Digitally Greenhouse Monitoring and Controlling of System based on Embedded System

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Abstract- *The system proposed in this paper collects temperature of leaves and humidity on leaves of crop. As well as greenhouse environmental information such as temperature, humidity, etc. Crop diseases, especially, have deep relationship not only with indoor environmental factors but also with humidity lasting time on leaves and temperature of leaves. Accordingly, monitoring crop itself is as important as monitoring indoor environments. Using these collected greenhouse environmental data, indoor environments can be more effectively controlled, and monitoring crop itself can contribute to improve productivity and to prevent crops from damages by blight and harmful insects. In addition, it will be possible for farmers to do control plant growth through closely studying relationship between indoor environmental information and monitored information on crop itself. Collected data can be stored to database either in server installed in greenhouse or to remote server. It is made possible to collect information and control effectively and automatically greenhouse in the site or from a remote place through web browser. System components are temperature sensor, humidity sensor, leaf temperature sensor, leaf humidity sensor, Zigbee based wireless sensor node, relay nodes for automatic control, and data server to store greenhouse information. The system is implemented using low power wireless components, and easy to install.*

Keywords- ESP8266, temperature sensor, huimidity sensor, LCD display, light sensor, microcontroller.

I. INTRODUCTION

The in the last several decades, systems for Greenhouse management have been greatly developed, in which kinds of sensors have been used to measure various information of the environment. Most of the typical systems have mostly been developed based on wired utilities. The wired systems limited easy installation and extension ability and increased maintenance costs. Wireless Sensor Network based systems are believed to eliminate the considerable costs of just wiring [14]. Also, the extensive farm or greenhouse requires the monitoring system or the control system to be built wirelessly. Wireless sensor network also will help improve existing systems installed the greenhouse efficiently and easily by radio [5]. In this paper, we propose a system that can collect the information related to greenhouse environment and crop status and control the greenhouse automatically based on the collected information. Conventional greenhouse control systems have monitored mainly the environment data such as ambient temperature and humidity in the greenhouse. These data are very important in the control of greenhouse environment because the growth of plants is very affected with these values. However, precise diagnosis of the crop growth status or the crop disease requires more various data than ambient temperature or humidity. Crop diseases, especially, have deep relationship not only to indoor environmental factors but also to humidity lasting time of leaves and temperature of leaves. Accordingly, monitoring crop itself is as important as monitoring indoor environments. The system proposed in this paper is designed based on the plants temperature and humidity remained on the leaves of the plant. This is the distinct feature of the proposed system. The temperature of leaves and the humidity on leaves of the crops are key factors for the system to control and maintain the environment condition of the greenhouse. The system can collect environment information inside greenhouse using temperature and humidity sensors and collects temperature and humidity of crop leaves using leaf temperature sensor and leaf humidity sensor. In this system, it is able to possible to measure the crop status change caused by environment factors inside greenhouse. Also, the system is able to be utilized to closely examine the relation between environmental information and crop growth status and especially crop disease. Also, our system can apply the efficient automatic control system of greenhouse environment to prevent the crop disease.

II. OBJECTIVES

The objective of our project is to implement a real time system for green house monitoring using internet of things and automatic control on it. System should be simple as possible Cost effective to all people Accurate reading More efficient More flexible for modification.

III. SYSTEM SPECIFICATION

A. Microcontroller ATmega328

The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three timer/counters with equate modes, programmable watchdog timer with internal oscillator, a byte-oriented 2-wire serial interface, internal and external interrupts, serial programmable USART, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

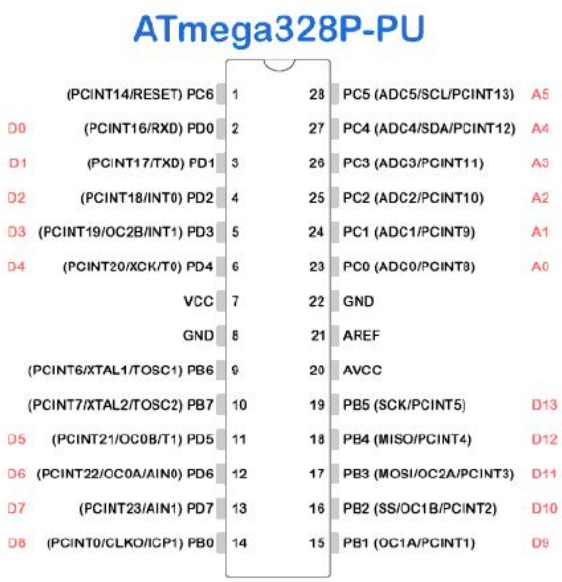

Figure 1.

B. DHT 11

The temperature and humidity sensor, DHT 11 is a complex Sensor contains a standardized digital signal output of the temperature and humidity. Application of an enthusiastic digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The sensor contains a sense of soggy environment connected with a high-performance 8-bit microcontroller. It is low cost, long-term stability, relative humidity and temperature measurement, excellent quality, fast response, strong anti-interference ability, long distance signal transmission, digital signal output, and precise calibration. The DHT11 is a dual temperature and humidity sensor, meaning that it can read both temperature and humidity. Even though it has dual operation it is only used as a humidity sensor. A higher accuracy temperature sensor is implemented instead. This sensor uses serial communication that is reliable and has long term stability. HVAC, humidity, testing and inspection equipment, consumer goods, automotive, automatic control, data loggers, weather stations, home appliances, humidity regulator, medical and other humidity measurement and control DHT11 uses a simplified single-bus communication. Single bus that only one data line, the system of data exchange, control by a single bus to complete. Device (master or slave) through an open-drain or tri-state port connected to the data line to allow the device does not send data to release the bus, while other devices use the bus; single bus usually require an external one about 5.1k pull-up resistor, so that when the bus is idle, its status is high. Because they are the master-slave structure, and only when the host calls the slave, the slave can answer, the host access devices must strictly follow the single-bus sequence, if the chaotic sequence, the device will not respond to the host.

Parameter	Conditions	Minimum	Typical	Maximum
Temperature Range		-55°C		+125°C
Supply Voltage	Local Power	+3V		+5.5V
Thermometer Error	-10°C to +85°C -55°C to +125°C		+15°C to +30°C	±0.5°C ±2°C
Active Current	V_{supply} = 5V		1mA	1.5mA

Figure2.

Parameters	Conditions	Minimum	Typical	Maximum
Resolution		1% RH	1% RH 8 bit	1% RH
Accuracy	25°C 0-50°C		±4% RH	 ±5% RH
Measurement Range	0°C 25°C 50°C	30% RH 20% RH 20% RH		90% RH 90% RH 80% RH
Response Time (Seconds)	1/e(63%) 25°C 1m/s Air	6s	10s	15s

Figure 3.

C. ESP8266

For self-sufficient Wi-Fi networking solution, ESP8266 gives a complete and, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. ESP8266 on-board processing and storage capabilities allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. With its high degree of on-chip addition, which contains the antenna switch balun, power executive converters, it requires minimal external circuitry, and the entire result, including front-end module, is designed to occupy minimal PCB area. Interchangeably, allocation as a Wi-Fi adapter, wireless internet access can be added to any microcontroller-based design with simple connectivity through UART interface or the CPU AHB bridge interface.

ESP 8266 block diagram shown below:

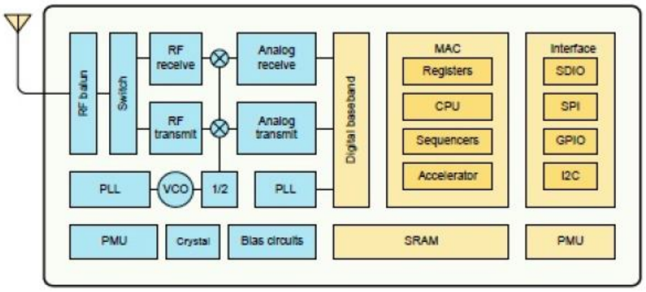

Figure 4.

Features

1. 802.11 b/g/n protocol.
2. Wi-Fi Direct (P2P), soft-AP.
3. Integrated TCP/IP protocol stack.
4. Integrated TR switch, balun, LNA, power amplifier.
5. Integrated PLL, regulators, and power management units.
6. +19.5dBm output power in 802.11b mode.
7. Integrated temperature sensor.
8. Supports antenna diversity.

D. Light dependent resistors

Light dependent resistors have a perticular property in that they have the lightning condition in which they have been stored. These effects can be reduced by storing the LDRs in light prior to custom. The light storing decreases steadiness time to reach steady resistive values. Two cadmium sulphied photo counductive cells with spectral responces comparable to that human eye. The cell resistance decrease with growing light intencity. Applications contains smoke detection, automatic lightning condition, batch counting and burgler alaram system

E. LCD display

A liquid-crystal display (LCD) is an electronically modulated optical device that uses the light-modulating properties of LCD. Liquid crystals doesn’t produce light directly, in its place using a backlight or reflector to yield an images in color or monochrome.LCD used to show information in digital mode such as value of a temperature, humidity. It also used for display information providing by the microcontroller. This particular SainSmart 2004 LCD has its own on-board microcontroller. This means that it has hardware that converts serial control signals received by the microcontroller board into the right output signals for this LCD display. The onboard microcontroller communicates with the Arduino UNO through an I2C bus which stands for Inter-Integrated Circuit. There are special pins on the Arduino UNO that allow for I2C communication. There are two connector pins on the LCD which are labelled as SDA (System Data) and SCL (System Clock) that connect to analog pins A4 and A5 on the Arduino UNO. The other two pins on the LCD display are ground and the voltage that needs to be supplied by the microprocessor. By using a LCD with its own microcontroller the number of pins required is reduced on the Arduino. Other features include a 4-line 20-character LCD module that has a contrast control nob and a backlight. The LCD is being used to display our temperature sensor, humidity sensor and our light sensor directly in the greenhouse room.

F. Web Server

The web server is hosted on the ATmega328 It can be accessed by any internet connected device such as smart phones or PCs by using the servers IP address as the URL. The web server is responsible for sending the received greenhouse sensor values as well as the web interface to the connected users browsers. It also receives commands from the users and responses accordingly. An Ethernet shield is used on the ATmega328 to enable internet connectivity. An 8GB micro SD card is plugged in the shields on-board SD card slot which is utilized for storing the html web page _le. Ethernet was chosen over Wi-Fi because the University of Manitoba campus uses WPA2-Enterprise security protocols which are not supported by most Wi-Fi shields. Additionally, Ethernet provides a more reliable connection, and the existing Ethernet connection in the greenhouse uses wide area network IP address, which means users can access the IP address from any location on or campus. The ATmega328 microcontroller board was chosen as the master controller to host the web server and coordinator ESP8266. The ATmega328 and has 28 digital I/O pins as well as 16 analog input pins. The main reason for selecting the Mega is due to its increased ash memory of 128 KB. This provides enough room to host the web server as well as the data logging software

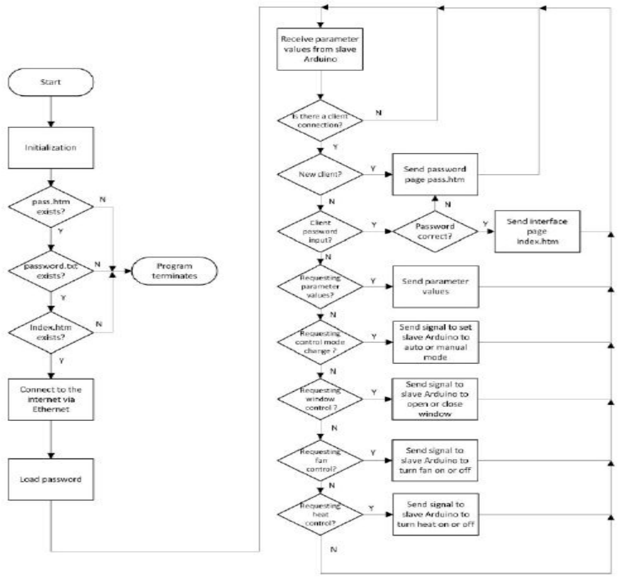

Figure 5.

The web server is contained in the ATmega328 Mega program code. It utilizes the Ethernet library for connectivity as well as the SD library for accessing the SD card [13]. Once the program is initialized, it starts to monitor and process client connections continuously. The program first ensures that the html _les and the password file can be found as the server cannot function without these files. The program then attempts to establish a connection to the campus network. Since the campus is using Dynamic

Host Configuration Protocol (DHCP), the MAC address is the only information needed to connect. The Ethernet shield does not have a fixed MAC address. To establish a connection its MAC address must be set to one that is permitted to connect to the campus network. Finally, the program loads the password file and stores the password in memory for later use. Polling method is used to listen to client connections. During each loop, the program tests whether or not there is a connection request. If a request is found, the program reads its header line and uses string processing methods on the line to find out the purpose of the request. The server only accepts certain requests and all other requests will be ignored.

G. MD10C Motor Driver

The MD10C motor driver takes input from the ATmega328 microcontroller to control the direction of current flow from the 12V power supply to the dc motor. This controls the direction of the motor and allows the window to be opened or closed. The driver is controlled by inputs to the DIR (direction) and PWM (pulse width modulation) pins. The DIR pin controls the direction the motor spins and the PWM pin allows for speed control of the motor by taking input values from 0-255 from the microcontroller.

H. Sun Founder 2 channel Relay

The Sun Founder 2 channel 5V relay shield consists of two SRD-05VDC-SL-C relays which can be used to switch devices up to 250V AC with up to 10A of current using 5V input signals from the ATmega328 microcontroller [6]. This active low device switches the relay on when it receives a 0V signal and of when it receives a non-zero signal. This device adds the capability to operate additional temperature control devices in the greenhouse such as swamp coolers or heaters.

I. 8507840 Linear Actuator

The 8507840 linear actuator is the original component chosen to open and close the greenhouse windows. Using a 12V dc power supply the actuator can lift up to 270 lbs with a stroke length of 12 inches [7]. In the testing phase the approach for opening the windows was changed from using a linear actuator to using a rotational motor as it is easier to implement with the existing manually operated greenhouse controls. This allowed for less intrusive testing of the system in the greenhouse and minimized the mounting hardware required.

IV. FLOW CHART

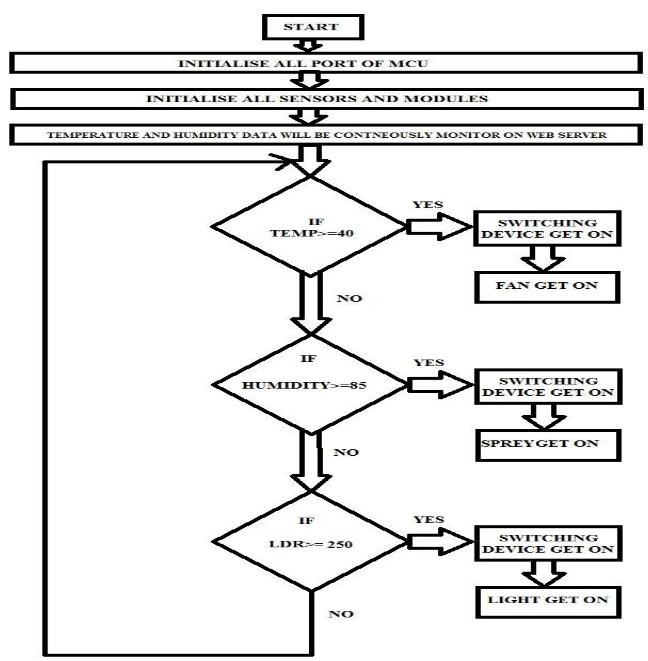

Figure 6.

V. RESULT

Temperature sensor detect temperature and microcontroller compare it with threshold value and take decision to on fan Humidity sensor detect humidity and microcontroller compare it with threshold value and take decision to on spryer motor ESP8266 gives info through internet to monitor temperature and humidity continuously.

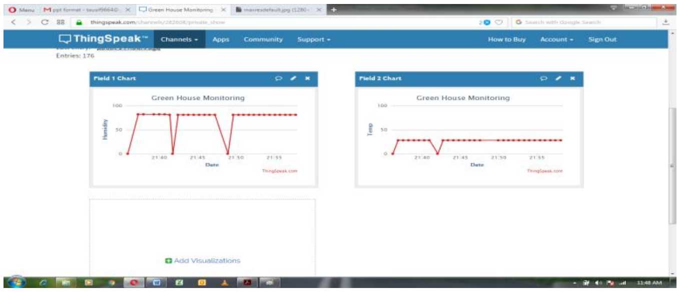

Figure 7.

VI. CONCLUSION

A step-by-step tactic in designing the microcontroller based system for measurement and control of the three crucial parameters for plant growth, i.e. temperature, humidity and light intensity, has been followed. The results obtained from the measurement have shown that the system performance is quite reliable and accurate. The use of internet gives continuous update about humidity and temperature. It helps to analyse environment of green house. The system has effectively overcome quite a few inadequacies of the existing systems by dropping the power consumption, maintenance and complexity, at the same time providing a flexible and precise form of maintaining the environment. The continuously decreasing costs of hardware and software, the wider acceptance of electronic systems in agriculture, and an emerging agricultural control system industry in several areas of agricultural production, will result in reliable control systems that will address several aspects of quality and quantity of production.

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