Intelligent Greenhouse Monitoring System

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Abstract— A Greenhouse effect ----- is one of the leading trends all over the world because of Global warming. It is usually a closed structure, controlled-environment bounded by glass or transparent, and at times translucent, fabric. Since technology is set to go Green making the use of greenhouse vaster than ever. The system so produced is designed in such a waythat will provide constant monitoring of certain parameters (i.e Light, Humidity and Temperature) for better growth of plants. In order to create a controlled environment for different sets of plants, a device is designed using sensors for each of the parameters mentioned priorly. Incase of poor light, the sensor will sense the drop-in value and light a source (e.g. bulb), If the temperature is high the environment is cooled down by using fans and in case of low temperature the device will turn on heaters to maintain the temperature threshold. The humidity sensor helps in providing the values for the sprinklers to be set on or off. Every reading taken from the sensors and every action taken in response are all being saved in a database. A log will be maintained stating the current climatical condition and the action taken accordingly. This will ensure the better growth of plants in a customized environment as per their needs. The system proposed in this paper and has been successfully implemented and extensively tested in the premise of Bahria University Karachi Campus.

Index Terms— Eco-Friendly, Controlled environment Greenhouse, humidity sensor, light sensor, sensor-based monitoring, sensing parameters, temperature sensor and log monitoring.

1 Introduction

Green House is an Intelligent and helpful technology for plants and trees to be nourished with a better growth. The major source of nourishment coming from the sunlight and at the same time preventing the plants from the harmful environmental effects. Greenhouse protects and gives a complete controlled environment for better growth of plants, whether they be indoor plants or outdoor.

Our Project is sensor-based system with a temperature sensor, humidity sensor, and light sensor being controlled and monitored with wireless system. This technology plays a vital role in facilitating the farmers to use it, in order to prevent the plants from harsh climatical conditions and enhance the growth of their plantation within an eco-friendly environment. This provides a favorable environment for the plants and results in an increased life span for the plants. The plants arevulnerable to many adversities in an open, un-controlled environment.

The objective of the system is to provide a low cost and effective solution, which may consume less power from the environment.

The paper describes the Green House established and its parameters in section 2, the Design Methodology in section 3, the Proposed Architectural Model in Section 4, the software Implementation in Section 5. The Procedural Flow of the system proposed is defined in section 6, the Experimentation in section 7 with its results given in Section 8. Section 9 proposes the conclusion and finally in Section 10 we discuss a few future enhancements.

2 Green House

As the human population is increasing at alarming rates, the natural environment may not be able to provide the optimum conditions for required crop production. The demand of many vegetables and fruits has increased enormously, beyond their seasonal outcomes. Thus, our proposed low-cost Greenhouse System will help the crops to produce better, under a controlled environment of their needs. This system will facilitate in the production 0f good quality products. To achieve this purpose a greenhouse as shown in Fig. 1, was established and tested at Bahria University Karachi campus.

Fig. 1: Greenhouse established at Bahria University

Greenhouse has many advantages, they protect the plants from uncertain temperature rises and falls. They control the production of plants (i.e. vegetables and fruits), provide protection to non-shady plants from sun-light, incorporates efficient use of water, fertilizers, insecticide and pesticides and

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many more advantages. In a user-controlled Greenhouse, the production of crops are based on market need, when users require them or which industry may use them for their synthethic products (food industry, cosmetic industry, medicine industry etc) beyond any season.

3 Design Methodology

We used the Work breakdown structure methodology for designing the system. Following are the steps we followed for the design of the proposed system:

LCD Design: Firstly, we integrate the sensors (temperature, light and humidity sensors) with a LCD using Arduino that shows the greenhouse's real-time values of light, temperature and humidity.

Light Sensor: In the second step we integrate a light sensor with a bulb, that is programmed to indicate the light intensity in the greenhouse. If the requirement is high the bulb is turned ON otherwise OFF.

Temperature Sensor: The next step is to connect a fan and heater using actuator. If the LCD depicts high environmental temperature a fan connected to the outputs of the sensors is turned ON on the contrary if the low temperatures are observed a heater is turned ON.

Humidity Sensor: In the subsequent step, humidity management is performed by the output of the sensor. The output of the sensors suggests whether the sprinklers should be turned ON or OFF.

Database: After designing the hardware module we worked on developing a database that shows all the readings of sensors in the Excel sheet in a real- time environment.

Documentation: The readings so obtained from the database are logged. This step provides us a clear picture of connected devices and their usage. Also it provides us a better knowledge of the climatical patterns so as to generate good quality products in the future as well.

Testing: As a final stepl, we tested our system in the greenhouse established in Fig. 1, for checking its efficiency and working capability. The whole design explained in this section can fairly be depicted by Fig. 2, which exhibits the modus operandi of the greenhouse.

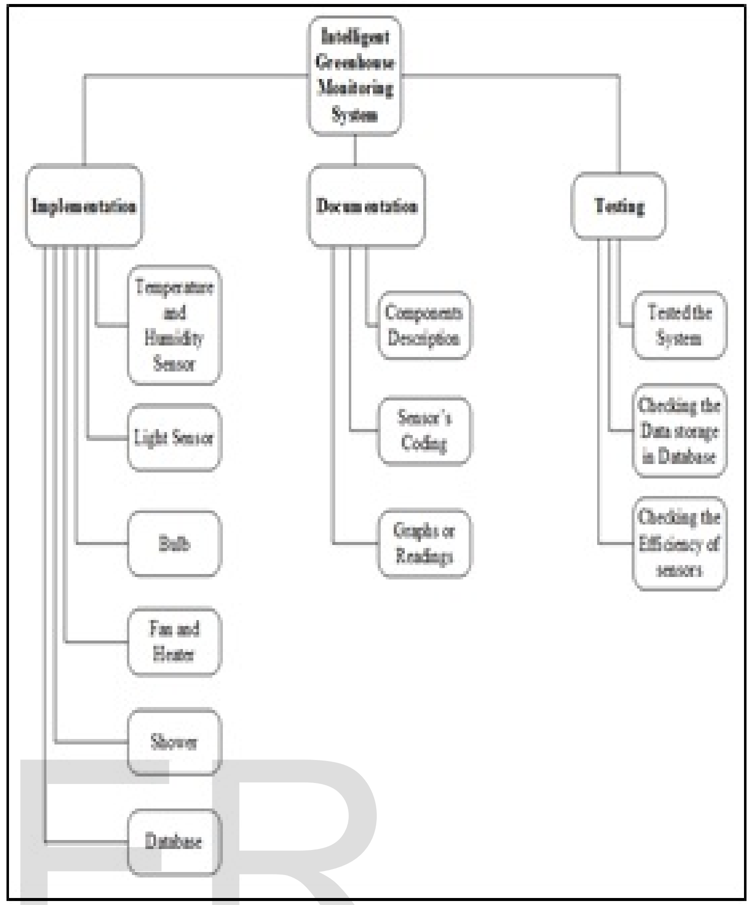

Fig. 2: Overview of the Proposed Project

4 Architectural Model

Our manisfestation of the Greenhouse is best depicted in Fig. 3. The greenhouse incorporates two sensors, namely LDR as the light sensor and DHT11 for measuring the temperature and humidity. The system is further connected with Fan, Heater, Bulb and Sprinklers. All this equipment controlled by Arduino and all the requirements shown on LCD. Regarding this data will sync in Database for further use. This is all about the architectural view of the presented model.

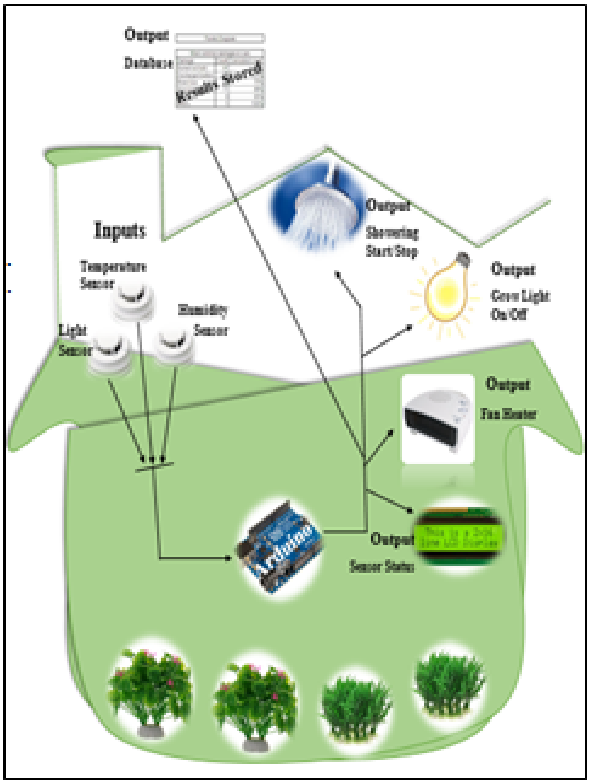

Fig. 3: Architectural Design

4.1 Sensors

Humidity and Temperature Sensor

DHT11 sensor detects the humidity and temperature of the greenhouse without any interference of any substance or element in the environment and gives the results according to its reliability and performance. It is efficient in use and consumes less power and gives accurate results according to environment. Table 1 shows the sensing parameters of DHT11.

Resistance	400ohm to 400kohm
Sensitivity	About 3msec
Voltage ratings	3V,5V and 12V
Max power dissipation	200mw

TABLE 1
DHT11 SPECIFICATIONS

Light Sensor

LDR is used for light sensing purpose. It is made of a high resistance semiconductor. As designed using a resistor whose resistance is decreasing with increasing incident light intensity [2-3]. Its operating temperature range is -400C to 750C [2-3.] LDR is mainly used with visible light.

So the problem of external light will affect the LDR. The effects of visible light are more in LDR then that coming from Photo diodes. Sensitivity is defined as the time taken for output to change when input changes. Table 2 represents the LDR specifications of the configuration being used by our proposed model.

Supply Voltage[1]	+5 V[1]
Temperature range[1]	0-50 °C [1]
Humidity[1]	20-90% RH ± 5% RH[1]
Interface[1]	Digital[1]
Supply Current	measurement 0.3mA standby 60µ A

TABLE 2
LDR SPECIFICATIONS

4.2 Electronic Model

The system in discussion is currently designed on a Breadboard, so that testing and reconfiguration becomes easier [4], we have designed the circuit as depicted in Fig. 4. We connect our sensors, LCD, shower, bulb, heater and fan with it through Arduino.

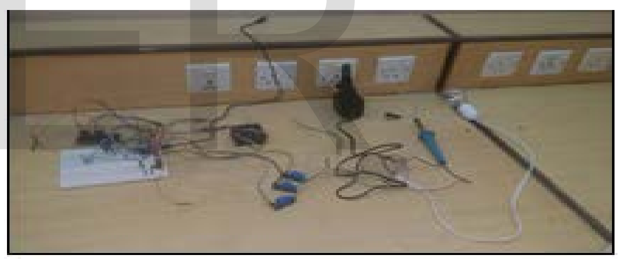

Fig. 4: Circuit Design

4.3 Data Representation

Data so obtained by our system is now stored in the excel sheets by using the software (PLX-DAQ). This software ensures the simulation of the real time data of sensors and stores the results in the sheet for future use. By using this sheet different charts can be generated for future prediction (i.e. the level of the requirements. Fig. 5 shows the graph generated for the sensor values of DHT11.

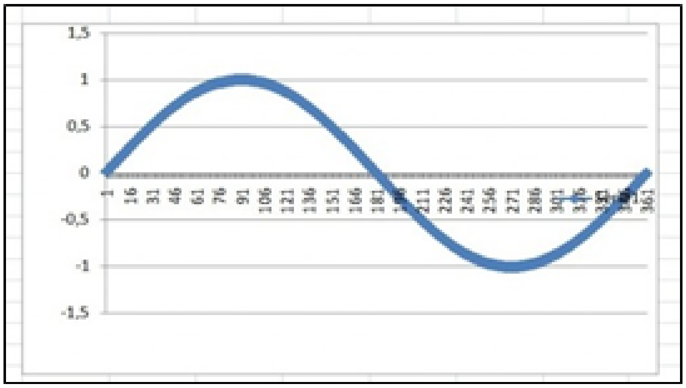

Fig. 5: PLX-DAQ (Reading and Graph for Sensors)

5 SOFTWARE OF THE SYSTEM

Arduino is used for uploading the sketch of code. For running the system and for making the components work efficiently. For uploading the code, copy and paste the code in the editable environment of IDE, if any error occurs in the sketch after compilation, the software will mention it in the error window with all the necessary details.

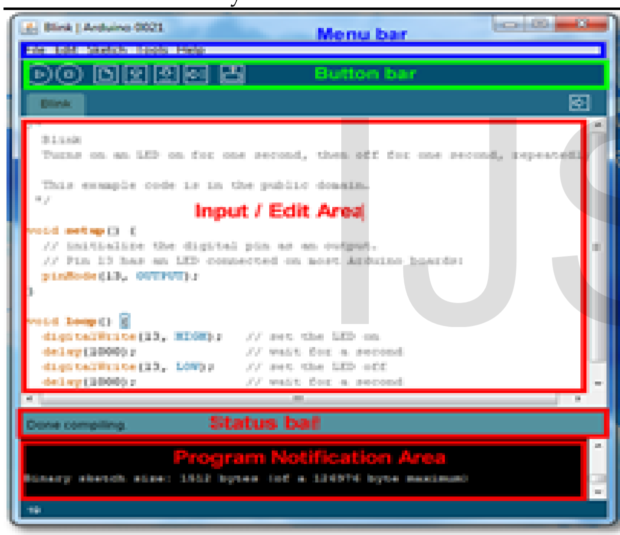

Fig. 6: Arduino IDE

5.1 Using Arduino:

1. Code your sketch
2. Compile your code to check the possible errors
3. Upload the program to the Arduino board

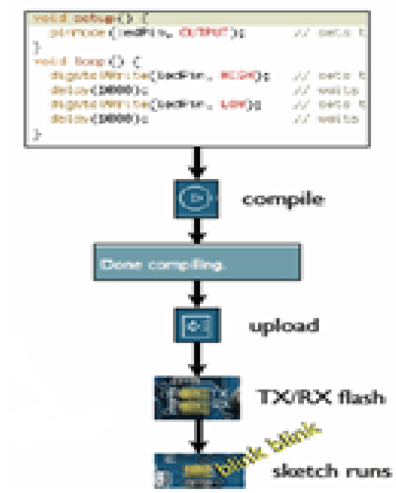

Fig. 7: Steps to Run the sketch

Fig. 8: Data Acquisition for Excel

6 PROCEDURAL FLOW OF THE SYSTEM

The system will start from the protocol setting (i.e. Switch on the system, connect the Arduino with the system, check the serial port of the Arduino. Then load the code in the Arduino, It will read the environment light, temperature and humidity from sensors (LDR and DHT11). Through actuator, (relay module) the bulb, fan, heater and shower that are connected to the Arduino will fulfill the requirements for the plants. All the readings will be shown on the LCD. The data will be then send to database that will be stored there for future use may be for prediction.

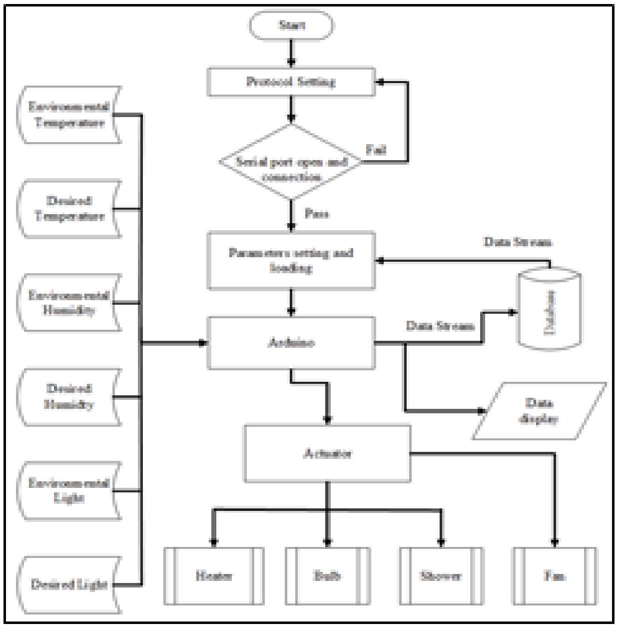

Fig 9: Procedural Flow of the System

7 Experimentation

For monitoring the performance of the system, the system is tested in the Greenhouse of Bahria University Karachi Campus. Some of the shady (money plant) and non-shady (caladium plant), plants were there for testing the system. Variation of temperature, humidity, and intensity of light were measured with the consumtion of power included too. Below mentioned results shows the efficiency of Greenhouse system in summer season but it can cater other seasons too.

7.1 Shady Plant (Money Plant)

1. Light: It requires no direct sunlight, only required fluorescent light under range of (50-60%) (According to weather condition)
2. Temperature: Room temperature 16 to 24C or 60 to 75F.
3. Humidity: Keep humidity level at 50% or higher.

Fig. 10: Money Plant

7.2 Non-Shady Plant (Caladium Plant)

1. Light: They require direct sunlight from the sun or if you give them fluorescent light so must give at 67 to 75 average of the day sunlight.
2. Temperature: At the hotter temperature they will grow faster. Temperature range must be 38 to 40C
3. Humidity: Just maintain humidity level at 24 to 28% or less in rainy season.

Fig. 11: Caladium Plant

8 Results

Fig. 12 shows the temperature measured with its connected device (i.e. Fan) in the Greenhouse.

Fig. 12: Temperature Monitoring Result

Fig. 13 shows the humidity measured with its connected device (i.e. Shower) in the Greenhouse.

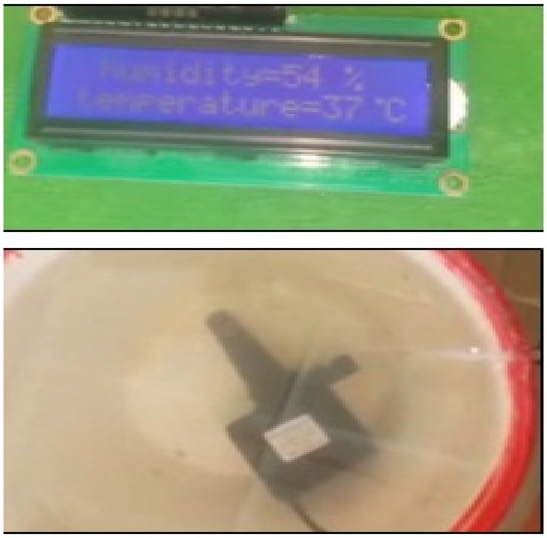

Fig. 13: Humidity Monitoring Result

Fig. 14 shows the light measured with its connected device (i.e. Bulb) in the Greenhouse

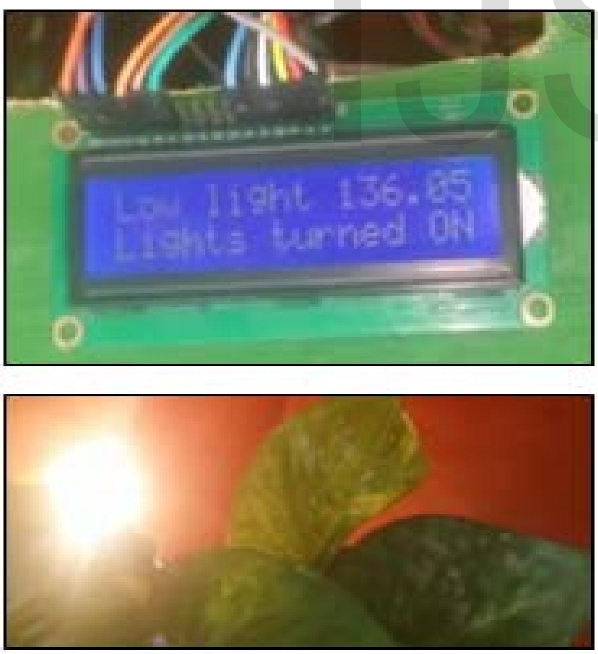

Fig. 14: Light Monitoring Result

These results shown above are the measured temperature, humidity and light in the Greenhouse. It shows how efficiently these sensors sense the degree of these parameters at different intervals.

9 CONCLUSIONS

This paper basically describes all the theory based on wireless communication between sensors. In this Greenhouse, sensors wirelessly monitors the temperature, humidity and light, without any interference of network and work efficiently according to the nature of plants. This Greenhouse system gives high reliability, confidentiality and less power consumption.

10 FUTURE ENHANCEMENT

This system will be remotely controlled in future and will provide all the informarion to mobile through GSM so that system can be operated remotely. By this GSM module we can easily operate this greenhouse through our cell phones and then system will enhance its capability and portabilty. The given below diagram describe how it will work in future remotely.

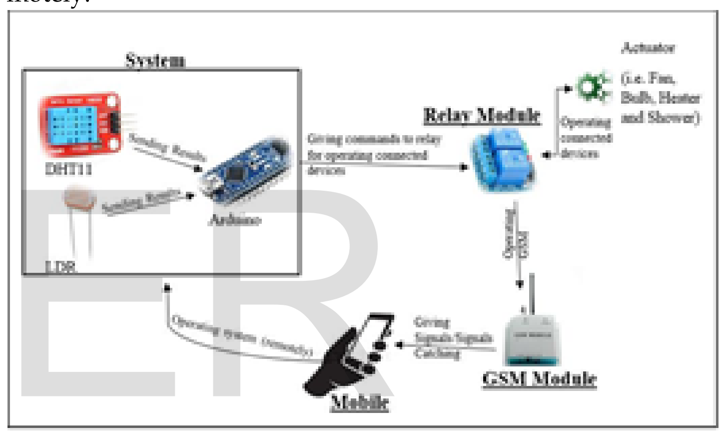

Fig. 15: Future Enhancement

11 REFERENCES

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[3] https://www.electronics-notes.com/articles/electronic_components/resistors/light-dependent-resistor-ldr.php
[4] https://www.google.com.pk/?gws_rd=cr&ei=XmX_WLDbIcSNvQSpj5DADA#q=what+is+breadboard+in+electronics
[5] http://webcache.googleusercontent.com/search?q=cache:LyiNZuVJVlQJ:www.ijeit.com/Vol%25203/Issue%25202/IJEIT1412201308_50.pdf+&cd=1&hl=en&ct=clnk&gl=pk
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