

# An IOT based Greenhouse System using ZigBee Technology

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**Abstract**—India is the country where agriculture is the primary occupation of people since early days. The greenhouse is one of the types of modern agriculture. A covered land where plants and crops are grown under controlled climatic conditions is a greenhouse. As there is a change in the climate of greenhouse, it affects the growth of plants in greenhouse. This system is used to monitor the climatic conditions such as temperature, humidity of a greenhouse. This greenhouse system uses ZigBee technology and wireless sensors to monitor the climatic condition of greenhouse. The system collects all climatic parameters inside the green house by using sensors and shows the report on the users mobile phone or computer using the internet. The low cost and low power wireless ZigBee technology applies in greenhouse so the user will get a healthy environment for planting crops by using agriculture greenhouse monitoring system

**IndexTerms**— Internet of Things, ZigBee.

## 1. INTRODUCTION

The Internet of Things (IoT) is multiplying at the rapid rate, and it is becoming more and more important for professionals to understand what it is, how it works, and how to capture its power to improve business. We will look at the things that make up the Internet of Things, including how those components are connected together, how they communicate, and how they generate data. Greenhouse is a man created closed space with control of environment. The most important factors for the quality and productivity of plant growth are temperature, humidity and light. Continuous monitoring of these environmental variables provides valuable information to the grower to better understand, how each factor affects growth and how to maximize crop productiveness. So the greenhouse monitoring system is designed to satisfy the need of the remote monitoring and control of greenhouse.

## 2. ARCHITECTURE

The greenhouse monitoring system is the designed to satisfy the need of the remote monitoring and control of greenhouse. It is typical IOT based system, the system can improve the efficiency of the environment room management and reduce the human resources investment and save energy. It includes physical layer, network layer and application layer. In this system CC2530 is used as processing chip of the wireless sensor nodes and coordinator which gives complete ZigBee solution. The ZigBee technology is adopted in wireless communication, the gateway uses the Cortex-A8 processor and Linux operating system as the core.

In this System, the network topology model of the ZigBee is a satellite. Zigbee coordinator is the organizer of Zigbee network. It receives the wireless sensor node information and sends the information to the room gateway through the serial port. The server transplanted in the gateway receives the user's request and disposes the information by the CGI program, and feeds back the processing information to control and display terminal.

The hardware design of the system includes room gateway design and zigbee wireless sensor node design. The IOT gateway is a join point of public network and wireless sensor network in the greenhouse system. The function of IOT gateway is data gathering, uploading it and processing the remote user control information. The gateway is base on modularization method. This method improves the compatibility and fulfill the need of complex agriculture environment. All the camera data and wireless nodes data are transmitted to the gateway. The gateway receives the data, transfer the data, and sends the data to display to the user by internet or sends to smart phone by GPRS.

This system contain CC2530 chip produced by TI corporation. CC2530 chip is the power saving, low cost. This chip is used as processing chip of the wireless sensor node and coordinator. The Zigbee technology is adopted in wireless communication. The IOT gateway uses the Coretex-A8 processor which is 32 bit processor core. CC2530 provides a complete Zigbee solution with combination of the Z-Stack protocol. The wireless sensing and control nodes of system uses the CC2530F256 as the core, includes wireless transceiver circuit, power module, debugging module, crystal oscillator circuit, reset circuit, information collection or control module. The information collection module sensor uses the STM8S103F3 chip as the micro processor. The sensing information converted by the AD is sent to CC2530 through the serial port using controller.

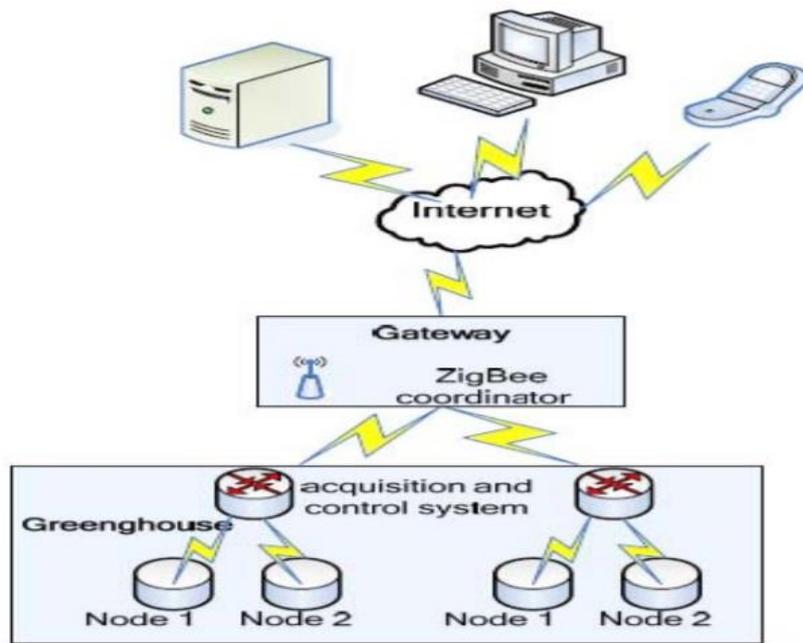


Figure 1. Structure of Greenhouse Monitoring System

### 3. Structure and Function of Greenhouse System

#### a. Sensor nodes

The total number of sensor nodes used in greenhouse depends upon the size of greenhouse. About 150 nodes are sufficient if the size of greenhouse is 30m\*200m. This is physical size of target area. It is under the edge of sensing capacity of hardware. The sensor nodes can be classified as A, B where type A is climate sensor for outside, and type B is climate sensor for inside of the greenhouse. Type B sensors can be placed at a distance of 8 to 13 meters of diameter, to capture precise environmental conditions. The main objective of the WSN system for greenhouse is to control the climatic conditions as per the crop data sheet. The sensor is design for collecting information about climate of agriculture greenhouse like temp, pressure, light, humidity, CO<sub>2</sub>, wind speed and wind direction. All these parameters gives the outside world information about the climate. With the help of this, system will decide the action about the controls like, in or out air flow control, sunlight control and sprinkler. A typical agriculture greenhouse with the sensor nodes is as shown in figure.

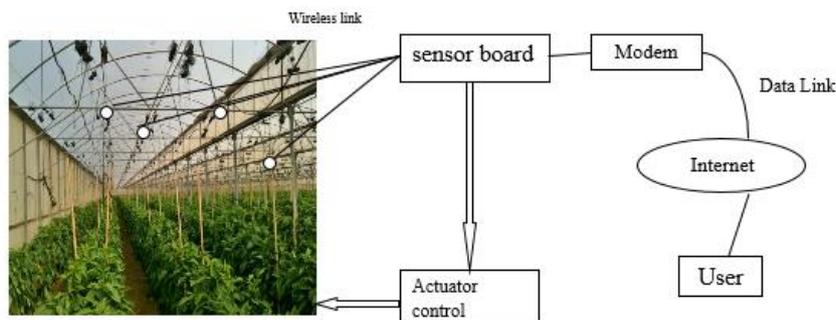


Figure 2. Typical Greenhouse and Remote Control

#### b. IoT Gateway

The development process of gateway is

Loading boot program, transplanting the embedded operating system, transplanting the root file system, Transplanting the embedded web server, Running program, Running the local GUI control application.

Hardware design of the IoT gateway is shown in figure

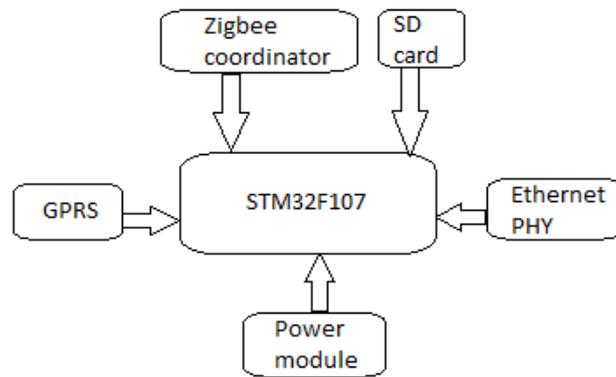


Figure 3. Design of IoT Gateway

As shown in the figure the hardware design of the IoT gateway is made up of Ethernet PHY, ZigBee module, GPRS module and the MCU using STM32F107, which based on Cortex-M3 a32 bit processor core, DP83848 is using as the Ethernet PHY which is specially designed for Ethernet connectivity in harsh environment and connected the Ethernet MAC of the MCU through MII. The Zigbee coordinator is connected to the gateway through the serial port.

Its tasks are

- Initializing CC2530F256 and protocol stack
- Building the Zigbee network with the temperature nodes and light intensity nodes
- Monitoring the Zigbee wireless signal

So the basic flow of the system is, the data collected by all sensor node are get transplanted to the gateway using ZigBee coordinator. Then server transplanted in gateway receives user request and dispose all the information to the user using CGI program. If network is not available then all the data get stored in SD card and after getting the network the data stored in SD card get transplanted to the upper computer.

## 5. LITERATURE SURVEY

**1. Liu Dan, Cao Xin.[1]**” Intelligent Agriculture Greenhouse Environment Monitoring System Based on IOT Technology” Author demonstrated a low cost zigbee technology in greenhouse which improves operational efficiency and system application flexibility. The system demonstrated by the author uses zigbee coordinator which collects the information from sensors and sends it to the gateway for processing and display the result on terminal.

**2. Chin-Feng Tsai, King-Chu Hung. [2]**” Campus Greenhouse Monitoring with A Simple Zigbee based Sensor Network” Authors have presented the system in which all programs including sensor control, data process of router and coordinator, protocol generation, and ZigBee control are created on the basis of the development system Arduino IDE. And the remote monitoring system based on internet consists of three terraces, i.e., desk top, server, and mobile device. On desk top, a SQL database is built for recording all sensed data in the WSN.

**3. LUI Dan, Sun Jianmei, Yu Yang, Xiang Jianqiu. [3]** “. Precise Agriculture Greenhouse based on the IoT and Fuzzy Control” Author demonstrated system which uses fuzzy control and zigbee technology for greenhouse monitoring which depend upon qualitative understanding of the dynamic characteristics of system. This paper take a full consideration of cost, practicability and other factors, combining the IoT with fuzzy control method, using GPRS to remote control, designing an intelligent greenhouse monitoring system with stable performance.

**4. Yan liu, Chunhua Bi. [4]**”The Design of Greenhouse Monitoring System based on Zigbee WSNs” Authors presented the design of greenhouse system which includes two main modules: the host computer and the slave computer. The host computer is mainly to display and control the main parameters of the greenhouse in real time, while the slave computer is responsible for the detection of greenhouse environment, collecting and transmitting the data to the host computer by using Z-stack protocol stack which employs the rotation cycle mechanism to handle the event and reduce the power consumption of the greenhouse system to the great extend.

**5. Thu Ngo Ouyinh, Nien Le Manh, Khoi Nguyen Nguyen. [5]**” Multipath RPL protocol for Greenhouse Environment Monitoring System based on INTERNET OF THINGS ” Author had used different routing solutions of IoT: single path RPL and multipath RPL protocols to achieve better performance in terms packet delivery rate and decrease data error for higher monitoring performance.

**6. Zhaochan Li, Jinlong Wang, Russell Higgs, Li Zhou, Wenbin Yuan . [6]** ” Design of an Intelligent Management System for Agriculture Greenhouse based on the INTERNET OF THINGS” Author have took into consideration the development of agriculture greenhouse of China. Also the overall design of intelligent management system of agriculture for analysis of network structure from a macro perspective on the basis of the research going on the current development of new technologies which are applicable to agriculture and summarizes the strong points concerning the application of the Agricultural Internet of Things both at home and abroad. Also proposed some new methods of agricultural greenhouse management.

## CONCLUSION

In this paper, We study the low cost, low power wireless the Zigbee technology is applies in the greenhouse monitoring system. The system realizes the remote Intelligent control to the room equipment through Internet netwoek. It improves operational efficiency and system application flexibility by using the wireless sensor network instead of the traditional wired network, and at the same time reduces the manpower cost. The IoT gateway run fine in the greenhouse monitoring system, the environment data of the greenhouse can transfer reliably, and the control instruction sent timely. Compare with the traditional greenhouse this design realizes remote intelligent monitoring and control of greenhouse, and is helpful to farms to scientific and rational planting crops. So this design has certain of value to the popularize.

## FUTURE-SCOPE

Using this greenhouse system we can monitor the environmental parameters of greenhouse like humidity ,temperature, co2 at distant places using IOT. But in future not only monitoring plant parameters but we can also monitor the internal health conditioning of the plant through the image processing ,it means we can check which part of the plant is having the dead cells, and which part of the plant is healthy. In future using different technology we can also know how much amount of chemicals are required for certain plant growth.

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