A Survey on Smart Farming Systems

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Abstract- *Agriculture today needs innovation for better management of precious resources like water and better monitoring of environment parameters to improve the crop growth. Keeping this motivation in mind, this paper presents a survey on the smart farming or agriculture solutions and systems designed by the researchers using the principles of Internet of things and Wireless sensor Networks. This survey includes systems developed for collection of environmental, soil & crop data through sensors, remote monitoring of the farm and controlling the irrigation system automatically mostly using Wireless sensor Networks. This paper also proposes our own smart farming system using wireless sensor network for smart monitoring of the farm, automatic irrigation control and providing smart advise to the farmer based on the pH of the soil with the help of sensors like temperature, humidity, soil moisture, light intensity, pH and water level.*

Keywords- Wireless Sensor Network, Arduino, Raspberry Pi, XBee, Internet of Things

I. INTRODUCTION

Climate is changing rapidly due to global warming. It's effects are now plainly visible in the form of reduced and irregular rainfall. The worst affected sector of economy due to this is the agriculture. Optimal utilization of water is the need of the moment. In India agriculture depends on the Monsoon rains. If the rain doesn't fall as per expectations then the farmers face lot of difficulties. There should be a way to ease the troubles faced the farmers by providing an automatic irrigation tool that provides the water to the crops in required quantities only. There is a tremendous increase in innovations in the field of Internet of Things(IoT) and Wireless sensor Network(WSN). The agriculture sector should be benefited with this treasure of innovation. This paper takes a survey of the research done by the researchers in the field of automatic irrigation and remote monitoring of the form using novel approaches. Most of the systems surveyed in this paper used wireless sensor network technology for collection of sensor data wirelessly from the wireless sensor nodes using either ZigBee protocol, Bluettoth or RF chips. A wireless sensor node consists of sensors, microcontroller unit(MCU), radio for wireless transmission of data and power supply unit. Some researchers also designed either a website or a smart phone application for remote monitoring of the farm.

In this paper, section II provides a survey of the existing smart farming systems, related work in the smart farming domain using internet of things, WSN and other technologies, in section III the Smart Farming System using Wireless Sensor Network(WSN) is proposed.

II. SURVEY OF SMART FARMING SYSTEMS

In [1] researchers presents a smart farming system using Arduino and data mining. They designed an android application for assisting farmer in getting the details like cost of seeds, what fertilizers and pesticides are to be used in the farm, weather information etc. This paper introduces a plant watering system using Arduino for decision making. A hygrometer sensor is used to detect the soil moisture value. If the value of soil moisture is less than the set threshold value then the Arduino will take the decision to turn on the motor else the motor will be turned off. A regression mining algorithm is employed by the researchers to mine the data from database. The database consists of sensor data and information on seeds, fertilizers, pesticides. This paper depends on the output of a single sensor i.e. hygrometer to take the decision of watering the plants.

Paper [2] discusses a novel approach for chicken farm management. It uses sensors like humidity, temperature, air quality sensor module and light sensor. Sensor data are collected by the Arduino and transmitted to Raspberry pi. Based on the sensor data, it will take the decision to turn on/off the ventilator (fan In or fan out) or electric lamps. An android application is also developed by the researchers for remote monitoring of the chicken farm. Remote control of ventilator, electric lamps is also possible using this application.

In paper[3] researchers used wireless sensor network technology to control the irrigation system and power distribution system. Researchers used DHT11/ AM2302 sensor for detection of temperature and humidity. Researchers also measured the soil parameters like soil moisture and water level in the soil. For wireless communication in between the sensor node and coordinator node ZigBee Mesh protocol is used. For this purpose researchers used XBee series2 devices. Researchers used Matlab software for implementing fuzzy logic to simulate the irrigation and power distribution.

Paper[4] discusses an automated irrigation system using wireless sensor networks. It uses the sensors like temperature, humidity, soil moisture and underground water level sensors to collect the environment and soil data. The farm can be monitored using the smart phone application. Using this smart phone application farmer can control the sprinklers in the farm remotely.

In paper[5] researches presents a drip irrigation control system with the help of sensors like temperature and soil moisture. For measuring temperature LM-35DZ sensor has been used. Researchers have designed the soil moisture sensor using the concept of electrical conductivity. RF module 433 MHz has been used for wireless transmission of sensor data. Microcontroller ATMEGA 16 has been used to control the drip irrigation system.

Researchers in paper[6] has developed an irrigation system using the distributed wireless sensor network. They developed wireless sensor and Information units. Wireless sensor unit consists of microcontroller(PIC24FJ64GB004), soil-moisture sensor(Vegetronix-VH400), temperature sensor(DS1822), XBee Pro S2 and rechargeable battery charged by photo-voltaic panel. Sensor unit sends data to the information unit using XBees. Wireless information unit consists of PIC24FJ64GB004 microcontroller to control the irrigation and a GPRS module MTSMC-G2-SP for uploading the sensor data of temperature and soil moisture on a website.
In paper[7] researchers used the distributed wireless sensor network. They placed six sensor stations distributed in the farm for measuring soil moisture, soil temperature and air temperature. Sensor data is transmitted wirelessly to the base station by low cost Bluetooth devices. Base station receives the weather data from the weather station like air temperature, relative humidity, precipitation, wind speed, direction and solar radiation. Base station takes the decision to turn on/off the irrigation system based on the sensor and weather data and wirelessly communicates the decision to the irrigation control station. Irrigation control station sends its GPS location to the base station for real time monitoring. Base station sends the GPS location of the sprinkler to be controlled to the irrigation control station with the amount of water to be used.

Researchers in[8] presents a smart monitoring and automation system for controlling the environment parameters of greenhouse. They used sensors like temperature, humidity and light. Each sensor node sends the sensor data to the main node wirelessly using the ZigBee protocol. A sensor node consists of sensors, ARM microcontroller and relay to control the solenoid valve. Main node is similar to any other sensor node with addition of the ethernet which facilitates the online monitoring of the greenhouse parameters. All sensor nodes are connected to the control workstation through Controller Area Network(CAN) bus. This system was designed using embedded C and Java.

Paper[9] presents a hierarchical wireless sensor network system for measurement of soil parameters like temperature, and moisture. A sensor node is buried under the soil for measurement of these parameters. It sends the sensor data to the relay node above the gound. Relay node transmits the data to other relay node or base node. The base node sends the data to a workstation for analysis and storage.

Researchers in paper[10] proposed an agricultural environment monitoring using wireless sensor network. Sensiron SHT11 sensor was used by the researchers for measurement of temperature and humidity parameters. A sensor node consists of SHT11 sensor, MSP430F149 microcontroller, nRF2401 (Nordic Inc.) RF chip and a solar power module. The software for this system is designed using C programming language for displaying the sensor data, storage and analysis of data.

Researchers in paper[11] discusses a crop monitoring system using wireless sensor network. A sensor node consists of the CMOS image sensor OV7640, ATmega128A microcontroller unit, CC1101 low power RF module and power supply unit. A sensor node takes the images of crop growth for analyzing the growth pattern of crops.

Paper[12] presents a WiFi based solution for agricultural environment monitoring using wireless sensor network. Parameters like temperature, humidity, air pressure, light intensity, water level and soil moisture are measured by the sensors. Data is sent wirelessly to the central server for further analysis, monitoring and display using the WSN802G module.

III. PROPOSED SMART FARMING SYSTEM

Block diagram of the proposed smart farming system using wireless sensor network is shown in the Fig. 1.

Our proposed smart farming system has following objectives,

- Smart monitoring of farm
- Automatic irrigation control
- Smart advise to farmers regarding use of fertilizers

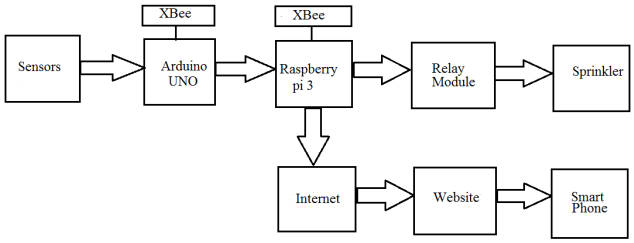

FIG. 1 Block diagram of Smart Farming System using WSN

Proposed system consists of sensors like temperature, humidity, light intensity, soil moisture, pH and water level. A wireless sensor node is formed using sensors, XBee, Arduino Uno and power supply unit. It acts as a router node in the WSN. The raspberry pi with XBee acts as the coordinator node in the WSN. The sensors send data to the Arduino. Arduino then transmits the sensor data to Raspberry Pi. This communication happens using the ZigBee protocol. XBees are configured in point to point mode to enable the wireless communication in between Arduino and Raspberry Pi. Raspberry Pi drives the relay to turn on/off the drip irrigation system or sprinklers based on the sensor data. Raspberry pi uploads the sensor data on to the website. The website uses a responsive design and farmer can access it using his/her smart phone. The website displays the sensor data for remote monitoring of the farm and also displays the recommendations to the farmer regarding the use of fertilizers according to the pH of the soil.

IV. CONCLUSION

This paper provides a survey of existing smart farming systems. These smart farming systems mainly constitutes of smart irrigation systems and smart farm monitoring systems. After doing a survey of all these systems a smart farming system using wireless sensor network is proposed in this paper. The proposed system provides the automatic irrigation and smart monitoring of farm using sensors like temperature, soil moisture, pH, humidity, light and water level sensor. It also provides guidance to the farmer about what fertilizers should be used based on the soil pH.

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