Cloud Computing on Irrigation System

Nurool Hudha, Sindhuja, Vinothini Selvaraj and Sridhar
Department Of Electronics and Communication Engineering
Engineering Nandha College of Technology
Vaikal Madu, Erode 638009, India

U. K. Sathis Kumaar
(Assistant Professor)
Department Of Electronics and Communication
Nandha College of Technology
Vaikal Medu, Erode 638009, India

Abstract **- This paper presents an automation of farm irrigation system using Raspberry pi and cloud computing. This system updates the status frequently to the server and clients. Raspberry pi is used as an automation purpose and cloud computing for security purpose. Raspberry pi makes the communication and controlling through Ethernet or USB port. The goal of raspberry pi in this is to collect the parameters like electric conductivity, nitrate level of the soil and power rating of motors. Each sensor node consists of EC, in soil nitrate and current with on coaxial cable for communication. Raspberry pi stores the collected data in the data base and cloud computing will handle the updated data. User can operate multiple motors in multiple fields/farms at the same time remotely. This system will reduce the water and fertilizer consumption and improves the efficiency of the motor. Because of this, there is no wastage of cost, water and fertilizer.**

Index Terms -- Automation, cellular networks, Ethernet, Irrigation, measurement, water resources, fertilizers, raspberry pi, cloud computing.

I. INTRODUCTION

Agriculture uses 85% of available fresh water resources and fertilizers Worldwide, and this percentage will continue to be dominant in water and fertilizer consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water and fertilizers, including technical, agronomic, managerial, and institutional improvements.

There is a challenge in front of every country to sustain the fresh food requirement and reducing the farm water consumption. Irrigation is the process of watering the soil and pouring the bio-fertilizers. The requirement of water to the soil and fertilizer to the plants depends on soil properties like Electric conductivity, nitrate level, pH range, Soil moisture and soil temperature. It also depends upon the crop which grows in the soil. From last decade, few existing system working for reducing the agriculture water consumption, but these systems have some limitations and there is very few systems are used to check both soil nutrients and motor power rating. These systems, watering is done without analyzing the soil properties, due to which systems apply non uniform water to the soil results in less yields and without checking the power rating of motor to decrease the efficiency of motor.

Also systems required more human intervention and time consuming. So we require modern technology to resolve this problem and support better irrigation management. For that we have proposed system which is Web based automatic irrigation system using raspberry pi and cloud computing. The raspberry pi creates the networks of multiple devices having capable of computation, communication and controlling. It provides a bridge between the real physical world and virtual worlds and having a wide range of potential applications of Agriculture, home automation, science, civil infrastructure and security.

Irrigation systems can also be automated through information provided by sensors like pH, in soil nitrate, EC and current sensor. All sensors are placed in the cultivating land to updates the status of soil nitrate level, pH level, salt level. On volumetric water content of soil, using dielectric moisture sensors to control actuators and save water, instead of a pre-determined irrigation schedule at a particular time of the day and with a specific duration.

Rpi has an Ethernet interface and it runs a simple data web server. Rpi is used to get the status of all sensor in the cultivating lands . It analyses the received data which are in required range. According to the current status it will sends the control signals to motors.

By using Ethernet the data's from Raspberry pi will communicate with server and client through cloud computing. By this way we can also send the control signals to the Raspberry pi. Cloud computing has an big data base to store the updated data from the Raspberry pi. This data will send to server and client through message and then the data can also be viewed by them by using their own id and password anywhere at any time.

II. AUTOMATED IRRIGATION SYSTEM

A. Proposed architecture used for automation irrigation

The automated irrigation system hereby reported, consisted of two components (Fig. 1), Raspberry pi (Rpi) and cloud computing, linked by Ethernet or USB port transceivers that allowed the transfer of data from the sensors like pH, in soil nitrate, EC and current sensor. All sensors are placed in the cultivating land to updates the status of soil nitrate level, pH level, salt level. The cloud computing is designed on Raspberry pi for monitoring and control the irrigation. Any devices which have the capability to access the web service will be used here for monitoring the data like PC, laptop, Smartphone etc by using their own id and password. Then this data will also send to the server and client through message and they can also send the control signals to the Raspberry pi.

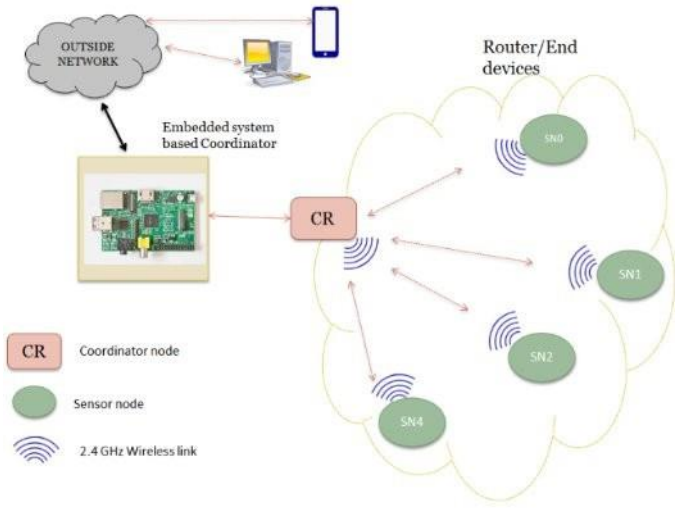

Fig 1, Automated irrigation system

1) *Raspberry Pi:* In this proposed system we have used Raspberry Pi as the controller of coordinator node. Rpi is the small, inexpensive minicomputer. It continuously collects the information send by sensor nodes and processing large quantities of data timely and available for users to view. It is the core of the system.

2) *Database and web server:* In this proposed system we have designed the database based on MySQL which is installed on Rpi. MySQL is the popular choice of database in web application. MySQL is the relational database management system (RDBMS). It is open source software. Database stores the soil parameter information send by a sensor node in it with time. It provides the information to the web page for monitoring the system remotely

3) *Cloud computing:* The cloud computing is play an important role in this system. The data from the controller is saved in the cloud data base. Then this updated data can be send to the both server and client through message.

4) Sensors:

a) *Current Sensor:* Typical applications include motor control, load detection and management, over-current fault detection and any intelligent power management system etc. The Winson WCS2720 provides economical and precise solution for both DC and AC current sensing in industrial, commercial and communications systems. The unique package allows for easy implementation by the customer.

b) *Soil nitrate sensor:* These advances in the in-field use of the nitrate ion-selective electrode ($NO3^{-}$–ISE) provide the ability for (i) assessing soil nitrate variation, (ii) linking soil nitrate variation to crop growth, (iii) developing site-specific crop management practices, and (iv) environmental monitoring of soil nitrate.

c) *EC sensor*: In this sensor, the soil salt content can be checked. Because of the soil content the nutrients of the crop. Then this data also updated in the cloud data base through Ethernet or USB port.

d) *Soil moisture sensor:* The sensor will detect the moisture of the soil surrounding it, i.e. shortage of water content of the soil. If the contents are low the module output will be high otherwise the output will remain in neutral conditions. This moisture sensor has two probes used to pass the current into the soil, and then it reads that resistance between two probes to get the moisture level.

B. Introduction of Raspberry pi:

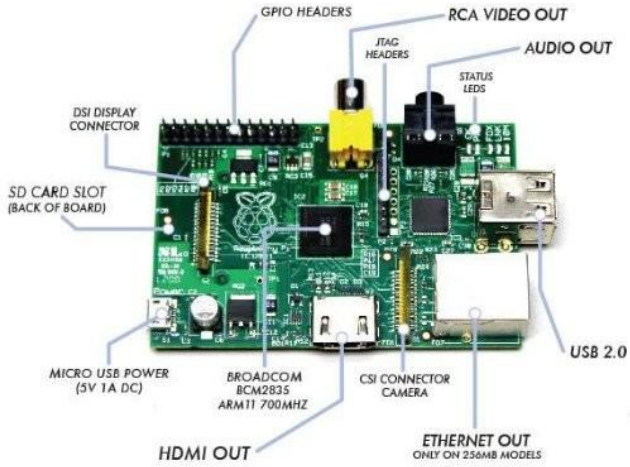

Fig. 2. Raspberry Pi

The Raspberry Pi is the low cost credit size minicomputer which has recently become popular. The Raspberry is the cheapest low power arm 11 based microcontroller operating at 700MHz frequency and having the 512 megabytes of RAM memory. Fig.2. Shows the picture of Raspberry Pi.

Features of the Raspberry Pi

- Model B+ Raspberry Pi with Mounting Points and 512MB RAM.
- Broadcom BCM2835 ARM11 700 MHz
- Integrated Video core 4 Graphics GPU capable of playing Full 1080p HD Video.
- 4 x USB Ports (Max Output 1.2A).
- Board Power Draw: 600mA.
- HDMI Video Output.
- 10/100Mb Ethernet Port for Internet Access.
- Micro SD Flash Memory Card Slot.
- 40-pin 2.54mm Header Expansion Slot (Which allow for peripherals and expansion boards)
- Dimensions 85 x 56 x 17mm.
- The Raspberry Pi is boot by external memory card with rasbian wheezy images.

C. Introduction of Cloud computing:

Fig 3, Cloud computing

Cloud Computing is a general term used to describe a new class of network based computing that takes place over the Internet,

- ∑ basically a step on from Utility Computing
- ∑ a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).
- ∑ Using the Internet for communication and transport provides hardware, software and networking services to clients.

III. IRRIGATION SYSTEM OPERATION

In this proposed system, The data from the all sensor was received by the raspberry pi. Then this updated data was periodically stored in the cloud data base. The data from the controller was send to the cloud by the use of Ethernet or USB port.

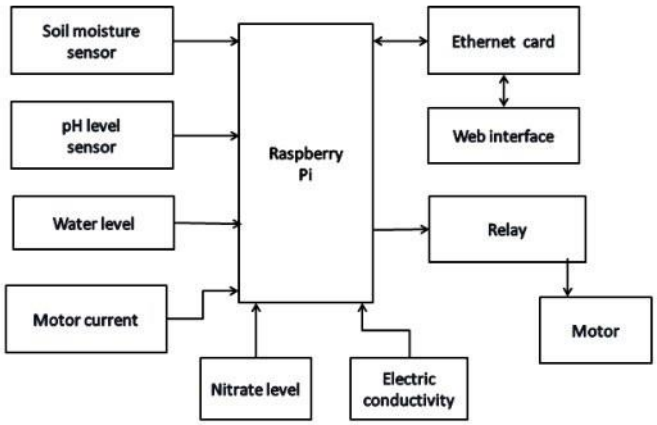

Fig 4. Block diagram

According to the block diagram the system was working in the field. Then the data was send to both the server and the client through message. And the stored data can be access by the user by using their own user id and password.

A. Communication:

The working of the system can be given as flow chart was given below.

Algorithm:

Step1: Start the program
Step2: Boot the Raspberry pi
Step3: Initialize the ADC and Ethernet
Step4: Get ADC Values from nitrate, EC, Ph, soil moisture, water lever and get the motor power status.
Step5: Check the conditions of the soil nutrient level and status of the motor.
Step6: If the condition is true TURN ON the motor otherwise motor is ideal.
Step7: Store the data in database using CLOUD COMPUTING.
Step8: Updating the current status to server and client.
Step9: Server and client handle the updates given to them.
Step10: End of the program.

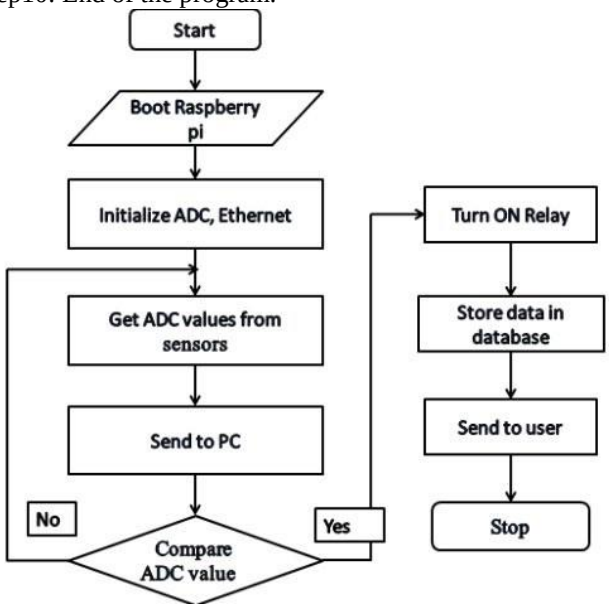

Fig 5, flow chart

IV. EXPERIMENTAL TEST RESULTS

First the sensors are deployed in the farm. The distance between the two sensor node is depends on the type of soil. The status of the all sensor can be collected by the raspberry pi. Then that data can be stored in cloud data base by using Ethernet or USB port. Then the updated data was send to both the server and the client through message.

It also identifies a system architecture that supports water management and requirements of the bio-fertilizer for farming land. The proposed system combines current, soil nutrients level and wastage of water. Raspberry pi used for the system promises long system life by reducing power usage. Then the cloud computing is used to store the updated data in the cloud data base. That stored data can be viewed by the user by using their own user id and password. According to the data they can easily control.

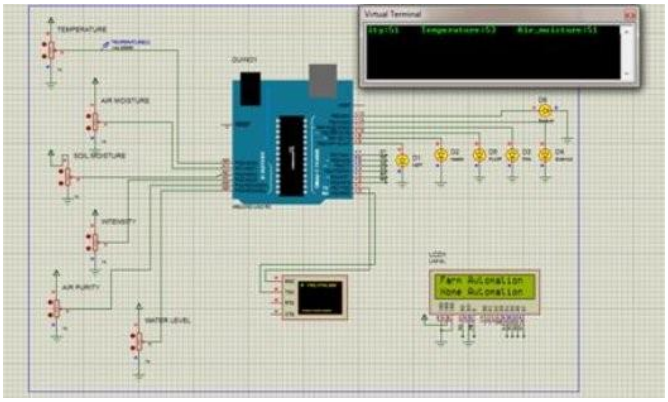

Fig 6, simulation

This the simulation execution of the proposed system. Depending on the moisture contain and temperature of soil the watering to the crop is given. The soil parameters are stored in database tables and these tables are displayed on the web page using PHP script and web server.

Fig 7, Web page displaying temperature and moisture data with pump status

V. CONCLUSION

This project presents the automation of farm irrigation system using raspberry pi and cloud computing. In this we have used raspberry pi as an automation which controls the multiple motors in multiple fields/farms according to the input data and cloud computing provide security to the updated data. By using the raspberry pi and cloud computing user can easily monitor the requirements of fertilizer by analysing the soil parameters and it reduce the wastage of fertilizers. The Ethernet or USB port is used for communication of raspberry pi with cloud computing. Then the stored data can be viewed by client by using their own id and password. The data can be updated periodically.

VI. FUTURE SCOPE

With the advancement of technology and cloud computing it is very easy to use a system with the help of remote server. Thus integrating technology and agriculture will aid farmers to a vast degree. The era of automation and microcontrollers components will help the farmers to manage their resources efficiently. This will not only increase the food production but also saves a large amount of water being wasted. Moreover implementation of microcontrollers system will be economical for the farmers as the power consumption by them is very low.

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