Smart Irrigation System Using Internet of Things

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***Abstract*— An automated irrigation system was developed for optimized usage of water in agriculture. The system has a distributed wireless network of soil moisture, humidity and temperature sensors placed at the root zone of plants. A centralized unit handles sensor information, triggers them and transmits data on the internet so the user can monitor the field in real time from any remote location. A mechanism was developed depending on the threshold values of the soil moisture, humidity and temperature and is programmed into the control unit to control the quantity of water fed to the irrigation field. Sensing unit and central control unit are connected with each other via a wireless link. Because of low energy consumption and cost, the system has potential to be useful in water-limited geographically isolated areas.**

Keywords—Smart irrigation, Dynamic System, Arduino, Automatic Irrigation System, Internet of Things

I. INTRODUCTION

As our country is an agriculture-oriented country and the rate at which water resources are depleting is a dangerous threat hence there is a need of a smart and efficient way of irrigation. This project is designed to develop an automatic irrigation system which controls the pump on sensing the moisture content of the soil. In the field of agriculture, use of the proper method of irrigation is important. The main advantage of this project is to reduce human intervention and still ensure proper irrigation.
This mechanism contains a control unit that receives the signal of varying moisture content in the soil through the sensor arrangement. Once the controller receives this signal, it generates an output that drives a relay for operating the water pump. The status of the soil is transmitted over the internet. The sensing arrangement is made by using soil moisture sensor.

The system has a network of soil moisture sensor and a temperature sensor placed in the root zone of the plants. A microcontroller handles sensor information; triggers pump and transmit data to the control unit. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller to control water quantity. This unit is powered by photovoltaic panels and has a wireless communication link with the control unit. The control unit has communication link based on a cellular-Internet interface that transmits data on the internet.

II. BACKGROUND/REALTED WORKS

A smart IoT irrigation system is defined as a system that controls field irrigation without user interference. The decision for watering is based on data that are collected through the Internet of Things (IoT) from weather websites and with the help of sensors and actuators. Based on this process of watering the crops, the irrigation systems using IOT are divided into the weather-based irrigation systems and sensor-based irrigation systems. In the weather-based irrigation systems the decision for irrigation is taken based on future weather conditions that are collect through the Internet. The system gathers data for temperature, rain, air humidity, . Based on the data that are gathered the decision for irrigation is made. The system monitors the air temperature in order to avoid irrigation in extreme weather conditions, as if the temperature drops down 0^{o}C, so as to prevent the plants from freezing. Furthermore, the system monitors the rain fall in the close future in order to avoid irrigation and save water if rain is about to start. Moreover, humidity and wind measurements are needed to estimate the dehydration of the plants. The system accesses the Internet through 4G/3G/GPRS gateways and it collects the data from weather websites. All the data gathered from the websites are stored in databases for future processing. Smart phones play a major role in these systems as the farmer is informed through its phone for notifications and alerts from the system.

Another system architecture for dynamic irrigation systems is based on sensors that are placed in the crop fields. They monitor soil moisture with the help of ground humidity sensors and try to decide if the field needs irrigation or not. This type of irrigation systems outperforms the weather-based systems as the measure with precision the humidity of the field. The only disadvantage they have is that they cannot predict the weather in the close future. A hydride system that combines information for future weather conditions for website and close field environmental conditions from local sensors is a good solution for the proper irrigation of the field with as watering saving as possible. Some smart irrigations systems have already been proposed. A smart irrigation system that uses a soil sensor and a central controller is offered by Koubachi company, in which an efficient irrigation algorithm that has statically assigned weights is used in a smart system. It monitors the pH, the temperature and the moisture levels in the field.

III. LITERATURE SURVEY

The provisioning of network connectivity along with computing capability to various objects and everyday items which are not normally considered computers and allowing these devices to generate and exchange data on the network, also consuming data with minimal human intervention is called Internet of Things. There is, however, no single, universal definition. This allows remote access and control of the components over any network infrastructure that creates scope for direct integration of the physical world into computer-based systems that results in improved efficiency, accuracy and economic benefit. When sensors and actuators are augmented with IoT, the technology becomes an instance of the more general class of cyber-physical systems, which also contains technologies such as smart homes, smart cities, smart and intelligent transportation. Every object based on their embedded computing system is identified as unique but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

Various researches have been carried out on how soil irrigation can be made more efficient. The researchers have used different ideas depending on the condition of the soil and quantity of water Different technologies used and the design of the system was discussed by the researchers. This paper aims at reducing the wastage of water and the labor that is used to carry out irrigation manually. The proposed system aims at detecting the moisture content of the soil using sensors that are placed directly into the soil. These sensors sense the water level of the soil and if the water level is not adequate then the user will be notified through a message that will be sent to the application which would be installed on the user's mobile phone. The Arduino microcontroller controls the digital connection and interaction, enabling the objects to sense and act in that system. Also, with its efficient on-board processing capability, various sensors and other specific devices can be integrated with it. In this mechanism, sensors detect the level of pH and moisture content and send data to a fixed access point, which in turn access irrigation components installed in the field or the physical sensor in the water tank, wirelessly. A wireless application of smart irrigation system is supported by different moisture sensors for usage in crucial areas. The traditional, discrete method and wired solutions came along many difficulties on measuring and controlling systems over the large geographical areas. If different kinds of sensors are involved in smart irrigation in future works, it can be said to be an IoT based access and control of irrigation through automation.

A. Arduino Uno

Arduino is an open source microcontroller that can be integrated with various other components to form a system. It is the best board to get started with electronics and coding. It supports the network operation by wireless communication based on the IEEE 802.15.4 standard. The network coordinator is also responsible for alerting a network operator or an emergency service using the Ethernet network or sending a SMS using a GSM/GPRS modem.

B. pH and Moisture sensors.

There are different sensors are used to controlling the process of irrigation system. Different sensors used are Temperature, PH, Humidity are all measured and checked with the previous data stored in a system. According to the comparator of the system automation process of pump and solenoid valve is opened for needed.

pH sensor checks alkalinity and acidity of the soil. It is important to maintain a hydroponic nutrient solution at a pH level where the nutrients are consistently available to the plant. If the content of the soil solution is too acidic or too alkaline it can cause lock up – a situation which restricts certain elements essential for growth from being absorbed by the root structure. Deficiencies in the required elements become apparent in the plants growth and can lead to plant death. Additionally, the pH of the water we drink is crucial to our health.

The Soil Moisture Sensor is used to measure the volumetric water content in the soil. This makes it ideal for performing experiments in plants by having constant information about the amount of water currently present in soil and accordingly providing water to the plants for proper nourishment. This includes constant checking of moisture content in soil and sending the readings to the android application. If the moisture content is less than the threshold value (which is pre-fed into the arduino board), a prompt message is sent to the device and automatically a sprinkler connected to the arduino will start sprinkling water on the affected area.

C. Internet of Things – system

The Internet of Things refers to a network of physical components that can be used with electronics, sensors, and network connectivity, which enables them to collect and exchange data. It allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit with continuous storage a retrieve. System software for data reading and controlling the various devices is written in Assembly language of the code and to store the data in server of MySql and directly send it to the IoT channel by writing code using java language.

IOT stores collected information within the info and analyzes the hold on information. The system can work consistent with the algorithmic program developed for watering the crop. The board has Associate in Nursing LAN interface and runs the easy information internet server. thus, arranger collects the info over wireless communication protocol and permit user to watch the info from an online browser. User will create the irrigation system ON or OFF remotely. The system can cut back the water consumption and giving uniform water to the crop leads to increasing yield. Each scanning provides a channel of data according to which the water flow is switched ON. The process remains in the same state

till the data of the same channel does not change, if the data is not high, then system scans the next channel and the process repeats as last continuously.

IV. PROBLEM STATEMENT

In the case of traditional irrigation system water saving is not considered. Since, the water is irrigated directly in the land, plants under go high stress from variation in soil moisture, therefore plant appearance is reduced. The absence of automatic controlling of the system result in improper water control system. The major reason for these limitations is the growth of population which is increasing at a faster rate. At present there is emerging global water crisis where managing scarcity of water has become a serious job. This growth can be seen in countries which have shortage of water resources and are economically poor. So this is the serious problem in agriculture area. So we want to design an Smart Irrigation System which is based on Internet of Things Architecture using Arduino microcontroller that operate automatically by sensing the moisture content of the soil and turn ON/OFF the pump without the intervention of farmer and hence save water.

V. PROPOSED SYSTEM

This system is a combination of hardware and software components. The hardware part consists of different sensors like soil moisture sensor, photocell sensor, etc whereas the software part consists of an android based application connected to the Arduino board and other hardware components using Internet of Things (IoT). The application consists of signals and a database in which readings are displayed from sensors and are inserted using the hardware. The improvement in irrigation system using wireless network is a solution to achieve water conservation as well as improvement in irrigation process. This research tries to automate the process of irrigation on the farmland by monitoring the soil water level of the soil relative to the plant being cultivated and the adaptively sprinkling water to simulate the effect of rainfall.

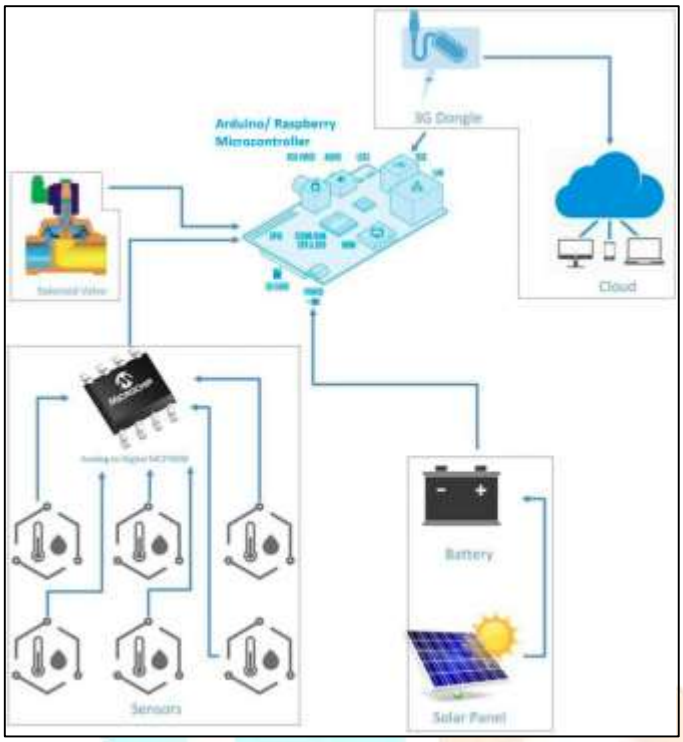
Advantages of the Proposed System

- Automatic Switching of pump.
- Maintenance Cost Reduction.
- Reduction in usage of water.
- Reduction in labor.
- Wireless Communication.
- Energy Saving.

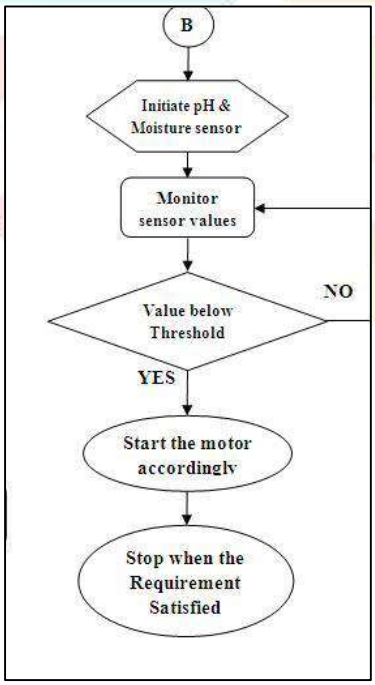
Arduino Board

1.	Arduino UNO Board	-	Rs.425/-
2.	Wi-Fi Module	-	Rs.625/-
3.	Soil Moisture Sensors (3)	-	Rs.360/-
4.	Solenoid Valves (2)	-	Rs.600/-
5.	Submersible water Pump	-	Rs.160/-
6.	Water Supply Pipes	-	Rs.15/-
7.	Relay Switch (3)	-	Rs.30/-
8.	Transistor BC 547(3)	-	Rs.9/-
9.	Diode IN 4007 (3)	-	Rs.6/-
10.	LED	-	Rs.5/-
11.	Battery 9V (2)	-	Rs.40/-
12.	PCB Board	-	Rs.40/-
13.	Connecting Wires	-	Rs.90/-
14.	2.54mm female header pins	-	Rs.40/-
15.	Field Model	-	Rs.250/-
	TOTAL COST	-	Rs.2695/-

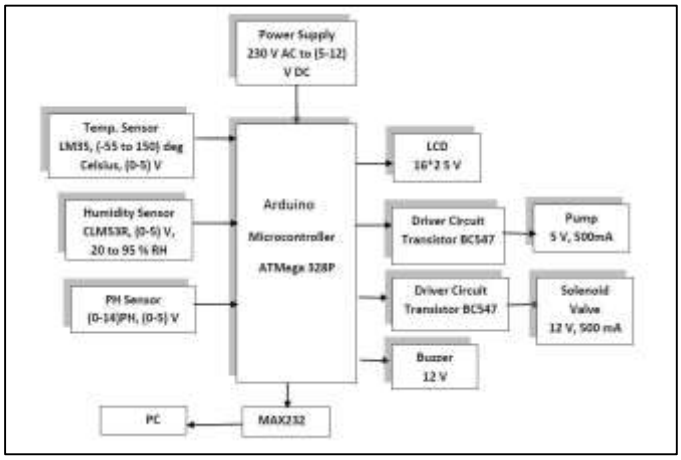
Cost Estimation



System Architecture



Data Flow Diagram



Block Diagram

VI. FUTURE SCOPE

This system can be further expanded to automatic control of water pumps in residential houses and large parks and gardens where there is a lot of wastage of water is happening currently, so this system proposes an solution to avoid those wastages and lead us towards water and energy conservation. Also the function of detecting nutrient deficiency can be added so that the farmer comes to know about the fertilizer to be used using the nutrient sensor.

VII. CONCLUSION

The smart irrigation system implemented is cost effective for optimizing water resources for agricultural production. The proposed system can be used to switch on/off the water sprinkler depending on the soil moisture levels thereby making the process simpler to use. Through this project it can be concluded that there can be considerable development in irrigation with those of IOT and automation. Thus this system is a solution to the problems faced in the existing process of irrigation.

ACKNOWLEDGMENT

We would like to thank our guide Ms. Sahaya Sakila. V, HOD (CSE Dept) and Dean of our University.

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