



## Green House Automation using Zigbee and Smart Phone

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**Abstract**— This paper proposes a wireless monitoring and control system for greenhouse based on Zigbee for solving the problems such as poor real time data acquisition, excessive manpower requirement and to overcome the shortcoming of the wired system such as complex wiring. Here we are going to make our own Visual Basic Software Web Server which will communicate with the other devices such as Android mobile phone using synchronizing software (TEAM VIEWER). This software will keep all the devices in synch with the server. A wireless camera is attached to monitor in real time Also the devices can view the required information anywhere from the world as these devices are connected via Internet enabling owner to check and control in a real time manner. The information is also updated to the user through SMS service. The proof-of-concept design applies commodity computing integrated to legacy data logging devices, ensuring cost-effectiveness and simple integration.

**Keywords**— Wireless sensor networks, Green House, Zigbee, Web Server.

### I. INTRODUCTION

The focus of our Greenhouse automation division is the optimization of environmental conditions for better plant growth. The aim of the paper is to control the devices or equipment's from the remote place through a web page. Here we are going to make our own Visual Basic software Web server which will communicate with the other devices such as Smart mobile phones PC's etc. The devices will communicate with server using synchronizing software (TEAM VIEWER). This software will keep all the devices in synch with the server. The main advantage of this technique is that the devices connected to the web server need not store the offline data or have the software required to view the data. In this way the devices connected need not store or run the software whenever they want to view the data. All the required software and the data are stored in the web server and the Client devices need not store the data neither the software. Also the devices can view the required data anywhere from the world as these devices are connected via Internet. The nature and complexity of the software systems had changed significantly in the last 30 years. The previous applications run on single processor and produce fixed output. But with the advancement in the technology application are having the complex user interface and these applications run on the various systems simultaneous like applications which support client server architecture. Here all the devices, which are to be controlled, are connected to the relays, there are four relays connected and are controlled automatically for different parameters like Temperature, Humidity, Soil Moisture, and Light Intensity. Real time monitoring is done with the help of a wireless camera. The web-server is connected to LAN or Internet. The client or a person on the PC is also connected to same LAN or Internet. By typing the IP-address of LAN on the web browser, the user gets a web page on screen; this page contains all the information about the status of the devices. The user can also control the devices interfaced to the web server by pressing a button provided in the web page. The sensors attached to the green house are interconnected to exchange houses, various parameters required to determine efficient crop yield like Temperature, Soil Moisture, Light Intensity, Humidity are sensed and sent to the Arm microcontroller for monitoring and control through Zigbee Wireless Sensor Network. As an open and global standard for WSN, ZigBee shows advantages on low-cost, low power consumption and self-forming. The current researches of ZigBee wireless sensor network on industrial automation, electronic products, smart buildings and medical care were presented and, as an explorative application of ZigBee wireless sensor network in protected agriculture overcoming the limits of wire connection, its applied design for greenhouse management was proposed by introducing both the hardware and software architectures. Computer communication systems and especially the Internet are playing an important role in the daily life. Using this knowledge many applications are imaginable. Home automation, utility meters, appliances, security systems, card readers, and building controls, which can be easily, controlled using either special front-end software or a standard internet browser client from anywhere around the world. Web access functionality is embedded in a device to enable low cost widely accessible and enhanced user interface functions for the device. A web server in the device provides access to the user interface functions for the device through a device web page. A web server can be embedded into any appliance and connected to the Internet so the appliance can be monitored and controlled from remote places through the browser in a desktop.

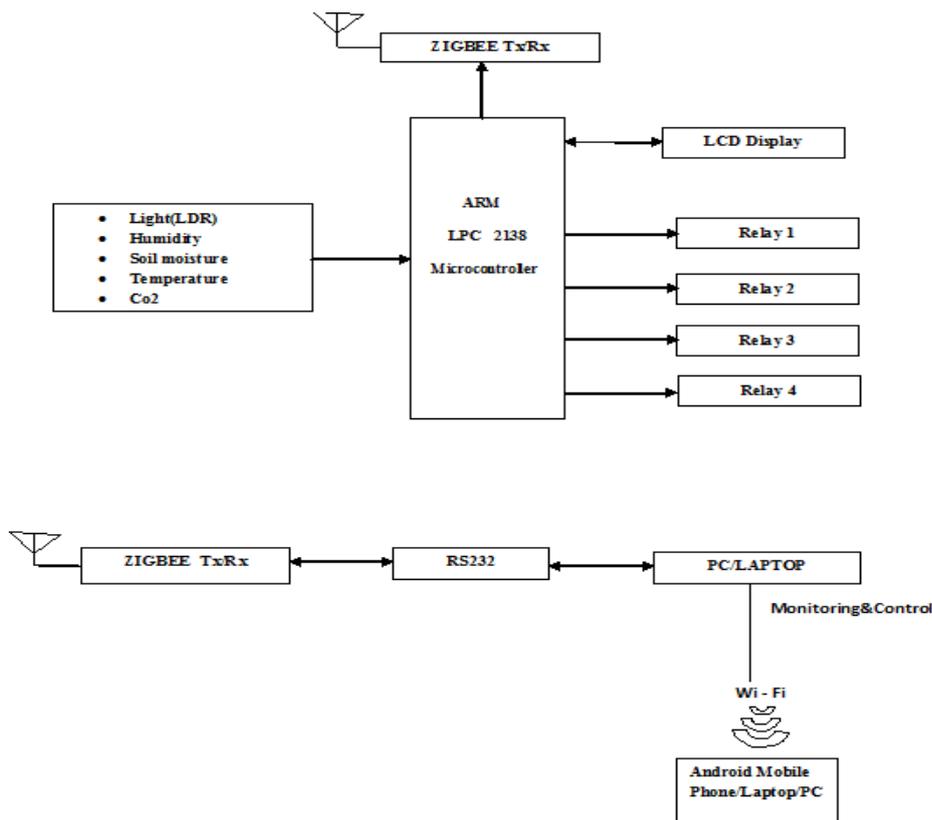
### II. LITERATURE SURVEY

Jia Song[1]. He proposed a system on Greenhouse Monitoring and Control System Based on Zigbee Wireless Sensor Network using 8051 controller. In this paper we have discussed about Greenhouse Monitoring and Control System Based

on Zigbee Wireless Sensor Network using ARM controller and is accessible to the user through the Internet. Ai,Wei,Chen,Cifa.[2]. They have discussed about Green House environment monitor technology implementation based on android mobile platform, which uses android mobile phone as the monitoring terminal. In this paper parameters in the green house are monitored on the PC as well as the android mobile phone from anywhere in the world as it is connected to the internet through the team viewer software.

He,Guomi Wang, Xiaochan; Sun, Guoxiang [3].They had discussed about humidity and moisture monitoring in green house using Zigbee monitoring system. In this paper we have proposed a low cost method using ARM microcontroller and Zigbee technology to accurately monitor and control the various parameters like humidity, soil moisture ,light intensity and temperature. Aryo H. Primicanta, Mohd Yunus Nayan, and Moohammad Awan[4].They proposed a method on ZigBee-GSM based Automatic Meter Reading system. In this paper we are using GSM modem to transmit fault messages to user via Zigbee.

### III. Block Diagram



**Fig.1 Block Diagram**

Here we are using an embedded systems approach to design an automated green house. Control of various environmental parameters artificially is of utmost importance to increase crop yield and productivity. The parameters, Light, Soil Moisture, Humidity and Temperature are monitored and controlled using ARM processor ,transmitted through the Zigbee to the VB based web server and then to the android mobile phone via a WI-Fi or internet connection. Thus an efficient, low cost and reliable method is used to implement the same with the TEAM VIEWER software . The block diagram of the proposed system is as shown above .It comprises of :

#### A. ARM Microcontroller:

The ARM7TDMI-S [6] is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The LPC21xx microcontrollers are based on a 16-bit/32-bit ARM7 CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory.

#### Advantages of using RISC machine

- Smaller die sizes
- Shorter time to develop

- Possible higher performance than CISC
- High clock rate with single cycle

Recently, some of the manufacturers of ARM architecture chips have started offering combinations of on-chip memory and peripherals, and price that put them into the same marketplace with 8 and 16 bit microcontrollers. If system requires lots of memory and performance, it is worth looking at ARM chips.

#### B. Zigbee:

Zigbee is a specification for a suite of high level communication protocols using small, low- power digital radios based on an IEEE 802 standard for personal area networks[7]. Zigbee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network. .

Zigbee is targeted at applications that require a low data rate, long battery life, and secure networking. Zigbee has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range wireless transfer of data at relatively low rates. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. Zigbee is a low-cost, low-power, wireless mesh network standard[8]. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. Zigbee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory . Zigbee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 900 kilobits/second. Here the Zigbee module works on TTL Txd and Rxd pins so we can directly connect the microcontroller Txd pin to the Zigbee Rxd pin and the microcontroller Rxd pin to the Zigbee Txd pin.

#### C. Sensors:

There are four sensors namely temperature ,humidity[9],light and soil moisture interfaced to the ARM microcontroller, used to sense the environmental parameters .If the set value is altered it is controlled automatically and the information is sent to the user through Zigbee and real time analysis is done as it is connected to the internet. Alert is also indicated by SMS to the user .

- *Temperature sensor:* LM35 is used to sense different temperature values.
- *LDR (Light Dependent Resistor)* is very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically, allowing current to pass through it.
- *Humidity Sensor:* HYSH 220 humidity sensor is used to sense the humidity values, it converts relative humidity to voltage.
- *Soil Moisture Sensor:* Here we are connecting a moisture based Electrode sensor. As soon as the water dries up then the electrode voltage rises to 5v which is applied to the non inverting terminal and the output of the amplifier is 0v which will in turn, turn on the AC motor. When the water level is up then the electrode voltage drops to 0v which is applied to the non inverting terminal and the output of the amplifier is 5v which will in turn, turn off the AC motor.

#### D. Relays:

There are four relays connected . It operates in two modes:

- Normally Open
- Normally Closed

Different devices can be controlled i.e. they can be turned On/Off whenever required.

#### E. LCD (Liquid Crystal Display):

LCD is used to display the prescription provided by the ARM microcontroller and is interfaced to the microcontroller.

#### F. GSM Modem:

It is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. The GSM modem is interfaced with the ARM microcontroller . If the parameter values of temperature, humidity, light intensity and soil moisture exceed the set points a SMS alert is sent to the user through the GSM .

#### G. RS232 :

The RS 232 IC is a driver IC to convert the  $\mu$ C TTL logic(0-5) to the RS 232 logic (+/-9v) . Many device today work on RS 232 logic such as PC, GSM modem , GPS etc. In order to communicate with such devices we have to bring the logic levels to the 232 logic (+/-9v). Communication as defined in the **RS232** standard is an asynchronous serial communication method. The word serial means, that the information is sent one bit at a time. Asynchronous tells us that

the information is not sent in predefined time slots. Data transfer can start at any given time and it is the task of the receiver to detect when a message starts and ends. The RS232 standard describes a communication method where information is sent bit by bit on a physical channel. The information must be broken up in data words. The length of a data word is variable. On PC's a length between 5 and 8 bits can be selected. This length is the net information length of each word. For proper transfer additional bits are added for synchronization and error checking purposes. It is important, that the transmitter and receiver use the same number of bits. Otherwise, the data word may be misinterpreted, or not recognized at all.

**H. PC/Laptop :**

We are designing a VB based web server ,VB is installed on the PC. The PC is used as a server for controlling and monitoring different environmental parameters along with their graphs and a detailed daily report of the exact values. The ARM board is connected to PC using RS 232 cable. The output is also observed on Laptop with RS 232 to USB connector.

**J. Android Mobile Phone :**

An android mobile phone or PC or Laptop can be used on the user end for monitoring and control in real time .The user will be able to observe the data from anywhere in the world as the devices are connected through the Internet or Wi-Fi. The synchronizing software Team Viewer is used which will keep all the devices in sync with the server. All the devices will communicate with the server using the team viewer.

**IV. SOFTWARE ARCHITECTURE**

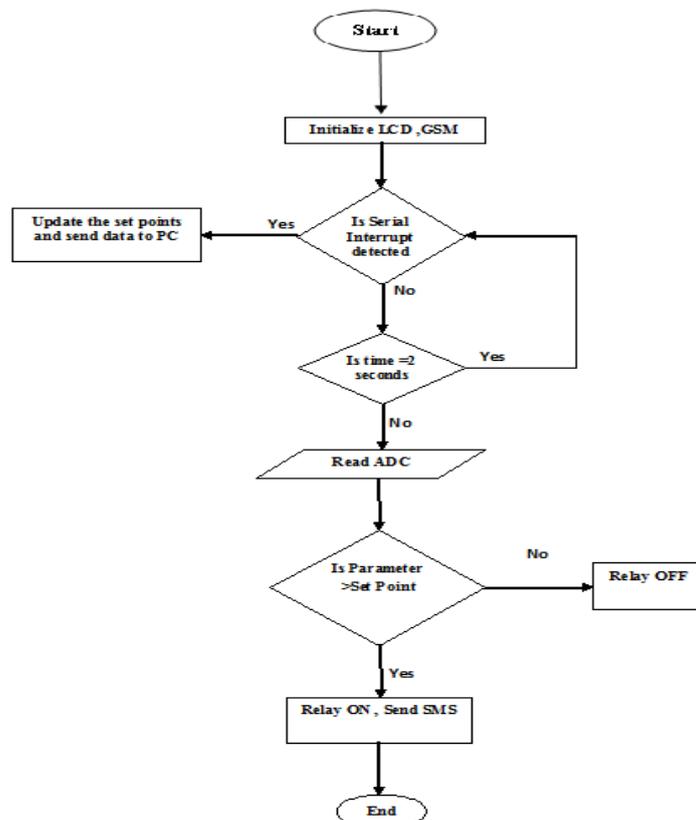
The software part will consist of:

1. Keil
2. Orcad
3. DipTrace
4. Visual Basic

Here we are going to make our own Visual Basic Software Web server which will communicate with the other devices such as Smart mobile phones, PC's etc. The ARM microcontroller will be programmed using the Kiel software. The different sensors ,light, temperature, humidity, soil moisture are connected to the ARM-7 microcontroller . The different values are monitored, controlled and are transmitted through the Zigbee,to the VB based server .The Zigbee is connected to the controller. They are further transmitted to the android mobile phone through the internet, enabling the user to get real time access of the information.

**Flowchart:**

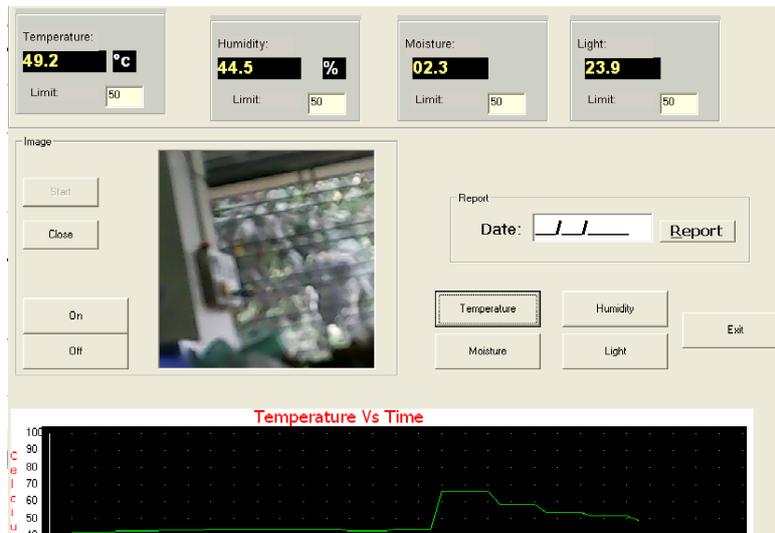
*The detailed flowchart is as shown below:*



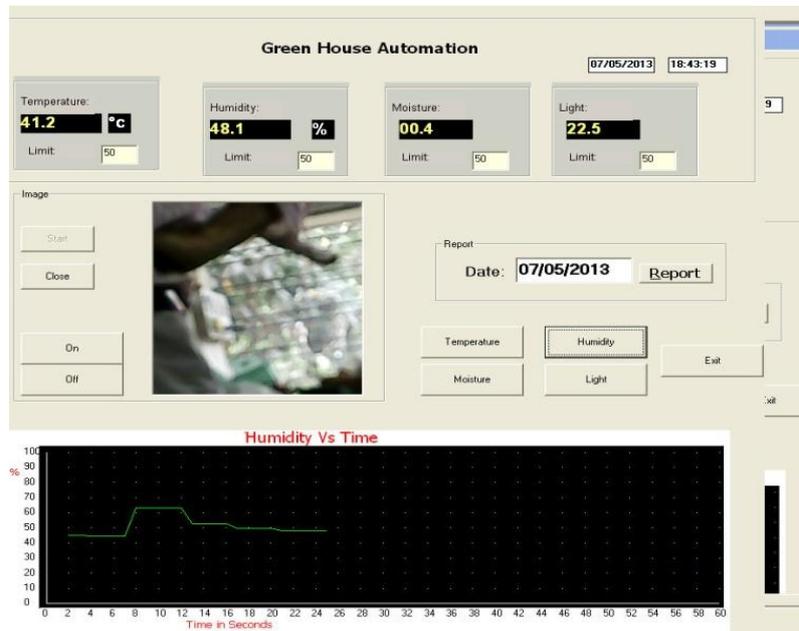
**Fig.2 Flowchart**

**V. Results:**

The results below show the server window displaying real time values of the parameters and their detail timely reports with along with their graphs and the camera window.



**Figure 3: Temperature versus time**



**Figure 4: Humidity versus time**



**Figure 4: Soil Moisture versus time**



**Figure 5: Light Intensity versus time**

Green House Automation					
Date: 07/05/2013					
Time	Temperat	Humidity	Moisture	Light	
17:23:46	2	38.9	00.0	00.0	00.0
17:23:50	2	38.9	00.0	00.0	29.3
17:23:52	2	38.9	34.0	00.0	29.3
17:23:54	2	38.9	34.0	05.0	29.3
17:23:59	2	39.6	34.0	05.0	29.3
17:24:00	2	39.6	34.0	05.0	29.3
17:24:04	2	39.6	34.0	05.0	36.5
17:24:06	2	39.6	33.9	05.0	36.5
17:24:08	2	39.6	33.9	05.0	36.5
17:24:13	2	43.7	33.9	05.0	36.5
17:24:14	2	43.7	33.9	05.0	36.5
17:24:18	2	43.7	33.9	05.0	34.9
17:24:20	2	43.7	33.9	05.0	34.9
17:24:22	2	43.7	33.9	05.0	34.9

**Figure 5: Detail Report with date and time of the parameters**

### VI. CONCLUSIONS

In this paper automated greenhouse control is discussed with advantages of low cost and accuracy. The benefits that a fully automated greenhouse control systems bring to the grower are many. Obviously, there will be the labour saving aspect but far more importantly, factors such as improved quality of produce and information gathering can mean the difference between earning a profit or suffering substantial losses. In this we propose a new approach using the team viewer software so the user can view the required data anywhere from the world on his android mobile phone as these devices are connected via Internet. Various other applications include in Biomedical data transfer system to monitor the parameters like body temperature and gas and level etc and send it to servers cabin, it can be used in hazardous areas like in coal mines, at high altitudes, in high temperature working environment such as in steel plants where human beings cannot monitor things properly and continuously etc. In our future work ,we can work on implementation of system using VLSI technology and propose to design the system using an embedded ARM web server.

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