Automated Irrigation system for Banana and Papaya Farms using WSN Network

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Abstract – India is an agricultural country and agriculture is backbone of Indian economy. The optimum use of agriculture resources can lead to a good crop yield. Water plays vital role in agriculture, so optimum utilization of available water is certainly beneficial to get good crop yield and hence profit. And the second important thing for cultivation is fertilizers and feticides, so proportionate usage of fertilizers gives proper growth in plants, good yielding and reduce the expenditure. Saving water and reducing expenditure for fertilizers can achieve profitable cultivation. Particularly rayaseema region known for its papaya and banana cultivation need to employ this method to achieve high yielding and profits.

The proposed system, sensor-based irrigation system is able to provide optimum solution by continuously monitoring the parameters like soil moisture, air temperature and fertilize sensors placed in fields with the help of control station and a base station. Wireless sensor network (WSN) uses ad-hoc networks which support flexibility and self-configuration which is beneficial for agricultural application. Data acquired from different sensors is provided to the base station by wireless transmission using Zigbee. Once the data are received at the base station, further data processing and computation requirements for decision making are carried out by using data mining. The result of data processing and computations are utilized for controlling automated drip irrigation system and gives information about condition of the soil. And the same data is sent to farmer mobile through GSM. Hence such enhanced automation for irrigation provides a good electric & water conservation and save the fertilizers with more efficiency.

Keywords – Wireless Sensor Network (WSN), Sensors (Temperature, Moisture and Fertility), Raspberry pi Processor, IOT technology and Python.

1. Introduction:

Indian economy is basically depending on agriculture. Because of population growth and increased food demand, we need to increase yielding of various crops by optimum utilization of resources. In Rayalaseema of Andhra Pradesh, commercial crops are Banana and Papaya fruits which lift the financial status of formers.

In agriculture, excess watering to the plants leads to wastage of the water and the roots of the plants will be rotten.

Using more (or) less amount of fertilizers to the plants results in damage of plants as well as virus attack leads to low yielding.

Using sensors, the moisture and nutrients always keep monitoring through sensors, IOT and take the required action accordingly. This enables a farmer to monitor and control the conditions in the field from anywhere, so that distant farming is possible for the farmer which can reduce his manpower and time.

Requirements:

1. Hardware components:
    a. Sensors (Temperature, Moisture and Fertility).
    b. Raspberry pi Processor.
    c. Other miscellaneous components.
2. Software components:
    a. Cloud technology (AWS, AZURE, IBM, ALIBABA)
    b. IOT technology.
    c. Python.
    d. Other required software.

Using IOT we can interconnect to the things to the water controlling device and motor. The interaction between these things can be made easy and the plant database can be sent to the cloud that monitors the fields and takes substituent action in impossible situations.

2. Existing System

At present, the requirement of water is rising as more than dualistic as the rate of population increases. Due to the shortage of water resources, there is a necessity for water saving irrigation technology for agriculture. The arid regions having very little shrimp of water and that has to be utilized very efficiently. In conventional water irrigation system, the misuse of water is very high. Therefore, the conventional method can be replaced by drip irrigation technology.

A new thought for saving each drops of water by testing the soil conditions before supplying water to the crop field. This functioning will cut down the task at hands of the cultivator and help to maintain suitable soil conditions for the progress of crop production. With this technology up gradation is possible to design systems that eradicate the direct participation of the cultivator in the irrigation field. For the sustainable utilization of water and its resources, the rainwater is hoarded in a tank and it is utilizing for irrigation or directed to recharge groundwater.

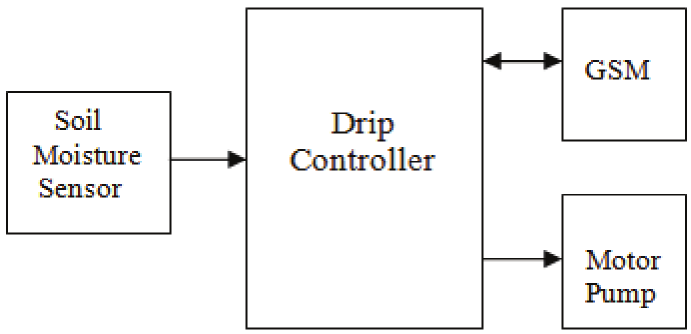

Fig.1. Block diagram of Wireless Sensor Based Control system

The rainwater is utilized for agriculture in rainy seasons and the well or bore well water is consumed for other times. The entire sensor network is analysed by the micro- controller and the sensors data to irrigation control center (ICC). In ICC, the whole drip irrigation is controlled by the electromagnetic actuators. The ICC has two technologies one is GSM and secondary one is the ARM controller. The GSM serves as the major part for handling the drip irrigation which sending the information to the cultivator using SMS to a mobile device. Then the user controls the entire agriculture irrigation system through SMS.

Problem Statement: The main objective of this system is to give right amount of water and fertilizers for the plants at the right time to achieve higher yielding at various climate conditions. The objectives of this project are:

- Optimum utilization of water.
- Consumption of fertilizers is optimized.
- Reducing man power.
- Stabilize the fertility of the soils.
- Farmer can monitor and control the various conditions of the soil.
- Analysis of soil can be made easy.

3. PROPOSED SYSTEM

The Configuration of an automatic drip irrigation system using WSN is shown in fig.1. The system consists of wireless sensor units placed in the field which are used to acquire the real time data, a base station which processes on data acquired and transmitted by wireless sensor unit, and a control section which controls the drips when it receives control command from the base station.

The soil moisture, temperature and fertilization are continuously sensed by the sensors and the same is are processed and values are calculated can be used for decision making. Once the data are processed and decision is determined at the base station then control command is sent to control section by wireless communication. Control section consists of microcontroller, and relay switching unit, receiver. Control section receives the control command from Base station and drips are controlled accordingly. The farmers are able to observe the data on his mobile through GSM in the form convenient to them and this data is in the integrated format.

3.1. Wireless sensor Unit:

The Wireless sensor unit consists of transmitter, sensors, a processor, and power sources. ***S***ensors units are deployed in the field for acquisition of data and sensed data send to processor (Raspberry Pi) through Zigbee.

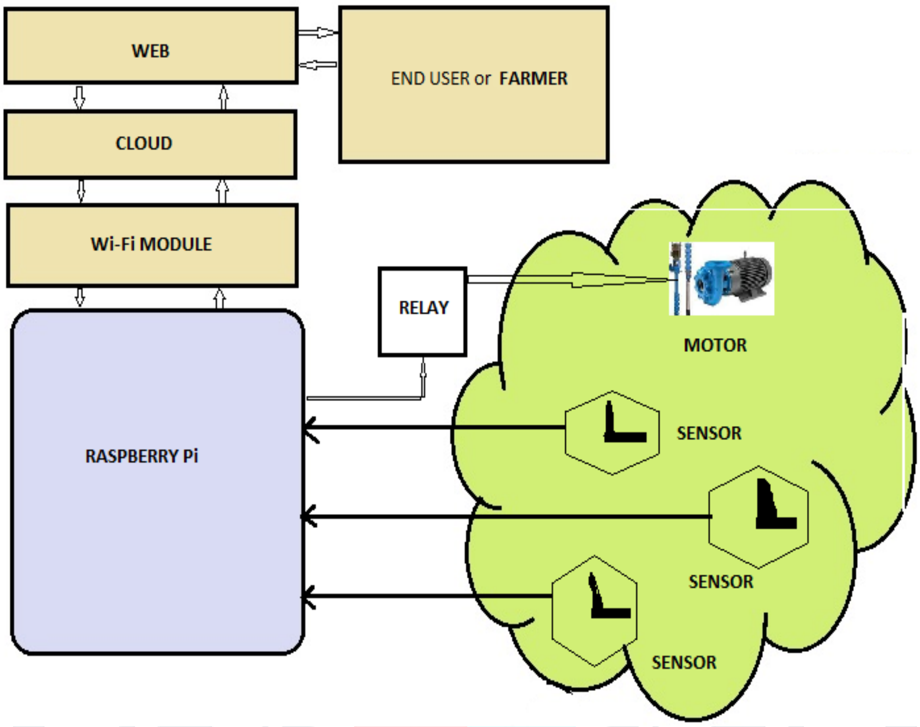

Fig.2. Block Diagram of Smart Irrigation

3.2. Base Station: The base station consists of Processor which process the data acquired by sensors and generate control signals based on threshold values given. These control signals given to pumping motor so as to control the water flow through drip. And the same information is sent to farmer mobile through GSM, so he could able to know condition of field and supplement required amount of fertilizer at right time. Processor, sensors, radio modem are powered by the rechargeable batteries which is being charged by solar energy. The efficient use of power is important for a long-term operational system.

3.3. Control section:

The receiver at the control section receives control command sent by the base station and accordingly gives command to relay switching unit. Thus, system automatically controls drip irrigation depending on decision determined through decision making algorithm from the real time values received from wireless sensor unit.

3.4. Relay:

The relay can be used to control pumping motor based signal given by processor. Relays are easy switches which are explored both electrically and mechanically. Relays are made up of an electromagnet and also a set of contacts. The switching operation is done with the aid of the electromagnet. There are also other managing ideals for its operation. But they differ according to their applications. The majority of the devices have the claim of relays. The key process of a relay is used in places where only a low-power signal can be used to operate a circuit.

Relays are also used in places where a single signal is used to control a clump of circuits. The application of relays started during the discovery of telephones. They deceived a major role in switching calls in telephone exchanges. Relay were also used in long distance telegraphy. Relay were used to send the signal coming from one source to another destination. After the discovery of computers relay were used to carry out Boolean and other logical operations. The high-end claim of relays needs high power to be driven by electric motors. Such relays are called contactors.

3.5. Raspberry Pi3 B:

The Raspberry Pi 3 is here to endow you with the same Pi as before but now with dualistic ram and a much-accelerated processor. It is minute sized computer which is proficient of performing similar things like desktop/PC it also performs high-definition video and games. It can run certain types of Linux OS and windows also. It is meant for teaching kids all over the globe, to learn how to program.

The mysterious nerve that makes this computer so minute and drastic is the Broad-com BCM2836, an ARMv8 Quad Core Processor (SOC), running at 900MHz, and a Video core 4 GPU. Raspberry Pi 3 when plugged into our HDTV, we can watch Blu-Ray quality video, using H.264 at 40MBits/s. The topmost change that has been on the up with the Raspberry Pi 3 is an elevation to the main processor and ram of 1GB. The RPi3 uses a micro-SD card to hold system capacity. Many of the Linux distributions for the Pi 3 will work on a 4GB micro-SD card but larger cards are also supported. RPi3 has 802.11n Wireless LAN with Bluetooth 4.1& Bluetooth low energy (BLE).

3.6. Fertilize Sensor: IMACIMUS 8 , the key for precision agriculture. MACIMUS Series (Multi ION with up to 7 selective electrodes in the same probe, pH electrode and a reference electrode.

Fig.3. Multi nutrient Sensor

IMACIMUS provides simultaneous information of pH & ISE up to 7 parameters (Ca+2, Cl-, K+, Na+, NH4+, NO3- and Mg+2).

Main features:

Analyser Type	IMACIMUS 8
Number of channels	8 (7+pH)
Electrodes Head /Holder	Multi ION probe- 7ch
No. of Electrodes/ Individual Sensors	7 Individual Electrodes + pH
Electrodes available	Ca2+/Cl-/K+/Na+/NH4+ /NO3-/Mg+/pH (simultaneous measurement 1 min)
Software Windows	Yes
Power supply	Power supply por USB (5V/1A)
Log Capacity	100.000 samples
Concentration range	mg/L or mmol/L
Time per sample	< 1 min
Volume min-max	15mL sample
Pre-treatment sample	No necessary

3.7. Moisture sensor: We are proposing the deployment of a high frequency VH400 series moisture sensor probes which enable precise low-cost monitoring of soil water content suiting our purpose.

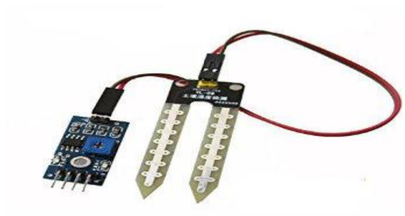

Fig.4. Moisture Sensor

Soil moisture sensors typically refer to sensors that estimate volumetric water content. It used copper electrodes to sense the moisture content of the soil. Its range is 0 to 45% volumetric water content in soil. It operates between –40°C to +60°C.

3.8. Temperature Sensor: A temperature probe used is THERM200 which provides temperature range from -400 C to 850C. It outputs a voltage linearly proportional temperature so easy to calculate temperature from voltage without using any complex equation. It consumes less current which satisfies power consumption constrain as well it is cost effective. It is highly precise with 0.1250 C of resolution. This sensory data are transmitted wirelessly via Zigbee.

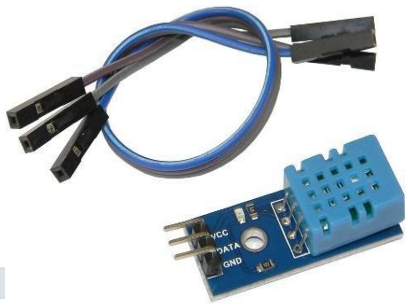

Fig.5. Temperature Sensor

4. WIRELESS TRANSMISSION

4.1. Wi-Fi module:

Wi-Fi module Wi-Fi is defined as an acronym for wireless fidelity. In Wi-Fi we can access or connect to a network using radio waves, without using wires. An example of Wi-Fi is when you go to Starbucks and can join on their network to get on the Internet without having to connect your computer to any wires. WiFi permit computers, PDA 's and other devices to access the wired connection in a wireless mode. The 802.11 standard defines the wireless communication operating via electromagnetic waves.

4.2. GSM (Global System for Mobile communication):

GSM (Global System for Mobile communication) is a digital mobile network that is widely used by mobile phone users in Europe and other parts of the world. GSM connects system to mobile. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies: TDMA, GSM and code-division multiple access (CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 megahertz (MHz) or 1,800 MHz frequency band.GSM, together with other technologies, is part of the evolution of wireless mobile telecommunications that includes High-Speed Circuit-Switched Data (HSCSD), General Packet Radio Service (GPRS), Enhanced Data GSM Environment (EDGE) and Universal Mobile Telecommunications Service (UMTS).

5. SUMMARY

Wireless sensor unit in the farm area collects data from the sensors, this acquired data are wirelessly transmitted to the base station. Base station reads values and compare with thresholds, applies data mining algorithm, calculates optimum values and creates drip control layout sends command to the control section which turns respective drip on or off. The same is send to end user or former through internet.

6. CONCLUSION

Using wireless sensor networks in automation for irrigation, this system provides a low-cost wireless solution for an in-field WSN and remote control of precision irrigation. Data mining algorithms used enhances automatic intelligence for WSN based drip irrigation system. This irrigation system allows cultivation in places with water scarcity, with optimum use of available water and hence offers electrical energy & water conservation.

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