

Implementation of Plant Soil Moisture Monitoring System Using Wireless Sensor Networks Based on IoT - Internet of Things

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Abstract - Monitoring the soil moisture generally done by manual observation of researchers in agriculture area. It is obviously take a long time, especially when monitoring the declining level of soil moisture. This practice is less efficient especially when examining the level of soil moisture contained plants in it. The Wireless Sensor Network (WSN) is integrated with Internet of Things (IoT) to achieve the above objective. Further, to enhance the network lifetime, Exponential Weighted Moving Average (EWMA) event detection algorithm is adopted in the proposed research.

Key Words: Organic farming, plant health, soil moisture
Wireless sensor networks

1. INTRODUCTION

Wireless Sensor Network (WSN) is the technology, in which the data collected from the field of interest is transmitted through wireless link. WSN can be used in various fields such as monitoring, wireless measurements, controlling, etc. In the field of precision agriculture and organic farming, it is important to continuously monitor the fields as they are site specific. Monitoring plant health is essential which enriches the productivity of food grains. Soil moisture is one of the primitive factor for plant health.

The water that remains in soil as a thin film aid in supplying nutrients to the plant growth. The age of The Internet of Things comes, wireless sensor networks become the core of networking. In order to achieve greater things on the technical requirements of The Internet of Things, we adopt the technology of wireless sensor network based on Zigbee, GPRS and Web Services technology designing a set of low cost, low power consumption, flexible automatic networking temperature humidity monitoring system of soil.

The system is a complete set of wireless sensor network induction, acquisition, storage, application, reporting, solution, has a good man-computer exchange interface. Users need not go into farmland, in a corner anywhere in the world, could prompt understand the changing condition of farmland soil temperature and humidity, scientifically guide agricultural production. The rest of the paper is organized as follows : Section II deals with the literature related to plant health monitoring system.

2.LITERATURE SURVEY

A system [2], that have developed a greenhouse automatic control system based on WSN to monitor the indoor environment. Based on the information received, the indoor environment is controlled and monitoring the crops is carried out which prevent the plant from blight and harmful insects. The data collected is stored either in a database or in a server which is controlled by the user remotely.

In [3], the authors have analyzed the growth of sweet potatoes under controlled and exposed environment. The miniature greenhouse setup is built that monitors various parameters namely temperature and humidity of green house, and temperature of soil. According to restrictions in parameter value, green house setup is controlled via relay switches connected to Aurdino based embedded unit.

In [4] the authors have developed a temperature and humidity monitoring system of soil based on WSN that uses GPRS as a gateway platform. The temperature and humidity sensor are placed on plant species. The data from these sensors are collected continuously and stored in atos pc software which is open source. Then it is uploaded to server through atos pc server for remote monitoring.

From the literature survey made, most of the monitoring system has been developed for controlled environment, i.e for green house rather than exposed environment. In this paper soil moisture monitoring system using WSN is developed for an open environment. Further, in order to enhance lifetime of WSN, Exponential Weighted Moving Average (EWMA) EDA is used.

2.1 Existing System

In survey of the specific application needs of soil environmental monitoring system and analysis those problem existing in monitoring system, we designed and implemented a wireless sensor network based on the soil temperature humidity monitoring system. The system can realize rapidly automatic networking and real-time data acquisition, transmission, display. With the characteristics of low cost, low power consumption, flexibility networking, without cabling, friendly interface, etc.

3.PROPOSED SYSTEM

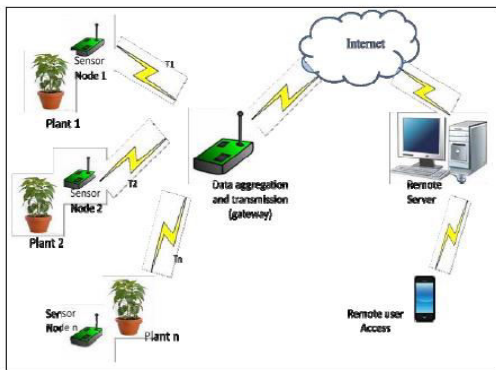
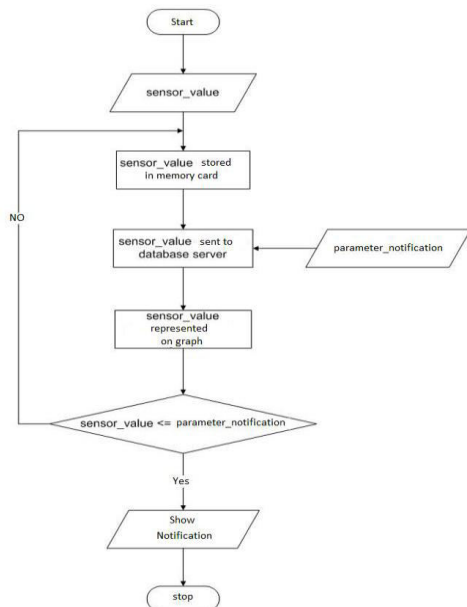


Fig: proposed soil moisture monitoring system

3.1 Notification System



Notification System: The process of the application system work when the sensor then read the data soil moisture (sensor_value), the data will be stored first in the memory card, after the data is stored then the data will be sent to the database server via the internet. The data stored in this database will be represented in graphical form. Then on the client side will be provided form input parameter (parameter_notification) from 1 - 100%. The input data will be stored in the database server.

3.2 Sensor interfaced

The below figure shows the interface between soil moisture sensor and PIC microcontroller. PIC micro controller is used in the proposed research as it is reconfigurable easily. PIC 16F877. A is cheaper when compared to other microcontroller. It has an inbuilt Analog to Digital Converter (ADC) which converts the analog values of sensors to digital. The digitized data is transmitted by the Zigbee Tx.

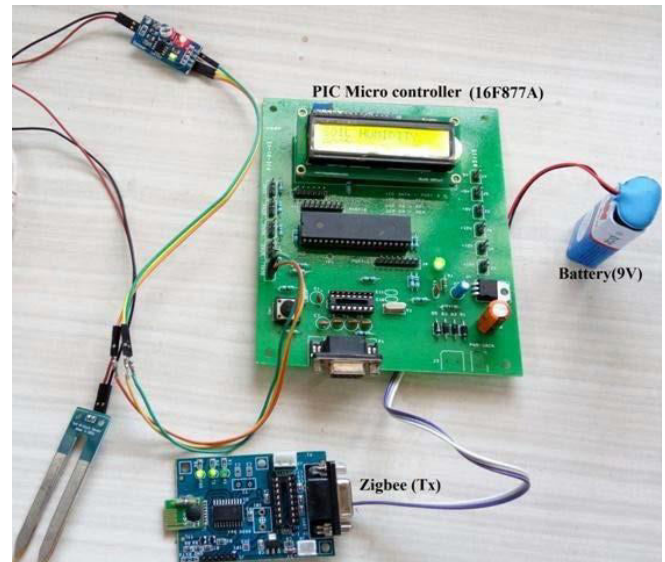


Fig: Sensor interfaced with PIC microcontroller and Zigbee

3.3 Event Detection Algorithm

Disadvantage of WSN is energy depletion due to the communication among sensor nodes. EDA is adopted to overcome the above issue. EWMA is one of the threshold based EDA which is used in this research, in order to set the control limits of soil moisture.

$$EWMA_t = Z_t = \lambda x_t + (1 - \lambda) Z_{t-1} \quad (1)$$

for $t=1,2,3,4,\dots,n$

Where,

t = no of observation at periodic intervals

λ = weighted average based on the previous values and ranges between 0 and 1

x = obtained value

Z_{t-1} = previous value of Z_t

Upper Control Limit (UCL) and Lower Control Limit (LCL) are computed using equation (2) and (3).

$$UCL = \mu_0 + L\sigma \sqrt{\frac{\lambda}{(2-\lambda)[1-(1-\lambda)^{2t}]}} \quad (2)$$

$$LCL = \mu_0 - L\sigma \sqrt{\frac{\lambda}{(2-\lambda)[1-(1-\lambda)^{2t}]}} \quad (3)$$

Where,

μ_0 =Mean; L =width of the control limits ; σ = standard deviation from the moving range chart

Fig : Event Detection Algorithm

4 SYSTEM TOOLS

4.1 Hardware Requirements:

System	: Pentium Dual Core.
Hard Disk	: 2 GB.
Monitor	: 15" LED
Ram	: 1 GB
Sensors	: Soil Moisture sensors 3

Sensors: A sensor is a device that detects and responds to some type of input from the physical environment . The specific input could be light , heat, motion , moisture, pressure, or any one of a great number of other environmental phenomena .

The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

Temperature Sensor: Measuring the heat in the environment.

Light Sensor: Controlling or switching on/off of the light.

Humidity Sensor: Measuring the amount of water vapour in the air.

4.2 Software Requirements:

Operating system	:	Windows 7
Coding Language	:	JAVA/J2EE
Tool	:	Net beans 7.2.1
Database	:	MYSQL

5. CONCLUSIONS

Indian farmers are facing a lot of problems, but the advancement of wireless sensor networks in agriculture would be promising in the present scenario of water scarcity and unpredictable weather conditions. This paper provides implementation of WSN based soil moisture monitoring system. As WSN is battery operated to enhance the lifetime. EWMA event detection algorithm is used which generate events only when threshold conditions is met. Rest of the time, the nodes are in sleep state which can save their energy. This work can also be further extended by considering more than one sensor module.

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