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A Prototype Modelling of a System for Smart Irrigation in Agriculture

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Abstract
Agriculture plays an important role in the development of food production in India Agriculture in our country depends on monsoon which is not an adequate source of water. So irrigation is used in agriculture. Internet of Things (IoT) is a milestone in the development of technology. IOT plays an important role in many fields, one of which is agriculture, in order to feed billions of people on the planet in the future. This paper aims to overcome this challenge, the entire system is based on micro control and can be managed remotely via wireless transmission, so there is no need to worry about irrigation time based on crop or soil conditions. Sensors are used to take soil sensor readings such as soil moisture, temperature, air humidity and the user (farmer) makes the decisions using a microcontroller. The data received from the sensor is sent to the server database via wireless transmission. Irrigation will be automatic when the humidity and temperature of the field drop. Farmers receive information about the state of the field through their mobile phones. This system will be most useful in areas where water is scarce and will be effective in meeting your needs.

Keywords: *Smart Irrigation, Sensors, Wi-Fi, ZigBee communication, micro controller ESP 32*

I. Introduction

In India, where 60-70% economy depends on agriculture, there is a great need to modernize the conventional agricultural practices for the better productivity. Due to unplanned use of water the ground water level is decreasing day by day, lack of rains and scarcity of land water also results in decrement in volume of water on earth. Nowadays, water shortage is becoming one of the big- gest problems in the world. We need water in each and every field. In our day to day life also water is essential. Agriculture is one of fields where water is required in tremendous quantity. Wastage of water is the major problem in agriculture. Every time excess of water is gives to the fields. There are many techniques to save or to control wastage of water in agriculture. The objective of the sys- tem is to a) conserve energy & water resources b) handles the system manually and automatically c) detects the level of water. Due to the climatic changes and lack of precision, agriculture have resulted in poor yield as compared to population growth. Irrigation is mostly done using canal systems in which water is pumped into fields after regular interval of time without any feedback of water level in field. This type of irrigation affects crop health and produces a poor yield because some crops are too sensitive to water content in soil. A smart irrigation system, contrary to a traditional irrigation method, regulates supplied water. The feedback mechanism of a smart irrigation system is a moisture sensor and temperature and humidity sensor. Evapotranspiration (ET), thermal imaging, capacitive methods, and neutron scattering method and gypsum blocks are some of the technologies that enable moisture sensing. Capacitive sensors, however instantaneous, are costly and need to be calibrated often with varying temperature and soil type. Neutron probe based moisture sensors are very accurate but present radiation hazards, calibration difficulty and are costly. A large agriculture field presents is with different part of areas, hence, moisture measurement at a single locating in the field does not make much sense. Consequently, what is required is a distributed number of sensor nodes and scattered pumping units to pump water to those specific locations covered by the sensor units. An automated irrigation unit, in conjunction with a low cost moisture sensor, is proposed in this paper.

II. LiteratureSurvey

2.1 Automated Irrigation System using WSN and GPRS Module:

Automated Irrigation system using WSN and GPRS Module having main goal is that optimize use of water for agriculture crops [1]. This system is composed of distributed wireless sensor network with soil moisture and temperature sensor in WSN. Gateway units are used to transfer data from sensor unit to base station, send command to actuator for irrigation control and manage data of sensor unit. Algorithm used in system for controlling water quantity as per requirement and condition of filed. It is programmed in

microcontroller and it sends command through actuator to control water quantity through valve unit. Whole system is powered by photovoltaic panels. Communication is duplex take place through cellular network. Web application manage the irrigation through continuous monitoring and irrigation scheduling programming. It can be done through web pages.

2.2 Crop Monitoring System based on WSN

The subsequent section introduces the Bluetooth technology. Wireless Sensor network crop monitoring application is useful to farmer for precision agriculture. The application monitors the whole farm from remote location using Internet of Things (IOT). Application works on sensor network and two types of nodes. Energy saving algorithm is used in node to save energy. Tree based protocol is used for data collection from node to base station. System having two nodes one node that collect all environmental and soil parameter value and the other consist of camera to capture images and monitor crops. In this System Environmental changes are not considered for sensor reading. System user is not able to program application. There is no controlling system for application.

2.3 Automatic Drip Irrigation System using WSN and Data Mining Algorithm

Data mining algorithm are used to take decisions on drip irrigation system. Automated drip irrigation system having WSN placed in all over farm and different type of sensors. [9] WSN uses ad hoc network which gives self-configuration and flexibility. Sensor data is given to base station and data is received using zigbee. Data processing is done at base station for decision making. Data mining algorithm is used to take decision on data from sensor to drip. All observations are remotely monitor through web application. This system works on Naïve Bayes algorithm for irrigation control. Algorithm works on previous data set for decision making if any attribute is not frequent result is zero [11].

3. Components

3.1. Arduino Microcontroller

Arduino is an open-source electronics platform based on easy-to- use hardware and software [5][4]. Arduino boards are able to read inputs – light on a sensor, a finger on a button – and turn it into an output activating a motor, turning on an LED. A microcontroller is a small computer on a single integrated circuit. In modern terminology, it is a system on a chip. It contains one or more CPUs along with memory and programmable input / output peripherals. Microcontrollers are designed for embedded application. There are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines and other embedded systems [4].

Fig.1:. ArduinoMicrocontroller

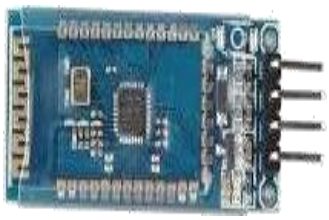

Fig.2. BluetoothDevice

3.2. Sensors

In this system two sensors are used in order to obtain the data about the soil and environmental condition, soil moisture sensor and temperature and humidity sensor.

3.2.1. Soil Moisture Sensor

Soil moisture sensors measure the volumetric water content in soil[11] .Since the direct gravimetric measurement of free soil moisture requires removing, drying and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. This sensor has two probes through which current passes in soil, then read the resistance of soil for reading moisture level. We know that water make the soil more prone to electric conductivity resulting less resistance in soil where on other hand dry soil has poor electrical conductivity thus more resistance in soil.

3.2.2. Temperature and Humidity Sensor

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor shown in Fig 3. It uses a capacitive humidity sensor and a thermostat to measure the surrounding air, and spits out a digital signal on the data pin. It measures relative humidity. Relative humidity is the amount of water vapor in air vs. the saturation point of water vapor in air. At the saturation point, water vapor starts to condense and accumulate on surfaces forming dew. It detects water vapor by measuring the electrical resistance between two electrodes.

3.2.3. Bluetooth Wireless Technology

Bluetooth is a high-speed, low-power microwave wireless link technology, designed to connect phones, laptops and other porta- ble equipment together with little or no work by the use. Unlike infra-red, Bluetooth does not require line-of-sight positioning of connected units. The technology uses modifications of existing wireless LAN techniques but is most notable for its small size and low cost shown in Figure 2. The current prototype circuits are contained on a circuit board 0.9cm square, with a much smaller single chip version in development. The fundamental strength of Bluetooth wireless technology is the ability to simultaneously handle data and voice transmissions, which provides users with a variety of innovative solutions.

4.Proposed System

Irrigation can be automated by using sensors, microcontroller, Bluetooth, android application as shown in Fig.3. The low cost soil moisture sensor and temperature and humidity sensor are used. They continuously monitor the field. The sensors are connected to Arduino board. The sensor data obtained are transmitted through wireless transmission and are reached to the user so that he can control irrigation. The mobile application can be designed in such a way to analyze the data received and to check with the threshold values of moisture, humidity and temperature. The decision can be made either by the application automatically without user interruption or manually through application with user interruption. If soil moisture is less than the threshold values, the motor is switched ON and if the soil moisture exceeds the threshold value the motor is switched OFF. The sensors are connected to the Arduino board. This hardwarecommunicates through wireless Bluetooth transmission so that user can access the data through his mobile that has an android application which can get the sensor data from the Arduino via Bluetooth. As far as cost of device is considered Bluetooth technology is used which can be replaced by Wi-Fi. motor is switched OFF.

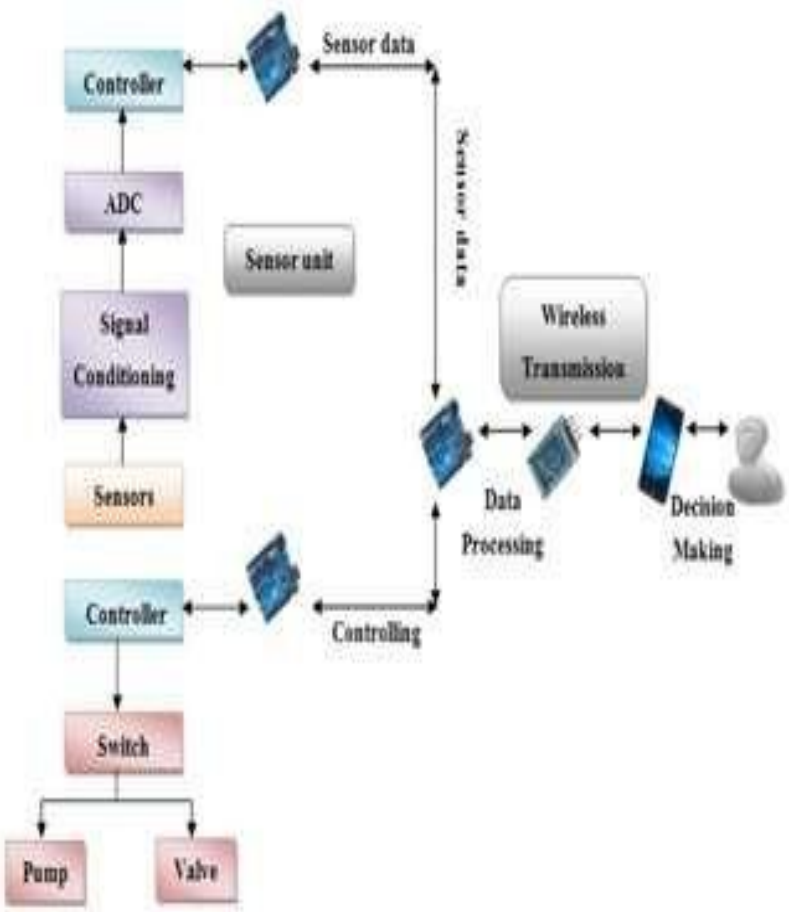

Fig. 3: SystemArchitecture

The Arduino board is programmed using Embedded C in order to control the transmission of sensor data and the working of motor according to the decision made. The coordination of the motor and 3 sensors is maintained by the program fed into the Arduino. Water is supplied to 3 different areas by using Servo Motor, motor that can move its head at different angles. Using this, the head of the motor is made to move at 3 different angle so that water can be supplied at different areas where the sensors are placed. The sensors continuously send data regarding moisture content of the soil. Whichever sensor indicates low moisture content to that place motor is switched on and then water is pumped, if it indicates high moisture content pumping of water is stopped by switching of the motor. All these are managed by the program that has been written into the Arduino Microcontroller. The coordination of all the components are shown in the fig 4.

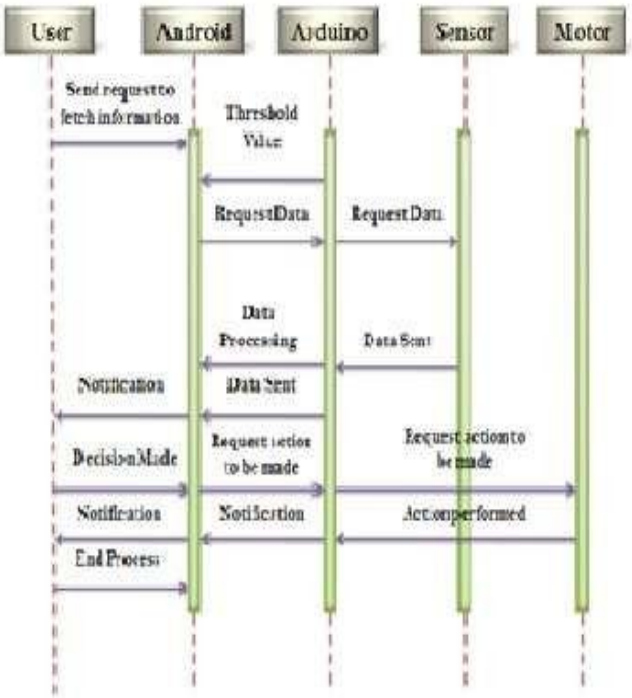

Fig.4::Sequence Diagram for the automatic irrigation

5. Conclusion and Future Work

The automated irrigation system implemented was found to be feasible and cost effective for optimizing water resources for agriculture production. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability. The irrigation system helps the farmer by making his work smarter. As the demand for water increases, along with the need to protect aquatic habitats, water conservation practices for irrigation need to be effective and affordable. As multiple sensors are used water can be provided only to the required area of land. This system reduces the water consumption to greater extent. It needs minimal maintenance. The power consumption has been reduced very much. The crop productivity increases and the wastage of crops are very much reduced. The extension work is to make user interface much simpler by just using SMS messages for notifications and to operate the switches.

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tron probe based moisture sensors are very accurate but present radiation hazards, calibration difficulty and are costly.

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