Design and Implementation of Modern Greenhouse System

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Abstract: *In this research, the modern greenhouse system which is closely monitored and controlled the climate parameters such as temperature, humidity, moisture and light of a greenhouse using Arduino and Wireless Communication system (Wi-Fi). This research was creating an intelligent greenhouse system which will operate automatically or be controlled by a web browser. The intelligent greenhouse system can operate independently and automatically when the web server disconnected. The web server can overwrite the signal and take control of greenhouse system wirelessly. It was store all this data and show the latest environment details of the greenhouse using the web interface.*

Key Words: *Climate, Wireless Communication, intelligent, web server.*

1. INTRODUCTION:

Greenhouse is used to reduce the human efforts and increase harvest by controlling key factors which will act the plant growth. A greenhouse is a closed space, which functions to support the growing of plants inside. Modern greenhouse can help to keep perfect temperature, humidity, light and soil moisture for the plants, so they grow faster. Arduino based systems are designed to monitor and control greenhouse environmental.

Considering the advantages of Wi-Fi an advanced automation system was developed to control the appliances in the greenhouse. Wi-Fi is a wireless technology that use radio frequency to transmit data through the air. The data send from PC or Phone over Wi-Fi will be received by Wi-Fi module connected to Arduino. Arduino reads the data and decides the switching action of electrical device connected to it. With the rapid development of the low cost, low power sensor and wireless communication technology, the conditions that construct wireless greenhouse monitoring and control system becomes mature, and it is important to realize agriculture modernization.

2. BLOCK DIAGRAM OF GREENHOUSE :

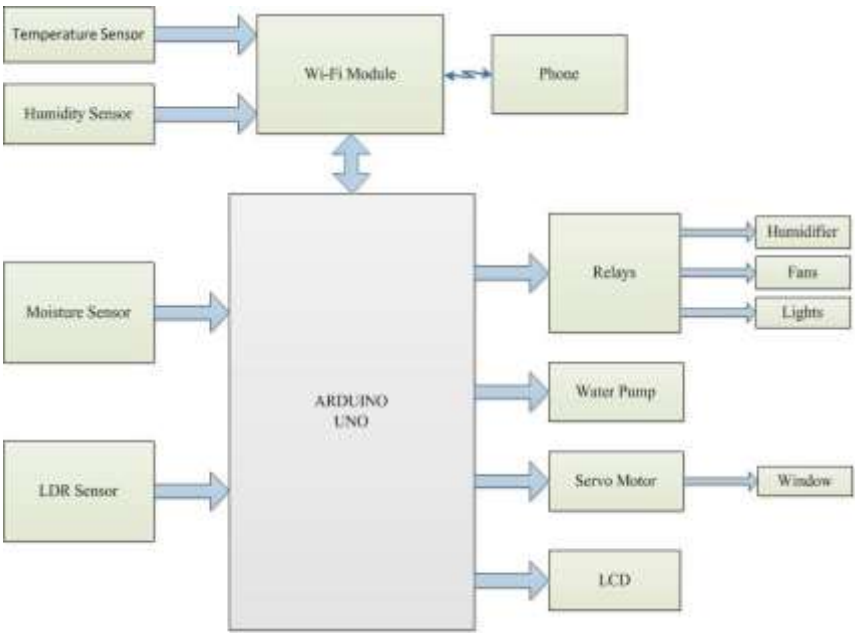

Figure-1 Block Diagram of Greenhouse System

Greenhouses are very useful for provide an optimal temperature around plants, protect them from weather extremes, extends the growing season. Basic factors affecting plant growth such as sunlight, water content in soil, air humidity, temperature. These physical factors are hard to control manually inside a greenhouse and there is a need for automated design arises.

3. HARDWARE DESIGN:

This research uses temperature, humidity, moisture and light sensors for sensing the environment in a greenhouse but additional sensors can be added to the system easily. Soil moisture and light sensors are connected to the Arduino through the wires. DHT11 sensor is connected to the GPIO2 pin of ESP8266 Wi-Fi module through the wires. The relay outputs are connected to humidifier sprayer, LEDs and fans to represent the greenhouse equipment that need to be controlled humidity, light intensity and temperature in the greenhouse.

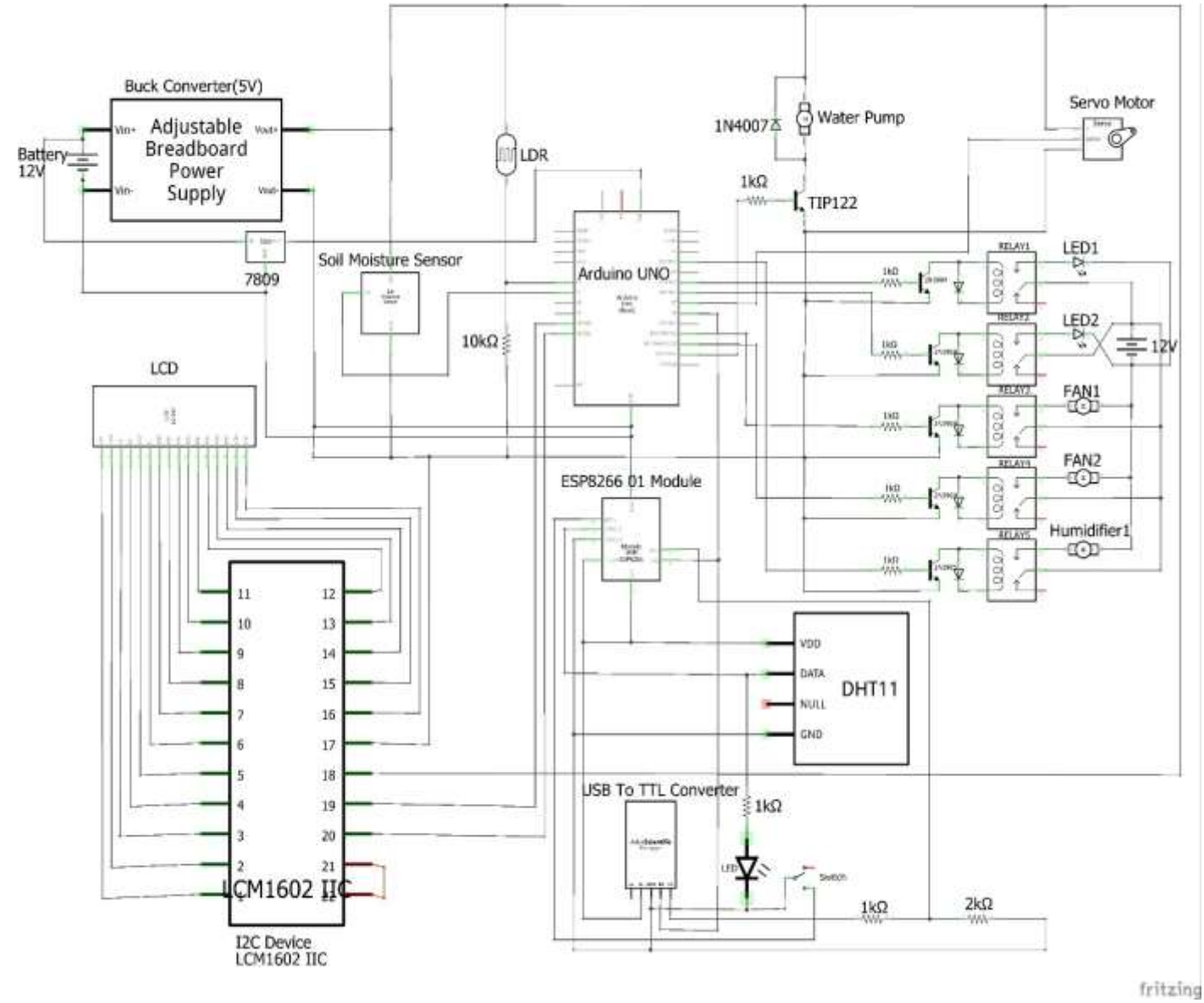

Figure-2 Block Diagram of Greenhouse System

Soil moisture sensor is used to measure the water content in the soil. Water irrigation system with a water storage tank, an electric pump 5V DC and a hose was implemented. The diode is connected parallel to the motor to provide a safe path for the short term current that might be created if the current is suddenly cut off. TIP122 transistor is used to switch the water pump. LDR sensor is used to detect light in the greenhouse. One leg of the LDR is connected to VCC 5V, and the other analog pin A0 on the Arduino. A 10k resistor is also connected to the same leg and grounded. Digital pin5 on the Arduino is used for relay input. The output of the relay is connected to light that controlled the light intensity of greenhouse.

FTDI CP2102 is connected to the ESP8266 module. The D8 pin on the Arduino connects to the ESP-01 Wi-Fi module TX (Data Out). The GND pin of the Arduino is connected to the GND of ESP8266 module. DHT11 (temperature and humidity) sensor is connected to the GPIO2 pin of ESP8266 ESP-01 Wi-Fi module. DHT11 sensor is used to sense the temperature and humidity. The temperature of the greenhouse is reduced by the fan that is placed inside the greenhouse. DHT11 data is displayed on the web page via Wi-Fi module. And also, this data is sent to the Arduino using serial communication between Arduino and ESP.

3.1. Parts of the System:

- Power supply
  - AC/DC Adapter
  - Adjustable Power supply module (Buck Convertor, CA1235)
- Arduino Uno (ATmega328)
- Wi-Fi Module (ESP8266 01)
- USB to TTL Converter (CP2102)
- Sensors
  - Temperature and Humidity sensor (DHT11)
  - Light sensor (LDR)
  - Soil moisture sensor (FC28)
- Liquid Crystal Display (LCD)
- Relays
- Devices controlled:
  - Fans
  - Sprayer
  - Water Pumps
  - Servo motor
  - Artificial lights

4. SYSTEM OF FLOW CHART:

The Wi-Fi connection has to be established to transfer data to user. Digital pins2&3 of Arduino is used for the communication with ESP8266.Whenever a button is pressed in the web browser, a HTTP GET request is send to the ESP8266. ESP8266 send again the data received from webserver to the Arduino which will be able to control lights, fan and servo motor (window).

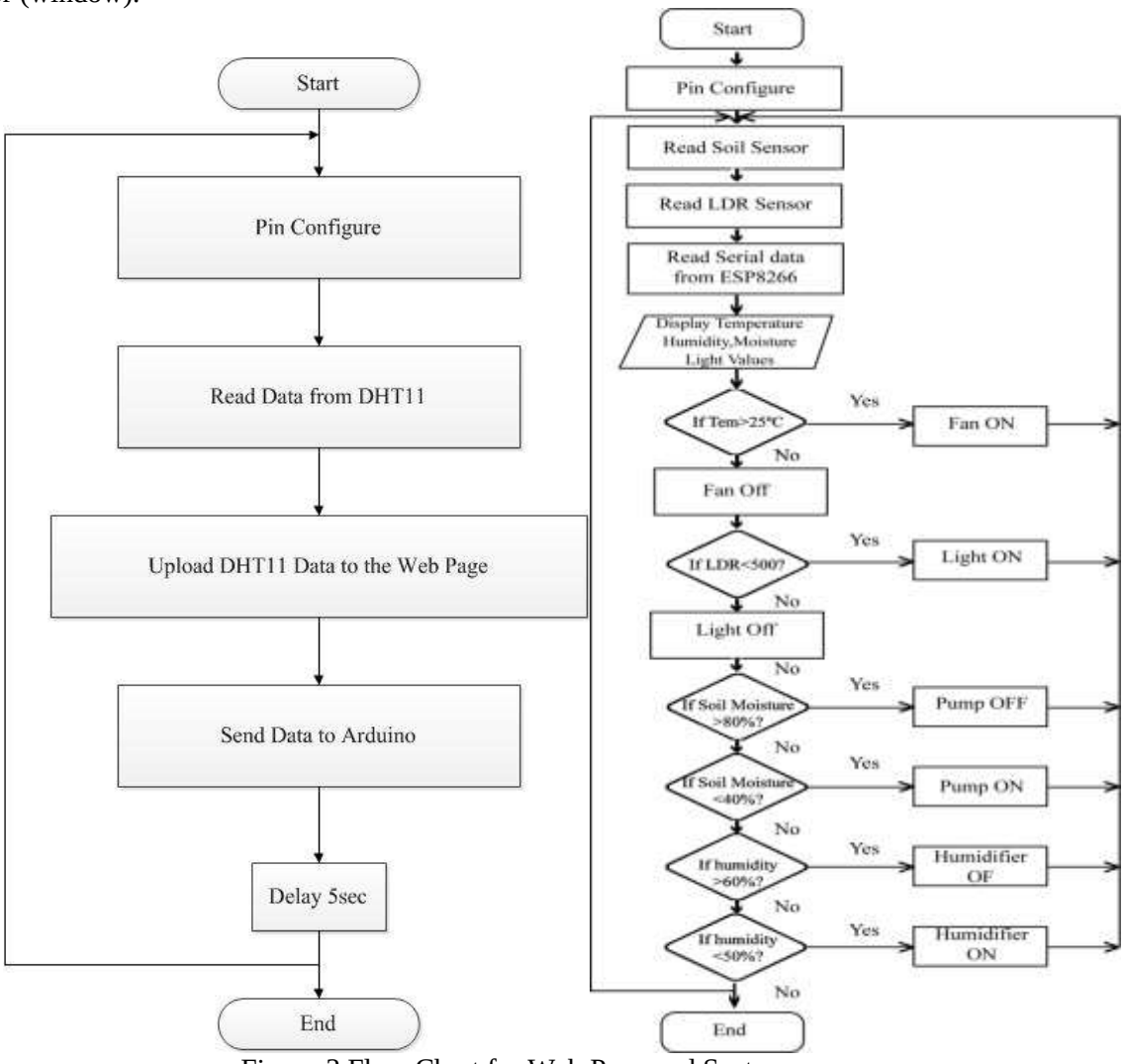

Figure-3 Flow Chart for Web Page and System

5. TEST AND RESULTS:

The temperature becomes higher than the set limit the system, the effect of control is clear which is reduced by using the small fan. This reduction may increase when using suitable size of fan for cooling. The acquired temperature in the greenhouse was decreasing comparable to the set one the system was respond by operating the fan will switch off. The program is written on the microcontroller according to the flowchart and shows the result for DHT11 sensor.

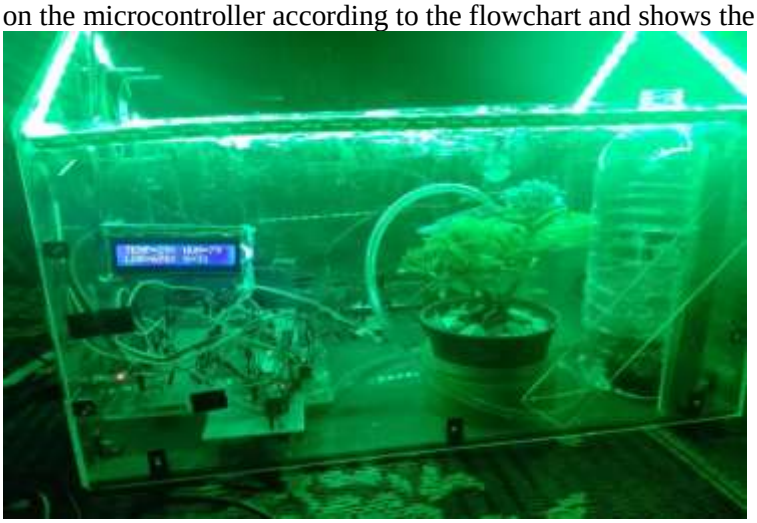

Figure-4 Result for DHT11 Sensor

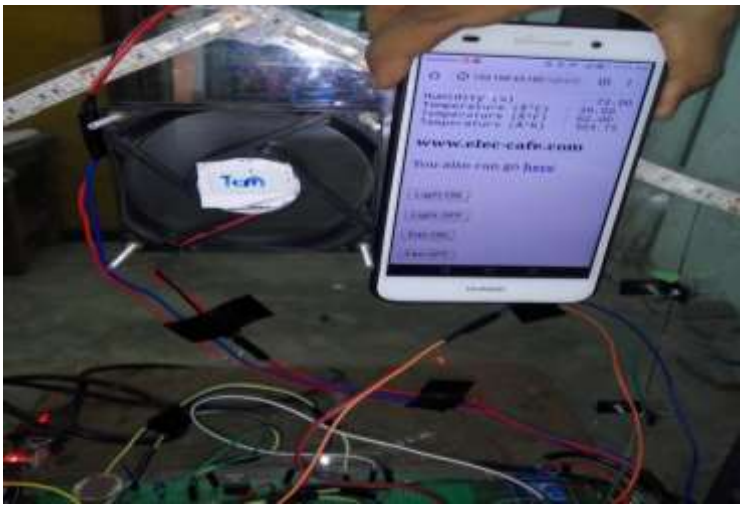

Figure-5 Result for Increasing of Temperature

6. WEB PAGE:

When ESP8266 code is uploaded, IP address will appear on the serial monitor as shown in Figure 6. This IP address opens from browser on phone or PC. The interface page then extracts and displays the DHT11 sensor values and buttons are used to input user commands including the control mode setting as well as the window, fan and light controls.

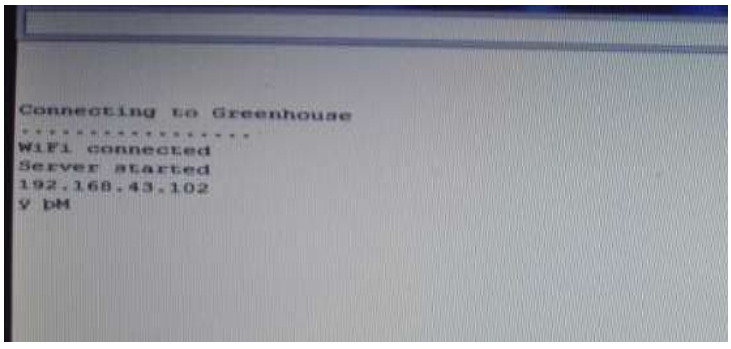

Figure-6 Appearing IP Address on Serial Monitor

Figure-7 Web Interface Page

7. CONCLUSION:

This system can control these greenhouse parameters and reduce wastage using Wi-Fi with sensor it can be monitored and controlled by web page. The system has successfully overcome quite a few shortcomings of the existing system by reducing the human efforts, power consumptions, maintenance and complexity, at a reduced cost and at the same time providing a flexible and precise form of maintaining the environment. In conclusion, the designed is implemented with Arduino platform for greenhouse monitoring, controlling the temperature, humidity, moisture and light with the help of the web server using Wi-Fi module.

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