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IOT Based Smart Irrigation

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Abstract - Agriculture remains the sector which contributes the highest to India's GDP. But, when considering technology that is deployed in this field, we find that the development is not tremendous. The Internet of Things (IOT) has been denoted as a new wave of information and communication technology (ICT) advancements. The IOT is a multidisciplinary concept that encompasses a wide range of several technologies, application domains, device capabilities, and operational strategies, etc. The ongoing IOT research activities are directed towards the definition and design of standards and open architectures which is still have the issues requiring a global consensus before the final deployment. This paper gives over view about IOT technologies and applications related to agriculture with comparison of other survey papers and proposed a novel irrigation management system. Our main objective of this work is to for Farming where various new technologies to yield higher growth of the crops and their water supply. Automated control features with latest electronic technology using microcontroller which turns the pumping motor ON and OFF on detecting the dampness content of the earth and GSM phone line is proposed after measuring the temperature, humidity, and soil moisture.Furthermore, the proposed model enables the farmer to monitor weather conditions using an Android Application, with which he also has a choice to override the system if required. Here we are using different sensors like humidity, temperature, moisture, light etc. These sensors give signal to the micro controller. Micro-controller gives the data to the isolated server through a serial communication. According to sensor values graph will be display on PC and Smart phone side and by using this graph user can on or off drip devices. In this we keep threshold value for each sensor. The data is sent and processed on an isolated server, which stores the information from the sensors in a database, allowing further interpretation of data in a simple and flexible way. The intended system may lead to enhance the farming practices, overcoming the water crises and developing an upgraded agricultural system for the country

Keywords: IoT Irrigation, wireless sensor network, Smart irrigation, IOT based irrigation

1. INTRODUCTION

Agriculture is the strength of Indian Economy. However, for agriculture water consumption is more than rainfall every year. Improving farm yield is essential to meet the rapidly growing demand of food for population growth across the world. By considering and predicting ecological circumstances, farm productivity can be increased. Crop quality is based on data collected from field such as soil moisture, ambient temperature and humidity etc. Advanced tools and technology can be used to increase farm yield. Developing IoT technologies can help to collect large amount of ecological and crop recital data.

“IoT encompass es many new intelligent concepts for using in the near future such as smart home, smart city, smart transportation, and smart farming” The technique can be used for application of accurate amount of fertilizer, water, pesticide etc. to enhance productivity and excellence. Sensors are hopeful device for smart agriculture. The real-time environmental parameters like soil moisture level, ambient temperature and tank water level have continuous influence on the crop lifecycle. By forming sensor network, good monitoring of water regulation in the agriculture field can be achieved.

This paper presents irrigation monitoring and controlling system. The system uses the wireless sensor network to monitor the environmental conditions such as temperature, soil moisture content, humidity and water level of agriculture land for controlling the irrigation. The system has automatic and manual mode. The real time sensed data is stored on the cloud server for decision making and controlling actions. The user can monitor the controlling actions taken at the farm as well as control the irrigation via android app on farmer’s mobile phone.

2. RELATED WORKS

Plenty of research work has been done to improve the performance of agriculture field. In the system uses arduino technology to control watering and roofing of the green house. It uses statistical data acquired from sensors (like temperature, humidity, moisture and light intensity sensors) compared with the weather forecast for decision making. Kalman filter is used to eliminate noise from the sensors. Agriculture System (AgriSys) uses temperature, pH, humidity sensors and the fuzzy inference to input the data from sensors. The system monitors the sensors information on LCD and PC. In Wireless sensing Network with ZigBee technology helps to control air humidity, soil moisture and temperature. System is implemented with components as soil moisture sensor, humidity sensor, temperature sensor, ZigBee, 18F458 PIC Microcontroller, water pump, fan, relay and buzzer. In paper , wireless sensor network is integrated with ZigBee to transmit soil moisture level and temperature values. The data is transmitted to a web server using GPRS through cellular network. The data monitoring can be achieved via internet using graphical application. In the paper explains wireless sensor network for sensing soil moisture level, temperature and relative humidity values. Network lifetime of the node is increased by using sleep - wake up plan. The system in this paper implements clustering of nodes. Graphical user interface (GUI) is designed in MATLAB for data handling. The paper defines automation for remote agriculture having sensors and actuators connected to IoT gateway running OPC UA server. Cloud services (installing or configuring process controller) are used to change the control rules without updating firmware of remote sensors/actuators. In WSNs integration with Cloud Computing is described. It provides performance comparison guideline for integrating WSN with Cloud Computing to improve performance and to overcome storage and energy constraints of WSN.

3. PROPOSED MODEL

The proposed system helps user to improve quality and quantity of their farm yield by sensing ambient temperature and humidity values, soil moisture value and water level of the tank from the field without any human intervention. By using the concept of IoT system can be more efficient. The system contains wireless sensor units node1 and node2 as shown in fig.1 placed in the field to acquire the real time values, a master node to receive and transmit acquired information to the control section, and a control section which controls the drips for watering subsystem. Each node includes temperature, humidity, soil moisture and water level sensors as well as microcontroller and relay switching unit. The sensed data from each node is transmitted to the master node via zigbee.

The received data from the master node is stored at the cloud server. The cloud server performs decision making by comparing between sensed values and predefined threshold values as per crop selection. Once the data is processed and decision is determined at the control section with the help of irrigation algorithm, the controlling action is sent to wireless sensor node. The microcontroller from the node controls relay switching unit and watering subsystem accordingly. Report system that is an android application is developed to deliver recent field information to user. Also it asks user to respond to an essential incident such as rise in temperature and water requirement for plants.

This architecture is designed using arduino technology to provide scalability for network. It uses AtMega 328 microcontroller at each node. The irrigation system is optimized in order to provide irrigation efficiency which will allow saving water as well as improving the crop quality.

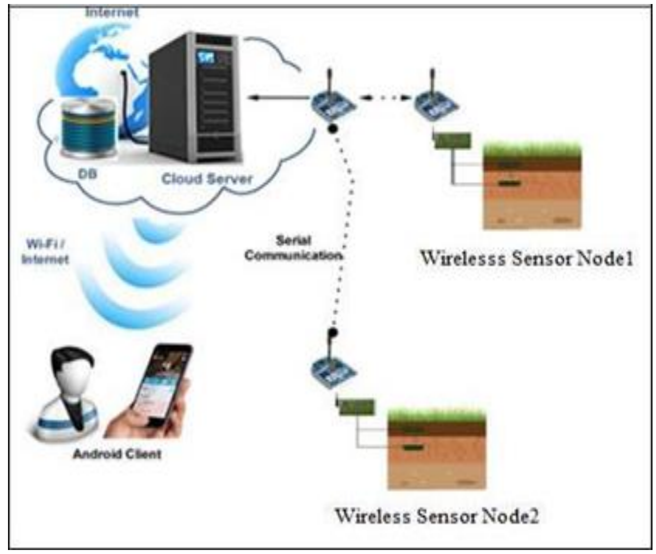

Figure1: Block Diagram of Wireless Sensor Node

The system offers following advantages.

- Smart irrigation system can enhance crop quality and yield with the help of sensing parameters like, soil moisture, air temperature humidity and water level of the tank.
- Using irrigation algorithm the control section informs the wireless sensor node whether to start or stop watering.
- The system monitors water level of the tank via water level sensor so that if water level is below bottom then irrigation will not be started.
- Remote monitoring and controlling avoids human intervention.
- Reduction in water consumption reduces the power consumption and cost.

The system consists of following blocks.

3.1. Wireless sensor Node and Control section

Fig 2 shows wireless sensor node and control section. It consists of DHT11 ambient temperature and humidity sensor, LM 393 soil moisture and M116 water level sensors, AtMega328 microcontroller, zigbee transceiver and relay switching unit. Data acquired by sensors is processed by microcontroller and transferred to the zigbee for transmission. The threshold values of soil moisture and ambient temperature are set according to the crop selection. The microcontroller processes control action taken by the server resulting in controlling the irrigation.

3.2. Master node

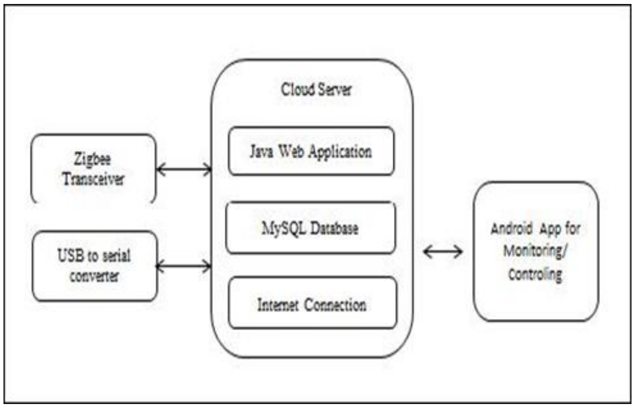

Figure 2:Master node

Master node receives data transmitted from all the wireless sensor nodes via zigbee receiver. The received data is transferred to the cloud server via internet for handling to compute final values. Master node receives controlling action from cloud server and transmits it to the respective node. The microcontroller at respective node executes action received from master node.

3.3. Control Section

The decision for controlling action is taken at cloud server and the corresponding action is performed at the node. Fig. 3 shows the cloud server with android application. The decision making is based on comparison between sensed values (of soil moisture, air temperature, tank water level) and respective threshold values. Master node receives the control command from the cloud and transmits it to the node which performs the corresponding action. Thus system automatically controls drip irrigation depending on decision from the real time values.

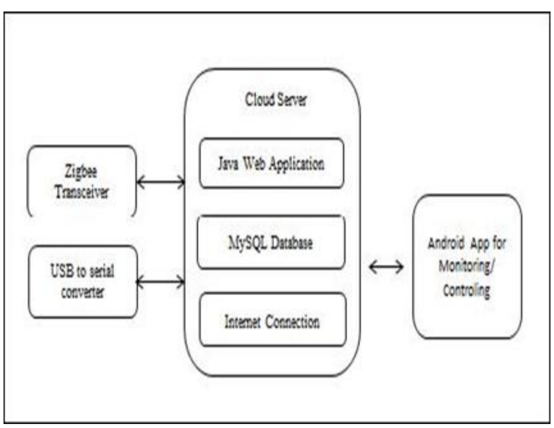

Figure 3. Cloud Server with Android App

Besides storing all the measurements received from the WSN, the cloud platform is also responsible to detect whenever the plants need irrigation as well as sending messages to the wireless sensor node in order to activate or deactivate the irrigation system. This decision making is performed through distinct pieces of information: the air temperature, soil moisture, water level and humidity measurements of WSN nodes

All sensing nodes comprised in the WSN send soil moisture measurements frequently, which will help the algorithm taking decisions concerning the need for irrigation. When a soil moisture message of any node has a value below the defined threshold, the algorithm will read the values of ambient temperature and humidity next 4 hours, in order to decide whether to irrigate or not. The cloud is also responsible for finding the right moment to stop the irrigation. For that, whenever all soil moisture sensor of the network assumes a soil moisture value larger or equal to the defined threshold will specify the end of the irrigation. When this condition is assured, the cloud sends a message to the WSN which contains an instruction to stop the irrigation.

According to the type of crops, the threshold levels for soil moisture and air temperature can be varied. Accordingly the duration as well as frequency for watering can be changed.When the wireless sensor node is integrated with the cloud server the irrigation control decision will be taken at the server side.

4. SYSTEM IMPLEMENTATION AND RESULTS

System consists of combination of hardware and software. The hardware prototype is shown in fig. 5. It consists of wireless sensor node1 and node 2. The sensed data from node1 and node 2 is transmitted to master node via zigbee. The real time sensed data received by master node is shown in fig. 6 and 7 which is stored at the cloud for further decision making shows the sensed data from temperature, humidity, soil moisture and water level sensors transmitted by zigbee from node 1and node 2, received at the master node. Master node stores that data to the cloud server.

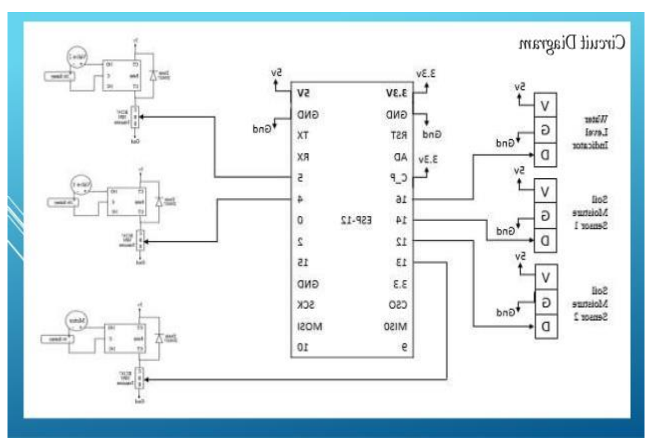

Figure 4: Architecture

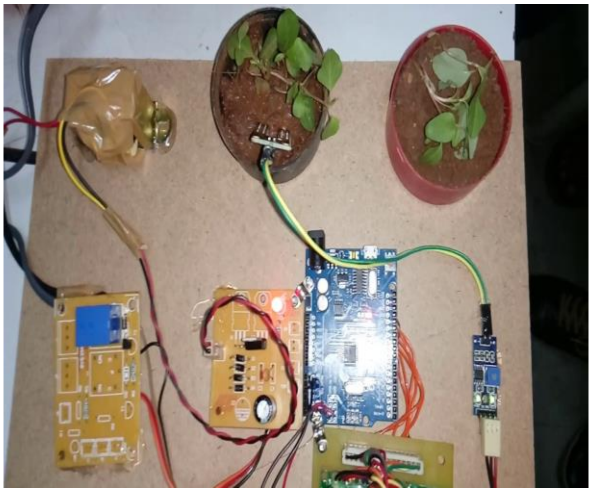

Figure 5: Project Implementation

The system uses Apache Tomcat HTTP web server hosted on the cloud server. The web server is used to monitor and store real time sensed data from master node. Fig 8 shows the real time sensors data from node1 and node2 stored at the web server.

5.CONCLUSION

The study and analysis related to the interconnected field studies of Internet of Things, Machine-to-Machine and Wireless Sensor and Actuator Networks, it was possible to identify that there are various developments in the last couple of years, there is still problem to address regarding the generated and collected data. Being cloud computing a recent resource providing approach, the main work developed within the context of the paradigms presented above was not properly integrated with the possibilities that a cloud computing platform could offer. The system proposed in this paper, aims to lead to the combination of such systems with the attractive features offered by cloud computing. This integration could be applied to the agricultural applications. The automated irrigation system presented in this work was found more viable, and can manage irrigation water supply more effectively. It helps to optimize the use of water for irrigation purpose. It shows that water consumption is reduced with the implementation of soil-moisture based automated irrigation system.

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