International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

SMART POLYHOUSE USING WSN

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ABSTRACT

In modern farming, several measurement points are required to study the various climatic conditions in different parts of the huge polyhouse to make the polyhouse automation system work properly. Wiring would make the measurement system expensive and vulnerable. However, the cabled measurement points are difficult to relocate once they are installed. Thus, a wireless sensor network (WSN) consisting of small-size wireless sensor nodes consisting of a radio transreceiver and one or several sensors, is an attractive, innovative and cost-effective option to build the required automation system. A sensor is an electronic component which measures physical parameters from the environment and converts it into electrical signal. Sensors then transmit them by wireless medium. In wireless medium the sensor and its associated components are called as node. A node is self-equipped by a processor, local memory, sensors, radio, battery and a base station that are responsible for receiving and processing data collected by the nodes. Nowadays, the applications of these networks in agriculture are being adopted widely. One interesting application is in environmental monitoring and polyhouse control, where the crop conditions such as climate and soil do not depend on natural agents. To control and monitor the environmental factors, sensors and actuators are necessary. Under such conditions, these devices must be used to make a distributed measure, spreading sensors all over the greenhouse using distributed clusters of node.

Keywords: Polyhouse, Wireless Sensor Network(WSN), Zigbee.

I. INTRODUCTION

A polyhouse is a new innovative technique of farming where plants are grown even in unfavorable climatic conditions. These are the structures which are useful to cultivate crops, in particular period of the year, in areas where cultivation cannot guarantee good quality crops. Polyhouse cultivation along with other controlling modes creates a microclimate conditions favorable to grow plants. Environmental controllable conditions include temperature control, water level, relative humidity, carbon dioxide level and so on. Here, all the natural aspects of environment are modified for maximum growth of the plant. Polyhouses are increasingly important in the food supply of high latitude countries. The closed environment of the polyhouses has its own unique requirements, compared with outdoor production. Pests and diseases, and extremes of the heat and humidity, have to be controlled, and irrigation is necessary to provide water. In warm whether it becomes necessary to allow only significant inputs of the heat and light to the vegetables. Because the polyhouses must be constantly monitored to ensure optimal environmental conditions, a WSN can be used to gather data remotely. Wireless

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sensor network (WSN) consists of network which is simply an autonomously distributed sensors to monitor physical or environmental conditions like temperature, humidity, carbon dioxide levels, moisture content, etc. and cooperatively pass their data through the network to a main computer. WSN can be used in some special automation for signal collection, processing and transmitting. Wireless technologies have been rapidly growing during these recent years. Its advantages include the reliability, simplicity, and low cost in installation as well as maintenance. WSN can become a useful part of the automation system architecture in modern farming. Wireless communication can be used to collect the measurement and to communicate between the centralized control and the actuators located in the different parts of the polyhouse. Compared to the wired systems, the installation of WSN is faster, cheaper and much easier. Moreover, it is easy to locate the measuring points when needed just by moving sensor nodes from one location to another within the communication range of the coordinator device.

II. WORKING PRINCIPLE

The sensors are used to monitor environmental parameters of crop cultivation, so that the farmer knows and control the various parameters such as humidity, temperature, moisture, etc. In order to avoid the risk of frost, as well as any plant diseases or you can control the level of irrigation based on soil moisture and leaf wetness. The polyhouse monitoring is, optimizing the production, considering local soil and climatic variations. At an event, all the sensors may send information to the major central node. The server management may face the problem of data congestion and intercommunication between nodes. Such challenges can be overcome by the application based WSN with a specific protocol. In automation and control applications, WSN are popular because they are scalable and easy to handle. Now-a- days there are various sensor nodes that are economical and are available with a high-level technology. They are capable to collect the environmental data with precise sensors and can transmit it to control station with high efficiency. In this project, the sensors in various nodes sense the various parameters of environment and the data is stored in the node. The wireless sensing node consist low performance CPU, memory, radio transmitter and sensors. They make environmental measurements (sensing) and transmit them to a collection point, which then forwards them to a remote processing system. The characteristic of these nodes is that they are small, low-power, wirelessly interconnected and cost-effective. The multiple nodes form a mesh topology of a WSN. The data is transferred between the nodes and the server using wireless protocol ZigBee.

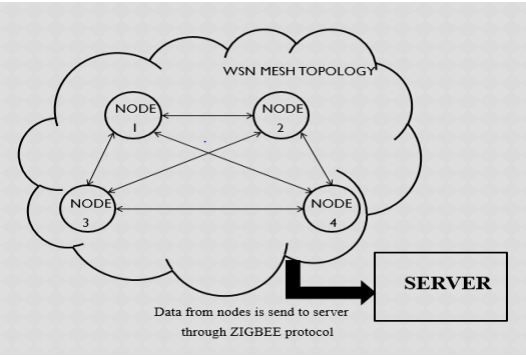

Fig .1: Wireless sensor network architecture

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III. SYSTEM OVERVIEW

Wireless sensor network consists of nodes at different intermediate areas. These nodes are combination of a controller, memory, radio module, and sensors.

A. Controller

The Arduino Uno is a microcontroller board which have ATmega328 IC on it. This IC has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything that is required to support the microcontroller. The board is simply connected to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

B. Communication Protocol Zigbee

IEEE 802.15.4 and zigbee are the standard protocols that provide the network structure required for wireless sensor network applications. IEEE 802.15.4 defines the physical and MAC layers, zigbee defines the network and application layers. For sensor network applications, design requirements demand for long battery life, low cost, small footprint, and mesh networking to support communication between large numbers of devices in a multi-application environment. ZigBee is the only technology that is standard based and has addresses that are the unique which is needed for most remote monitoring and control sensory network applications

ZigBee networks include the following device types:

Coordinator:

This is the device that initiates and controls the network. The coordinator stores information about the network, which includes acting of being the repository device of the network. It is also responsible for broadcasting a message throughout the network.

Router:

These devices further extend network area coverage, dynamically route data, and provides alternative routes in case of any device failure. They can connect to the coordinator and other routers, and also support child devices.

End Devices :

These devices can transmit or receive a message, but cannot perform any routing operations. They must be connected to the coordinator or a router. They do not support child devices.

Various Zigbee topologies consists of network topologies such as mesh, cluster, star, etc.

IV. SENSORS

Humidity and Temperature (DHT22)

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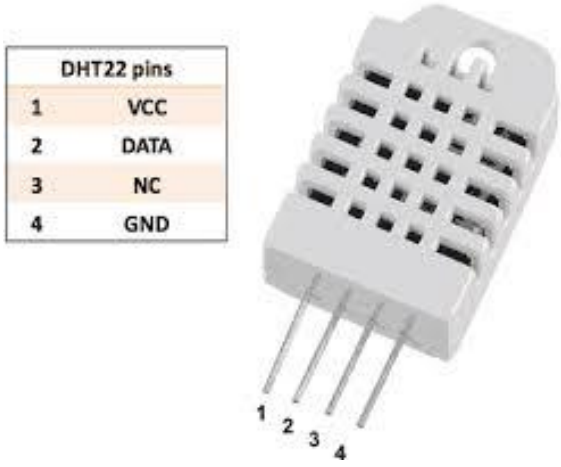

Fig. 2. Dht22 Sensor

DHT22 sensor output is a digital signal. Its exclusive digital-signal-collecting-technique and humidity sensing technology, assures its reliability and stability. Every sensor of this model is temperature compensated and calibrated with accuracy in calibration chamber and its calibration-coefficient is saved in form of programme in OTP memory. When the sensor is detecting, it will cite coefficient from memory. Small size & low consumption & long transmission distance(100m) makes DHT22 to be well suited in all kinds of robust applications. This sensor is a single-row packaged with four pins, making the connection very convenient. Relative humidity largely depends on temperature. Though the temperature compensation technology is used to achieve accurate measurement of RH, it is still strongly advised to keep the humidity and temperature sensors working under the same temperature. DHT22 should be mounted at the place as far as possible from parts that may generate heat.

Soil Moisture:

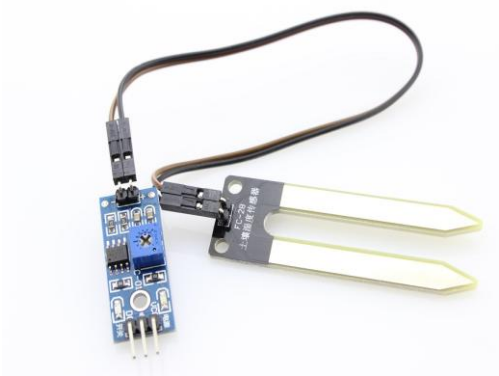

Fig. 3. Soil Moisture Sensor

Soil moisture sensors measure the volume of the water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil. These properties include electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relationship between the measured quantity and soil moisture must be calibrated and it may vary depending on environmental factors such as soil type, temperature, or electric conductivity.

Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

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