ARM BASED AUTOMATED WIRELESS GREENHOUSE ENVIRONMENTAL MONITORING SYSTEM

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Abstract: Monitoring and control of greenhouse environment play an important role in greenhouse production and management. To monitor the greenhouse environment parameters effectively, it is necessary to design a measurement and control system. The objective of this project is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield. The controller used is a low power, cost efficient chip manufactured by NXP. It communicates with the various sensor modules in real-time in order to control the light, aeration and drainage process efficiently inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the necessary condition of the crops. An integrated Liquid crystal display (LCD) is also used for real time display of data acquired from the various sensors and the status of the various devices. Also, the use of easily available components reduces the manufacturing and maintenance costs. The design is quite flexible as the software can be changed any time. It can thus be tailor-made to the specific requirements of the user. This makes the proposed system to be an economical, portable and a low maintenance solution for greenhouse applications, especially in rural areas and for small scale agriculturists.

Index Terms: *Green house, GSM, ARM7LPC 2148, Sensors.*

INTRODUCTION

In greenhouse more number of the parameters is to be control because, the varieties of the crops are large. They are increasing day by day because of the development in agriculture technology. The automation is possible with simple hardware by using microcontroller where only the controlling is possible but user will not get information about the greenhouse. On progress towards the improvement to monitor and control, an attempt was made using wireless technology. There are many technologies can be used for wireless application. It was tried to adopt the wireless communication like Infrared, Bluetooth, Zigbee and RF technology. But the attempt has failed because of technology constraints. In this situation, the wireless sensor network with additional hardware and software is a solution for

greenhouse control. If parameters still increase, then for WSN technology bandwidth may not be sufficient [1]. The Wireless Measurement and Control System for Environmental Parameters in Greenhouse [3], overcomes the disadvantages of wired monitoring system, such as complicated wiring & difficult maintenance.

PROPOSED SYSTEM

This project is designed to overcome the above mentioned disadvantages, using which the environmental parameters in every greenhouse can be measured and controlled by microcontroller remotely. Measuring of parameters like Humidity, Water pH, Soil wetness, Light intensity and temperature is done by sensors. The Parameters settings can be made in two modes i.e. by using push button keys or by GSM communication mode remotely. A user can know the greenhouse status or control the system at any time by sending the commands through the GSM technology. Also the monitoring device will send the environmental conditions to the user on request at any time. The system can be switched ON or switched OFF just by sending a power ON/OFF command.

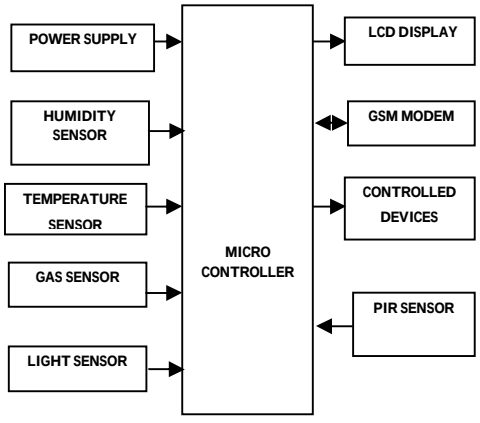

Fig: Block Diagram

PROPOSED HARDWARE

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

Temperature sensor:

A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.

Fig: Temperature sensor

Humidity sensor:

Humidity sensor is a device that measures the relative humidity of in a given area. A humidity sensor can be used in both indoors and outdoors. Humidity sensors are available in both analog and digital forms. An analog humidity sensor gauges the humidity of the air relatively using a capacitor-based system. The sensor is made out of a film usually made of either glass or ceramics. The insulator material which absorbs the water is made out of a polymer which takes in and releases water based on the relative humidity of the given area. This changes the level of charge in the capacitor of the on board electrical circuit. A digital humidity sensor works via two micro sensors that are calibrated to the relative humidity of the given area. These are then converted into the digital format via an analog to digital conversion process which is done by a chip located in the same circuit. A machine made electrode based system made out of polymer is what makes up the capacitance for the sensor. This protects the sensor from user front panel (interface).

Fig: Humidity sensor

Co2 sensor:

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

Fig: Co2 sensor

PIR sensor:

A Passive Infra Red sensor (PIR sensor) is an electronic device that measures infrared (IR) light radiating from objects in its field of view. PIR sensors are often used in the construction of PIR-based motion detectors (see below). Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall.

All objects emit what is known as black body radiation. It is usually infrared radiation that is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The

term passive in this instance means that the PIR device does not emit an infrared beam but merely passively accepts incoming infrared radiation. “Infra” meaning below our ability to detect it visually, and “Red” because this color represents the lowest energy level that our eyes can sense before it becomes invisible. Thus, infrared means below the energy level of the color red, and applies to many sources of invisible energy.

Fig: PIR Sensor

LDR:

LDRs or Light Dependent Resistors are 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. The animation opposite shows that when the torch is turned on, the resistance of the LDR falls, allowing current to pass through it. This is an example of a light sensor circuit: When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The LED lights on. The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitive.

FIG: LDR

GSM:

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service.

The network is structured into a number of discrete sections:

- Base Station Subsystem – the base stations and their controllers explained
- Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network"
- GPRS Core Network – the optional part which allows packet-based Internet connections
- Operations support system (OSS) – network maintenance

SM was intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. However, GSM is vulnerable to different class of attacks, each of them aiming a different part of the network.

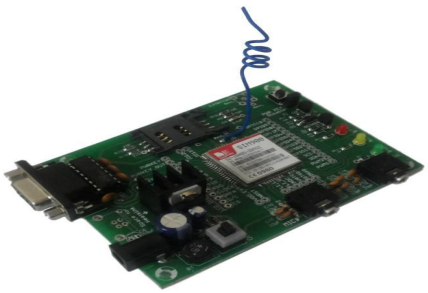

Fig: GSM Module

CONCLUSION

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 product and information gathering can mean the difference between earning a profit or suffering substantial losses. Greenhouse prevents the plant from the effects of climate; insects and so on, which makes great sense for agricultural production. The automation and high efficiency on greenhouse environment monitoring and control are crucial. If the parameters are within the range then the value is displayed in the LCD. If it is not within the range the controller will turn on/off the actuators as per the requirements. Thus controlling the Greenhouse automatically without human intervention. The system not only saves the energy consumption significantly, but also reduces a large number of inputting on the human and material resources in the management.

FUTURE SCOPE

This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters. Time bound administration of fertilizers, insecticides and pesticides can be introduced

- A speaking voice alarm could be used instead of the normal buzzer
- More sensors can be added to the sensing unit to monitor others environmental parameters such as soil pH level, carbon monoxide (CO) and oxygen (O) level.
- These extra features will allow the system to directly alert the user of any abnormal changes in the greenhouse environment through the transmission of a simple short text message.

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