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Humidity and Temperature Measurement WSN node for Grapes Environmental Condition Monitoring

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ABSTRACT

In agriculture sector today's weather forecasting systems accessible based on satellite and RADAR communication. These systems are heavy, difficult to handle and costly. They are sensing barely particular area and its partial range. But in agriculture field ubiquitously not identical environmental conditions it is necessary to monitoring each and every crops existing environmental circumstance. An agriculture field premises has dissimilar humidity, temperature, moisture, light intensity because corner of plot trees and water leakage, so that kind of changes across all parameters of field are necessary, and such parameters of crop sustain the quality. In present paper proposed system, optimization of humidity and temperature measurement WSN node using ATmega328 for grapes environmental condition are monitoring. There are many systems are available in the market based on Wireless sensor network (WSN) but this system is more energy efficient, small size, portable. Sensor is integrated package contains humidity and temperature measurement capability in single package.

Key words: Wireless sensor network, Precision agriculture monitoring system (PAMS), ATmega328, DHT22

INTRODUCTION

Wireless sensor network have many applications such as industrial automation, precision agriculture, library management, defence, hotel management, disaster management, weather monitoring etc. Weather monitoring is one of the essential applications for monitoring of diverse environmental constraint from agriculture field, warehouses; industrial filed etc and it is also supportive for maintaining the environmental conditions. These harmful conditions allow the A mild disease, called black rot, is widely widespread and often damaging. The disease first attacks the plant life and later spreads to the fruit. Infected berries soon become blackened, shrunken and worthless. Other fungus diseases are downy and powdery mildews. Fungal diseases usually grow in dense foliage that does not dry quickly. Appropriate pruning and training that encourages light penetration and air movement will help to eliminate or decrease the sternness of these diseases. A bacterial disease often occurs following an extremely cold winter. Fleshy tumours appear on the lower trunk of injured vines. Light and continuous rains or heavy dew related with high humidity and low temperatures favours the growth of the disease. The disease attacks the foliage, flowers, cluster and young fruits. Initial indication appear as light yellow spots on the upper surface of young mature leaves with corresponding white spots on the lower side. Affected portions of the leaves turn brown and cannot support the bunch development due to reduced photosynthetic activity. The losses are excessive when the clusters are attacked before fruit set. Entire cluster decays, dries and drops down. Infected small berries turn brown and become mummified. However, once berries begin change colour and softening, they stop to get infected.

For standard quality of grapes, based on species but it necessary to monitoring and take precautions are very essential. In India many states are to take production of grapes and from grapes different food products are making. In all over India, Area and production of grapes is major producing in Maharashtra and Karnataka states. In all over species of grapes Thompson seedless, Shared seedless, Sonaka, Ganesh, Manik, Chaman etc, are taken in Maharashtra, India.

Grapes usually require a hot and dry climate during its growth and fruiting periods. It is successfully grown in areas where the temperature range is from 15-40 ^{0}C. High temperatures above 40^{0}C during the fruit growth and growth reduce fruit set and consequently the berry size. Low temperatures below 15^{0}C followed by forward pruning damage the bud break leading to crop failure.

Area with annual rainfall not exceeding 900mm well distributed throughout the year is ideal. However, rainfall during flowering and fruit ripening is not sympathetic as it leads to the spread of downy mildew disease. High atmospheric humidity is detrimental during vegetative growth and fruiting. At a high humidity the vegetative growth of vines is energetic which affects the fruit size and quality. Similarly high humidity during 30-110 days after forward pruning favours the expansion of fungal diseases.

LITERATURE SURVEY

There are many wireless sensor network systems based applications given in literature and available in the market for precision agriculture, automatic irrigation system, weather monitoring etc. Chaudhary et. al proposed one of the applications of wireless sensor network (WSN) monitoring and control green house parameters in precision agriculture [1]. Zhang et al [2] proposed node system of wireless sensor network and introduced the communication protocol between the nodes in wireless sensor network and the method of application for sensor network in digital agriculture. A new method of information acquisition, information processing and information exploitation is proposed, it has the features of independence and real time, adapts to the production management of agriculture. Li et al [3] proposed such a system to managing and monitoring growth period of crop. This system consist design of WSN for Precision Agriculture Monitoring system (PAMS). Li et al [4] system can monitor the greenhouse environments, control greenhouse equipment, and provide various and convenient services to consumers with hand-held devices such as a PDA living a farming village. They also discuss the advantages of using management strategy along wireless sensor network technology for such cost-effective and environmental friendly greenhouse management. Xia et al [5] developed system can automatically collect the temperature, humidity, illumination, voltage and other parameters of the deployment zone, and transmit the data to the remote server via GPRS in real time. This system also includes a web-based platform integrated with Google Maps to release the greenhouse environmental status and provide real-time voice and SMS alarm service. Catania et al [6] Monitoring the micro-climate from different vineyard plots may thus be crucial as it may represent the key to a rational management of the vineyard, also with regard to a reduction of the costs of certain cultural operations.

SYSTEM ARCHITECTURE

Wireless Sensor Network is a spatially distributed autonomous sensor to monitor physical and environmental parameters such as temperature, sound, humidity, moisture, pressure etc. More modern Wireless sensor network are bidirectional and enabling control of sensor activity. Such WSN systems development is motivated by many applications such as process control or machine health monitoring in industry, defence, medical and so on. WSN built of nodes from few hundreds or thousands, each node has several parts such as RF transreceiver, Microcontroller, Sensors and power supply those WSN nodes vary size depends on the size of the grain dust. Fig.1. shows architecture of WSN system, there are mainly three parts Gateway, Router and Sensor node.

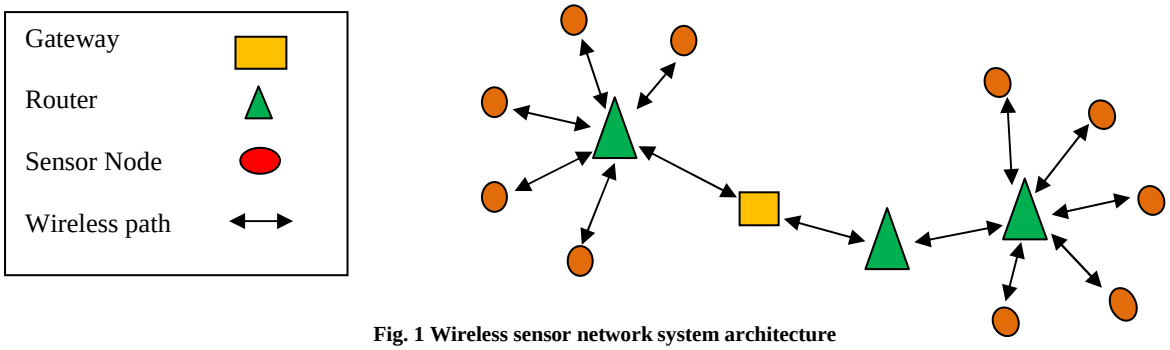

Fig. 1 Wireless sensor network system architecture

Gateway

It is a centralized device which collects all over sensor node data and share. Wireless sensor network (WSN) gateways manage the wireless network and aggregate data from distributed WSN measurement nodes. Each gateway features a 2.4 GHz, IEEE 802.15.4 radio to communicate with up to eight end nodes (in a star topology) or up to 36 WSN measurement nodes (in a mesh topology). Each gateway offers different connectivity options. With the WSN-9791 Ethernet gateway, you can create simple PC or real-time-based WSN systems. With the NI 9792, you can create a headless, embedded monitoring system that operates independently of a host machine. With the NI 9795, you can easily add WSN wireless I/O to existing NI Compact RIO monitoring and control systems. Router provides the pathway to data packets of sensor nodes and gateway. It checks traffic to that way and give direction from nearest paths.

DHT22

It is low cost temperature and humidity sensor. There are many series of such sensor is available in the market. DHT11 is a preliminary model of such sensor. It contains both parameters are integrated in a single package. Accuracy of such sensor is very good as compare to others sensor. Characteristics of DHT22 are given in table -1.

Fig. 2 Wireless sensor network node block diagram (Sensor Node Architecture)

Table -1 Humidity and Temperature Sensor and their Characteristics

Measure	Sensor	Characteristics
Relative Humidity and Temperature	DHT-22	• Power supply - 3.3-5.5V DC • Output signal - digital signal via 1- wire bus • Operating range - humidity 0 - 100% • RH; temp - 40~80 ^{0}C • Accuracy - humidity +-2%RH (Max +-5%RH)

Router

Wireless sensor networks are formed by small sensor nodes communicating over wireless links without using a fixed network infrastructure. Sensor nodes have a limited transmission range, and their processing and storage capabilities as well as their energy resources are also limited. Routing protocols for wireless sensor networks have to ensure reliable multi-hop communication under these conditions [7]. We describe design challenges for routing protocols in sensor networks and illustrate the key techniques to achieve desired characteristics, such as energy efficiency and delivery guarantees. We give a survey of state-of-the-art routing techniques with a focus on geographic routing, a paradigm that enables a reactive message-efficient routing without prior route discovery or knowledge of the network topology. Different geographic routing strategies are described as well as beaconless routing techniques. We also show the physical layer impact on routing and outline further research directions. The communication between all parts is wireless. For wireless sensor networks require many topologies but it appropriate is hybrid topology [8].

Wireless Path

It is wireless communication between gateway, routers and WSN nodes. Wireless path is bidirectional communication based on ZigBee. The range and data rate of wireless communication is depending on the ZigBee and their operating frequency. Fig. 2 depicts wireless sensor network node block diagram, which consist of DHT22 (Humidity and Temperature) sensor, ATmega328, ZigBee, and power supply.

ATmega 328

The foremost heart of the system is microcontroller which process and controlling the input and output parameters. Here we have used ATmega 328P microcontroller, it is high performance low power 8-bit microcontroller based on arduino board. It is advanced RISC architecture, High Endurance Non-volatile Memory Segments, 8-bit 10 channel ADC, High endurance, operating voltage 1.8V- 5.5V, less power consumption, six sleep modes, power on reset and programmable brown-out detection, internal calibrated oscillator etc.

For display received signal on 16x2 lines LCD is interfaced. It is economical, easily programmable, have no limitation of displaying special & even custom characters, animations and so on. It is 5x7 matrix display; some special commands are used to control this LCD.

RF Transreceiver

It is used for wireless data transmission, there are many types of RF transreceivers such as from Texas instruments we can used as CC1200. But many times we prefer the ZibBee.

ZigBee

It is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low - power digital. ZigBee is based on an IEEE 802.15.4 standard. Operating frequency of ZigBee is 2.4 GHz. It is low power consumption limits transmission distances 10–100 meters line-of-sight, depending on power output and environmental characteristics, ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. Before interface XBee to microcontroller load program in XBee using X-CTU through serial communication PC or Lap-Top to ZigBee.

Power Supply

We can either solar cell or battery cell. Such system is more energy efficient because it requires less power and small in size. System is more energy efficient but it will require less power because main microcontroller is energy efficient. We developed system board (PCB) by using eagle tool. It is special software for PCB designing. Its

performance and many features are better as compare to others. In this system, many sensors node can be interface on this single board. At present humidity and temperature measurements sensor are interfaced with WSN node. Fig. 3 shows circuit diagram of ATmega328 board which contains interfacing sensor, display and ZigBee whereas Fig. 4 shows the program flowchart.

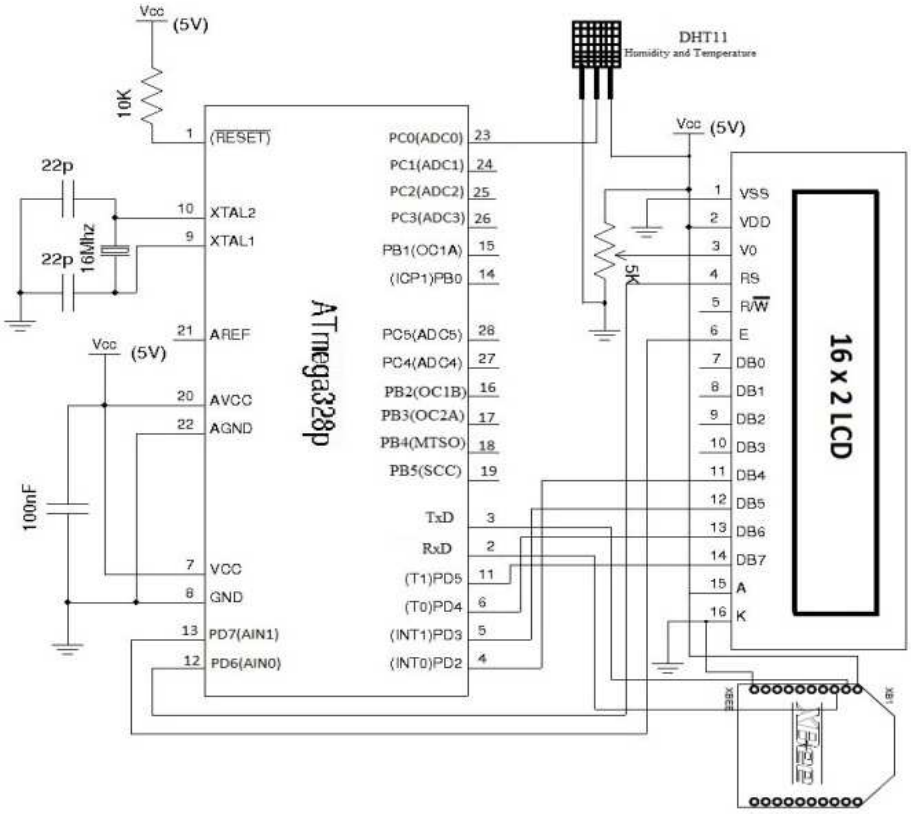

Fig. 3 Circuit diagram

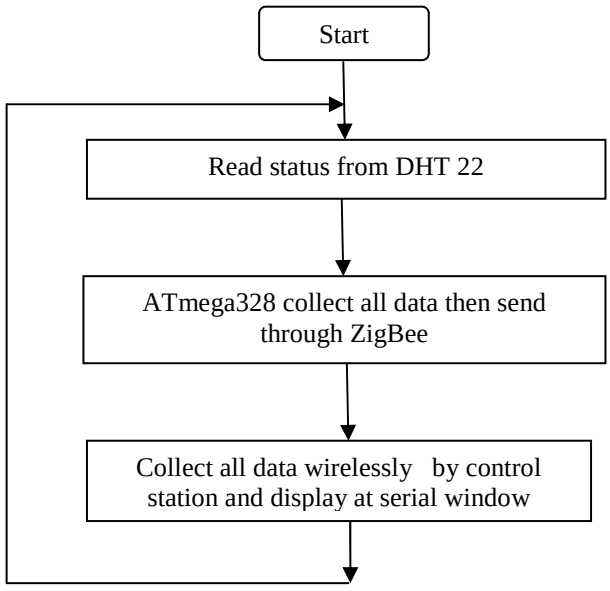

Fig. 4 Program Flowchart

RESULT AND DISCUSSION

We have developed such a system based on Atmega328 microcontroller. We received real time data of humidity and temperature from WSN node. We observed readings from different fields such as in room, on agriculture farm and in greenhouse. Those fields have different humidity and temperature readings, slight change in parameters. Table 2 shows that dated 16/03/2015 real time changes relative humidity and temperature data collected from system. Graph indicates the response of relative humidity and temperature at different time instants. At instant 5 there is change in temperature and relative humidity.

Table -2 Real Time Humidity and Temperature Readings

Relative Humidity (%)	Temperature (°C)
35	30
34	29
34	30
34	30
40	31
35	30
36	30
33	31
32	32

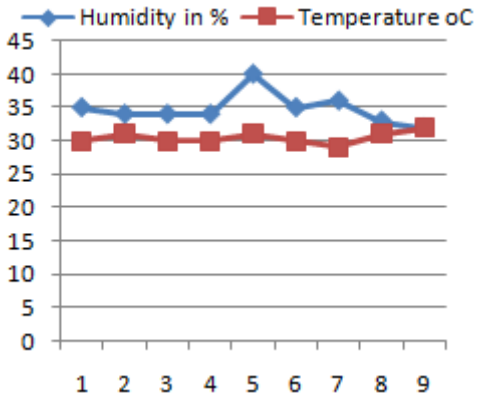

Fig. 4 Humidity and Temperature response at different time instant

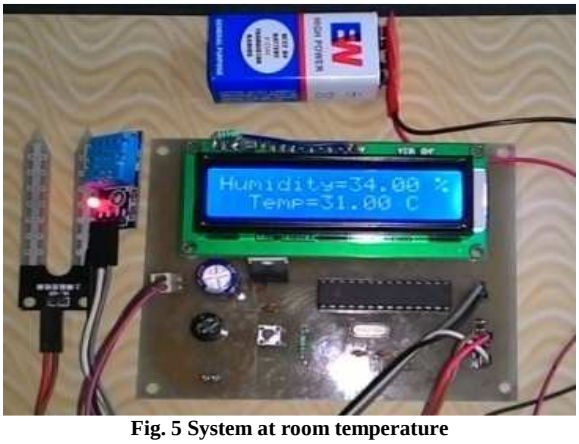

Fig. 5 System at room temperature

Fig. 6 System on agriculture field

CONCLUSION

Above system is useful in agriculture sector as well as weather forecasting. We will interface many another sensors to controller and data will transmit wirelessly. Users can achieve all real time data of such system through wirelessly.

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