Green House Automation with Climatic Control Using Arduino

Prof. Kimberly Morais[1] Mr. Bijo Raju[2] Mr. Miranda Braz Jaston[3] Miss. Alisha Ashok Mhamal[4]
[1]Assistant Professor [2,3,4]UG Student
[1,2,3,4]Department of Electronics and Telecommunication Engineering
[1,2,3,4]Don Bosco College of Engineering, Fatorda-Goa

Abstract— Crop production is the major requirement of any country. In today's world due to change in climatic conditions and unusual changes in the atmosphere at any instant, the crop production is going down day by day. Also the crop production has become very labor intensive as lot of things has to be taken care of like proper amount of water, sunlight, fertilizers, etc. In this paper we aim to propose a frame work to increase the crop production even in changing climatic condition. Also the proposed system is less labor intensive as it monitors the parameters inside the green house without much labor and controls these various parameters using sensors and motors thus proving a feedback to changing conditions inside greenhouse. This system makes use of improved system of opening roof top rather than the conventional exhaust fans.

Key words: Arduino, relay module, DHT11, groove sensor, DC motors, water pump

I. INTRODUCTION

The high rate of consumer needs and the rapid increase in the plant/crop products has put the need for increased crop production. Many advanced technologies are being implemented in the agricultural and horticultural field to increase the crop production. By merging technology in agricultural and horticultural fields, we have come up with a simple yet efficient system that can create artificial environment for enhancing crop/plant growth called as automated green house.

In the earlier systems proposed, the microcontroller used was the year old embedded system which were slow and hard to program. Also the parameters which were to be controlled were only monitored using sensors even if the parameters had to be controlled a person had to manually turn on or off the controlling element.

The basic blocks of this system is as shown in the block diagram in figure 1

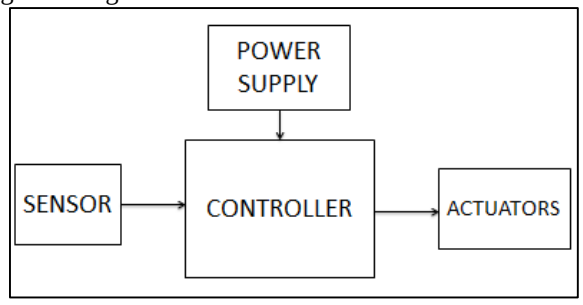

Fig. 1: Basic block diagram of the project

The above block diagram consists of the controller, sensor, actuators and the power supply. The controller is the one which monitors the entire system. The sensor senses the environment inside the green house and sends the appropriate values to the controller. The controller checks for the received values. If the values have reached a certain threshold then the controller will take certain actions based upon the algorithm provided. Power supply block consists of the element which provides the energy to run the controller, sensor and actuators.

Here in this prototype we use Arduino as the controller as it is very reliable and user friendly. The software required is the Arduino IDE application. It is used as the interface between the Arduino and the user. It also requires the knowledge of simple c programming which is used as the language to program the Arduino. Also we use DHT11 (temperature and humidity sensors) and groove soil moisture sensors.

II. BLOCK DIAGRAM

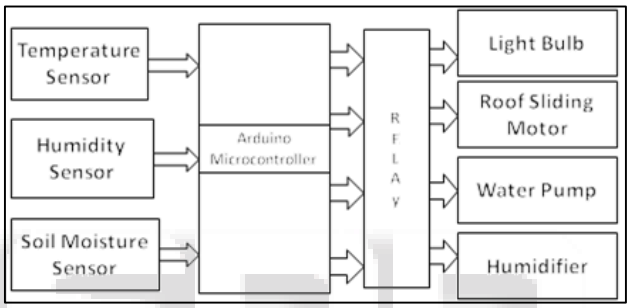

Fig. 2: Main block diagram of the project

The heart of this system is the Arduino Mega microcontroller. Temperature, humidity and soil moisture sensors are interfaced to Arduino Mega. It consists of the relay module. Whenever an AC load is to be turned ON/OFF, control signals from Arduino are given to the relay module to controls the AC load actions inside the greenhouse. The light bulb in the block diagram is used to increase the temperature inside the greenhouse while the opening rooftop is used for lowering it. The water pump is used to pump water inside the greenhouse. The humidifier is used to increase the humidity inside the greenhouse whenever it is low.

III. HARDWARE REQUIREMENTS

The main hardware required are as follows:

1) Arduino mega 2560
2) DHT11 sensor
3) Groove sensor
4) Light bulb
5) DC motors
6) Water pump
7) Humidifier

A. Arduino Mega 2560

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

Arduino IDE software is used to program the Arduino Mega. It is user friendly application. Fig. 3 shows the image of Arduino Mega 2560

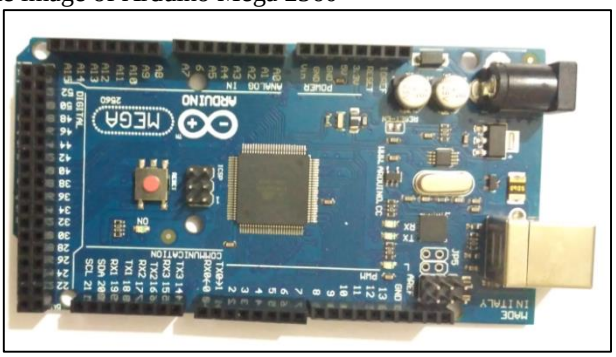

Fig. 3: Arduino 2560

B. DHT11 (Temperature and Humidity Sensor)

DHT11 sensor is used to sense the temperature of the greenhouse as well as the humidity in the air. DHT11 Temperature & Humidity Sensor highlights a temperature & humidity sensor complex with a calibrated digital signal input. It ensures high reliability and excellent long-term stability. This sensor incorporates a resistive-sort moistness estimation segment and a NTC temperature estimation part, offering fabulous quality, quick reaction, hostile to obstruction capacity and expense adequacy.

Measurement Range 20-90% RH , 0-50℃
Humidity Accuracy ± 5% RH
Temperature Accuracy ± 2℃

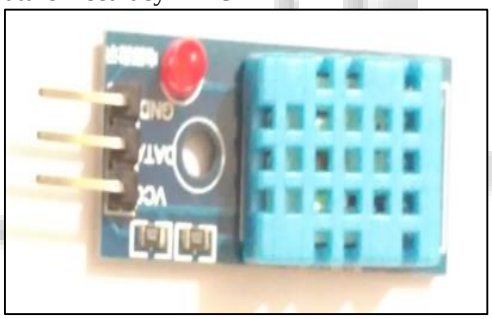

Fig. 4: DHT11 Sensor

C. Groove sensor (soil moisture sensor)

DHT11 soil moisture sensor is used in this project. It is used to sense the soil moisture inside the greenhouse. It is analog as well as a digital device. They can be easily utilized, simply embed it into the dirt and after that read it.

This sensor provides real time soil moisture data to the microcontroller. The sensor is embedded into the soil at strategic points to ensure soil moisture is at optimum levels at all required locations. Analog data of soil moisture level from the plant system environment is delivered from the sensors to the microcontroller.

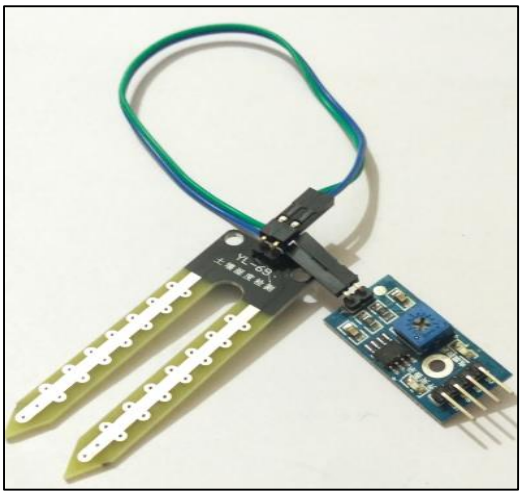

Fig. 5: Groove Sensor

D. DC Motors

A DC motor is any of a class of rotary electrical machine that converts direct current electrical power into mechanical power. In our project DC motors are used.

DC motors are used in opening the rooftop of greenhouse when temperature or humidity rises above a certain set point thus helping in cooling temperature and regulating humidity inside greenhouse.

The motors are connected to rooftop by an opening mechanism. Two motors are used, one opening the left side of roof and the other opening the right roof. They are connected through motor shield to the Arduino. On reception of control signals by Arduino, the motors perform the desired functions.

E. Water Pump and Humidifier

DC 12v mini water pump is used in this project to pump water in the green house to maintain the soil moisture. Whenever the soil moisture goes down, water pump is put on and whenever soil moisture acquires a certain amount of water, the pump is put off. Humidifier is used for regulating the amount of water in air inside the greenhouse. Whenever the humidity goes down inside the greenhouse the Humidifier is put on and whenever humidity reaches a certain percent, Humidifier is put off.

IV. ALGORITHM FLOW CHART

1) Step1: Start
2) Step2: Initialize Arduino 2560
3) Step3: Take the input from various sensors
4) Step4: Compare the input values with appropriate threshold
5) Step5: If values are within range, no action.
6) Step6: If compared value is higher than threshold, turn on actuator 1
7) Step7: If compared value is lower than threshold, turn on actuator 2
8) Step8: Stop

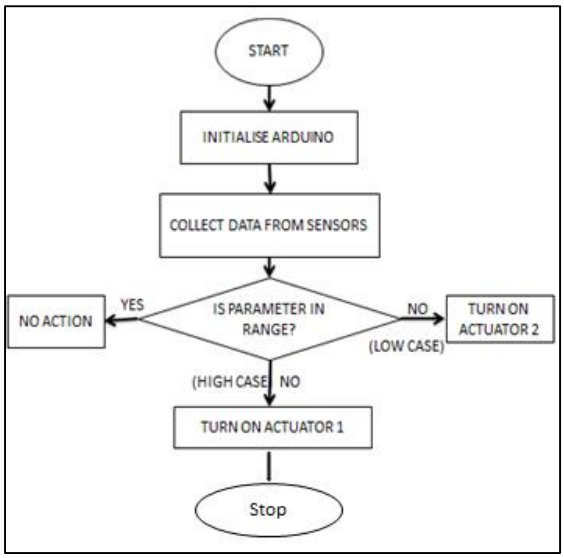

Fig. 6: General controlling flow chart for any parameter

The above flow chart shows the general procedure for controlling any parameters inside the green house.

The three main parameters controlled in this project are temperature, humidity and soil moisture. The first three steps for controlling all this parameter is the same. First step is starting the process then the Arduino is initialized. Next the different parameters to be controlled from the green house are sensed using sensors placed at different places in the green house. The value from the same type of sensors are taken and averaged out to get an average value of the controlling parameter in the green house. Now this average value is compared with the threshold value set for the respective parameters and accordingly actuators are made to run. In order to increase temperature when sensed value of the parameter is less than the threshold inside the green house light bulb is put on similarly to increase humidity Humidifier is put on. While water pump is put on when soil moisture has to be increased inside the greenhouse. In case of temperature and humidity being above the threshold rooftops are opened to lower them.

V. Result and Obsrvation

This project is planned and aimed at yielding higher crop/vegetables production or plant growth inside greenhouse with optimum care without much human interference. All the vitals for growth of plants /crops are monitored and automatically regulated if any change occurs, thus providing them a well sustained artificial environment.
Fig. 7 shows the interfacing of input parameters with Arduino 2560 and Fig. 8 shows the sensed values by these sensors

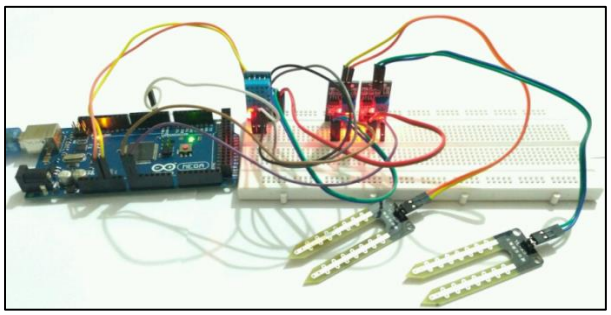

Fig. 7: interfacing DHT11 and Groove sensor with Arduino 2560

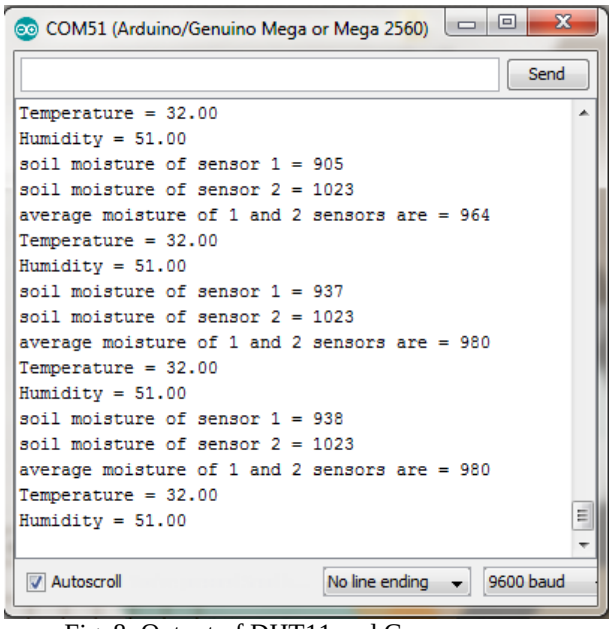

Fig. 8: Output of DHT11 and Groove sensors

As these values are read by controller, it checks and compares these vales with the preset threshold vales and based upon the algorithm, corrective measures are taken.
The output is given to relay module to control ac loads as shown in fig. 9.

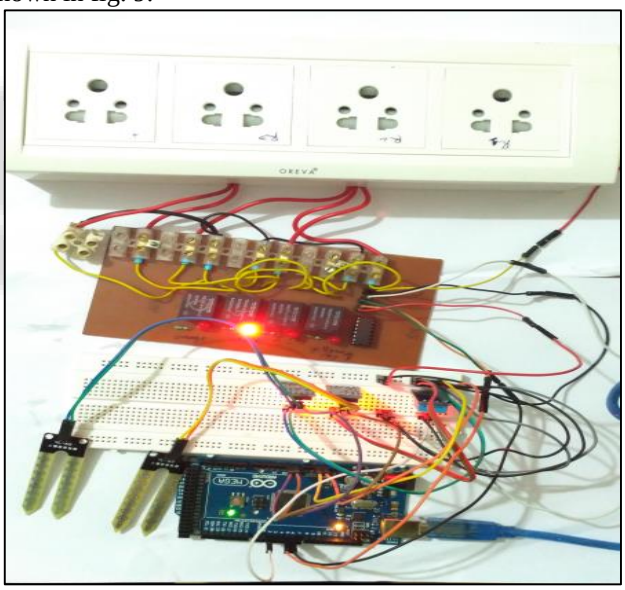

Fig. 9: Control signals given to relay module

VI. Application

This system is not only restricted in local villages or cities, it can also be implemented in hilly or terrains which suffers from climatic changes. Also the setup is much simpler and cost effective in long run.

Using this system, we can grow a number of plants, crop type by changing the threshold set points for each type of crop/plant. Therefore this system is not restricted to a particular type of plant/crop.

VII. Conclusion

The proposed project on greenhouse helps in automating the year old method of green house and makes it less labor intensive. Also it helps in conserving energy by making use

of opening roof top which consumes less energy as compared to the old exhaust fans. Also it is an advantage to the farmers as they can set the threshold of the parameters like temperature, humidity and soil moisture which if set properly can increase the yield of the crops grown inside the greenhouse.

Here the prototype can be also included with gsm module which will help the user to get all the relevant information of the green house by sms.

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