

# Different Techniques of Greenhouse Remote Monitoring System: A Review

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**ABSTRACT:** This review article discusses various techniques of remote monitoring of greenhouse systems and what is required for the variations in software and hardware implementation. It presents an overview of the existing state-of-the-art practices of greenhouse monitoring systems and is mainly focused on higher efficiency for the real-time monitoring result, low cost systems and can significantly reduce the workload for greenhouse environment monitoring. The major factors that usually rule the development of greenhouse systems are higher efficiency, satisfactory automation, a user friendly interface with the computer, and complexity of computation, profitability while minimizing unintended effects on green house environment.

**Keywords:** Greenhouse, Wireless sensors, LAB View, Data acquisitions.

## I. INTRODUCTION

Climatological condition monitoring is one of the most important aspects in agricultural production that has a direct impact on the productivity and maintenance of crop. A huge loss occurs every year due to damage of crops by various diseases caused by improper climatic conditions. Greenhouse is the advanced facility available in which we can control the climate to increase plant growth and avoid the effect of season changes on the plants. Greenhouse is playing a significant role in the production of out-of-season fruits, flowers and vegetables as well as high value and sensitive plants like capsicum. The purpose of greenhouse environmental monitor is to get the best climatic conditions (controlled temperature, humidity, light and level of carbon dioxide) for crop growth, increased crop yields, improved quality of crops, and regulated growth cycle of crops [1]. Greenhouses are often used for growing flowers, vegetables, fruits, and tobacco plants. Most



Figure 1. Greenhouse concept [2]

Greenhouse systems still use the manual system in monitoring the temperature and humidity. A lot of problems can occur not for worker but also affected production rate because the temperature and humidity of the greenhouse must be constantly monitored to ensure optimal conditions. The Wireless Sensor Network (WSN) can be used to gather the data from point to point to trace down the local climate parameters in different parts of the big greenhouse to make the greenhouse automation system work properly. The data are transmitted to a central location and used to control heating, cooling, and irrigation systems [2].

## II. WSN TECHNIQUES

The communication modes of environmental monitoring system basically have the following kinds: wireless communication based on Bluetooth [8], Zigbee protocol [1], Internet [3,5], GSM[6]. The mode of short distance wired data communication has several short comings, such as poor expansibility, short transmission range, instable system, etc [3].

TABLE 1: Comparison of Zigbee, Wi-Fi, Bluetooth

Technology	Zigbee	Wi-Fi	GSM
Range	1-100+	1-100	wide
Source metrics	Reliability, Cost, power	Speed, Flexible	Cost
Application	Monitor & control	web, email	Data X'er

However, compared with wired data communication, ZigBee communication mode is more suitable for short-distance communication inside greenhouse because its advantages, such as, no complicated wire, flexible networking, easy to upgrade.

In recent years, Ethernet has been introduced in the remote information transmission technology for greenhouse because of its fast speed, general protocol, good expansibility and easy Internet integration, etc [3].

Another wireless sensor GSM which has developed rapidly in recent years. Short Message Service of GSM is a value-added service based on data packet switching. Because the GSM network can be interconnected and roamed all over the country, it has strong network ability, the users has no need to organize another network. The coverage of the network is improved and expensive network building and maintenance cost can be saved for users. At the same time, the number of its users is not limited. GSM network provides a strong platform for remote data transmission and monitoring the communication of equipment, it is an important method of wireless remote monitoring system [4].

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physically or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location [2].

WSN can be used in some special situation for signal collection, processing and transmitting. 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 greenhouse. Moreover, it is easy to relocate the measurement points when needed by just moving sensor nodes from one location to another within a communication range of the coordinator device. WSN maintenance is also relatively cheap and easy [2].

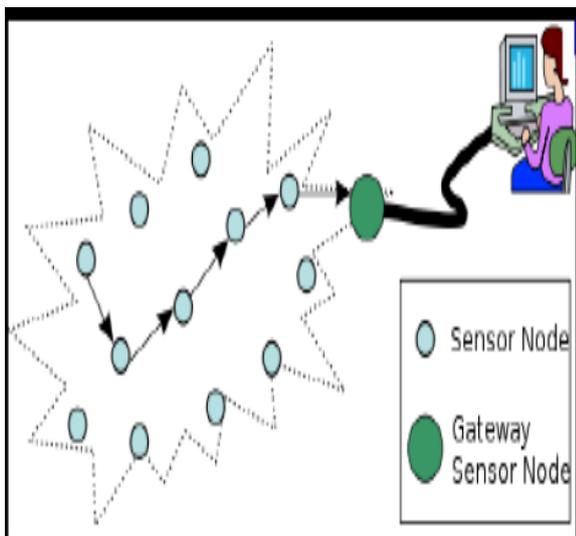


Figure2. Wireless sensor network architecture [2]

### III.DESIGN METHODOLOGY

Remote monitoring system of environment information for greenhouse composed by the computer monitoring system of Web server or some other wireless sensors which runs in the greenhouse field[3]. The wireless sensor network is composed of temperature sensor, the humidity sensor, soil moisture sensor, carbon dioxide sensors that are arranged in greenhouse [2]. Various sensors are transforms the non electric quantity to electrical quantity which change along with environment parameter then transmitted to host computer wirelessly. The system structure is shown in Figure3. The computer monitoring system hardware is constructed with single chip computer, host computer and wireless sensor network (WSN), and can achieve data acquisition, analysis, saving, printing and displaying. The whole system can not only used for acquisition of the real-time environmental data, but also achieve remote monitoring through Internet or other wireless sensors. The monitoring system generally employs Lab View as foreground development tool and access as background database [1],[3].

The network of field data acquisition and transmission is built on the wireless sensor network and RS232 bus. The sensor nodes arranged in the greenhouse sample temperature, soil moisture, humidity and other information [5].

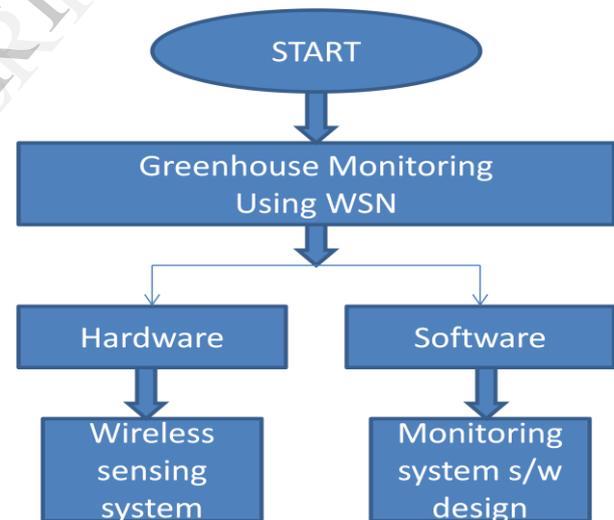


Figure3. System structure

Monitoring software of system server is the most critical part in the greenhouse environment information monitoring system, which is used for dealing with the users and obtaining information of wireless sensor. The main function of monitoring software consists of parameter setting, display, query, analysis, report processing and alarm for real-time data, online real-time monitoring, real-time curve display, and remote real-time communication [3].

#### IV. RELATED WORK

In research paper [1], the data from sensing node after amplification is fed to ADC and then to the microcontroller. This is then connected to the Zigbee module which transmits the data to the Zigbee module at the other end. It reads the data and displays on to the host computer through Lab View and the control sequence is generated to control the green house parameters from the control room wirelessly [1].

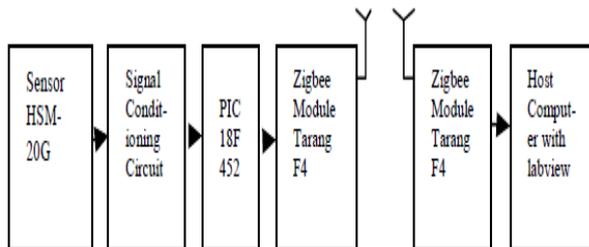


Figure5. Block diagram of wireless sensing system [1]

Another work [3], by applying Lab View virtual instrument platform, the field monitoring system can sample real-time environmental information in greenhouse with the wireless sensor networks and simultaneously transmit it to PC through RS-232 bus. The information distributing system establishes the connection between the field monitoring system and Internet and transmits the acquired information to the WEB data server [3].

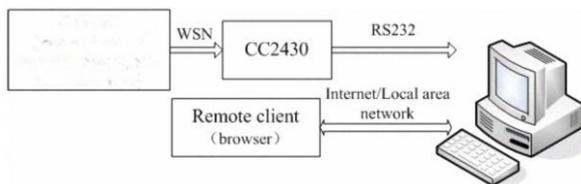


Figure4. Schematic diagram of remote monitoring system [3]

This paper [5] includes WSN technology and virtual instrumentation technology into greenhouse environment supervisory systems. Using virtual instrumentation technology software develop platform Lab View combine with zigbee based WSN protocol technology, designed remote monitoring platform to achieve control plc via OPC server.

The paper [6] is about remote monitoring greenhouse environment system by the smart mobile. They establish a system to control greenhouse environment through the smart mobile or PDA. Environment parameters are transmitted to a PC server after data processing. Users can use smart mobile or PDA to control and monitor the system in anywhere by the wireless network [6].

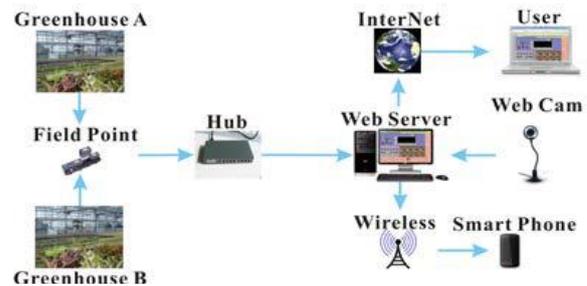


Figure6. Greenhouse environment control architecture [6]

The paper [9] includes the design and implementation of electronic system based on GSM (Global System for Mobile communication) for controlling the climate parameters by SMS (Short Message Service) in greenhouse. Several sensors and actuators are installed and connected to a management and acquisition card. These sensors provide relevant information that is used to control ventilation, heating and pump by SMS. It is simple to be installed and used by farmers who do not have knowledge in computer skills. Besides, most people use their cell phones to communicate and send messages [9].

#### V. CONCLUSION

A review of the literature on environmental monitoring systems elucidates that the existing systems suffer from several drawbacks and thus modifications are being continuously suggested. The available environmental monitoring systems have limitations as unstable system; all parameters cannot be measured simultaneously.

So there is a need for a system which can measure environmental parameters simultaneously; in addition, it should be energy efficient, economical, robust, and easy to operate.

#### VI. FUTURE WORK

After the study of this research review, future work related to this to implement the system of user friendly, low cost, easily implement & stable, it should be more efficient. The aim of research work is to design, develop and implement a sensor-based wireless communication system to monitor and control the greenhouse parameters using virtual instrumentation. Data analysis, control solutions and more complex network setups will be left to be the main directions of future work.

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