system ON and OFF remotely.

Operation

Algorithm:

The following steps are followed in automatic irrigation system.

Step 1: Begin the process.
Step 2: The initial power is supplied to GSM.
Step 3: Check soil moisture level.
Step 4: If soil moisture content is greater than a fixed value, then there is no need of irrigation.
Step 5: If the soil moisture content is less than a fixed value, then start irrigation.
Step 6: When the water reaches the prescribed point of water level sensor then the irrigation system stops itself.
Step 7: User can operate the system remotely through a web page.

Experimental results

Irrigation system is based on the soil moisture and temperature. Sensors are placed in the farm. Distance between the two sensors is based on the type of soil in

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farm. Micro-controller and sensors are used for capturing the moisture content in soil. Depending on the moisture content present in the soil, irrigation system works. Soil moisture and temperature values are displayed on the web page using PHP script. Sensor data is stored in the cloud. By Uniform Resource Allocator (URL) user can access the web page and by this user can monitor and control the system.

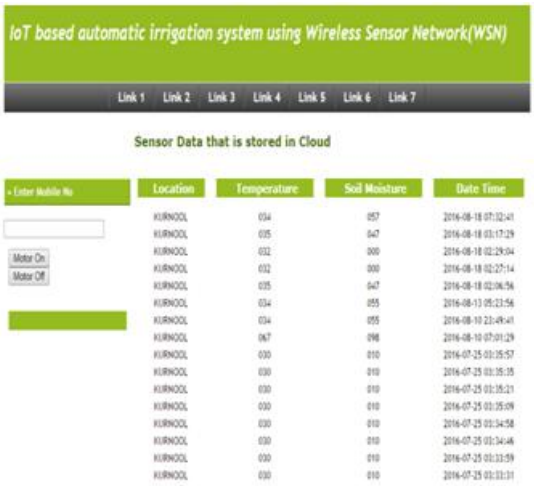

Fig2: Web Page Displaying Soil Moisture and Temperature values

User can make the motor ON and OFF remotely using a web page. The values of soil moisture and temperature can be sent to the user through SMS also.

Fig3: Temperature and Soil Moisture values through SMS

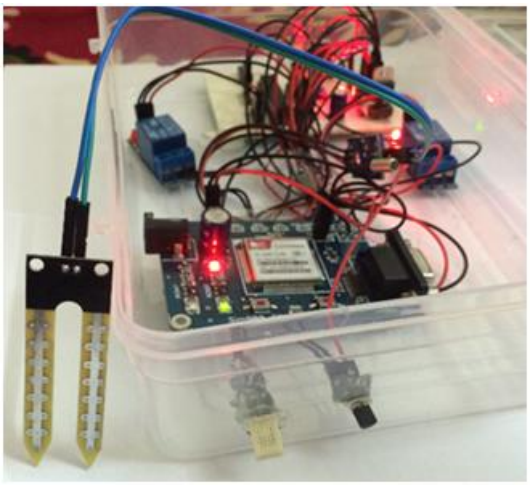

Fig4: Sensors Equipped With Micro-Controller

Water level sensor, soil moisture sensor and temperature sensor are the three different types of sensors which are present in the automated irrigation system. In callback URL when user sensors send information through SMS it will automatically call URL. In this page the logic to store the data in cloud should be written and to store the data a table should be created in cloud.

Fig5: System Set-Up

Conclusion:

This system provides several benefits and can be operated with less manpower. Over-watering and under-watering affects the crop so proper amount of water should be supplied. By analyzing the soil parameters system waters the farm. So by this wastage of water can be reduced.

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Soil moisture and temperature values are displayed on a web page using PHP script. These values can also be sent to the user through SMS. Through web page user can make the irrigation system ON and OFF remotely depending on the values of temperature and soil moisture. With the help of automation and web interface user can easily monitor the system and due to this human intervention is minimized. This system saves water and improves the growth of plants.

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