International Academic Institute for Science and Technology

International Academic Journal of Science and Engineering
Vol.10, No.1, 2023, pp.27-32.

ISSN 2454-3896

International Academic Journal of Science and Engineering

www.iaiest.com

Greenhouse Farm Monitoring is Automated with Smart Controls

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Abstract

In the modern day, greenhouses have emerged as a well-liked option for sustainable agriculture due to the growing worry about climate change and the rising demand for food production. Because of the growing concern about climate change and the increased demand for food production, greenhouses are becoming a preferred approach for sustainable agriculture. To get around these problems, clever control systems using Arduino microcontrollers have been developed to automatically monitor and regulate the ambient conditions within the greenhouse. Before a problem arises, intelligent control systems can identify and mitigate possible hazards. A more ecologically friendly and productive approach to farming may be achieved via the use of sophisticated management systems in greenhouses. The major objective of the project is to build greenhouses that provide a suitable environment with a high production capacity, protect endangered plants, and conserve people's time and energy.

We'll use the Arduino to help us automate this process. The Arduino is a device that has outputs that are used in greenhouses and inputs (sensors) that can be programmed in C++ on a computer. The tools and materials we utilize for the project are an Arduino, a fan, a spray can, a humidity sensor, a lighting sensor, and a temperature sensor. The temperature sensor in our project is utilized to measure temperature. It will send a sensor to Arduino when the temperature rises or falls. To maintain a temperature that is comfortable for the plants, the fan or air conditioner is switched on. When there is insufficient light, the light sensor sends a signal to the Arduino to switch on the lights. It measures the moisture content of the soil. It will be transmitted to Arduino if the soil needs water. Through a DC motor, water flows. In order to provide an appropriate climate for plants without a human to take care of them, a smart control of greenhouse utilizing Arduino is used.

Keywords: Greenhouse, Smart Controls, Agriculture Arduino.

DOI: 10.71086/IAJSE/V10I1/IAJSE1005
Received: 16 December 2022/Revised: 17 January 2023/Accepted: 22 February 2023/Published: 30 March 2023

Introduction

Plants are raised within a structure called a greenhouse, which is often composed of glass or translucent plastic. A greenhouse's main purpose is to offer a secure environment for agricultural development while allowing for the passage of natural light (AlShrouf, 2017; Fitriana, 2019). In light of such claim, the greenhouse's management system contributes to the preservation of control over its key factors (Wati & Sholihah, 2021).

In order to maximize the growth of a certain crop and lower production costs, producers must regulate the greenhouse environment more and more effectively (Naik et al., 2015; Kanagala, 2023). Over the past several decades, systems for controlling greenhouses have greatly changed, and now, a variety of sensors are used to collect data on a range of greenhouse-related variables (Srbinovska et al., 2015; Hadiatna & Susana, 2019).

Traditional management systems have evolved, mostly as a result of wired methods. The system may be reasonably readily established using the wired method with the possibility of an extension, but the higher maintenance costs of the wiring make it less efficient (Li, 2017; Syadza et al., 2018). To complete a control system, a large greenhouse will need a lot of cables. The temperature and humidity inside the greenhouse were the main environmental variables that traditional greenhouse management systems monitored. These important facts affect how rapidly plants develop, which makes them important.

To follow a crop's progress in depth, however, requires more exact and thorough information than just temperature and humidity. It follows that crop monitoring is just as important as environmental monitoring (Gondchawar & Kawitkar, 2016; Kanagala et al., 2023). IoT-based systems and wireless sensor networks have enabled integration of smart technologies for automation and remote monitoring, allowing for precision farming that improves efficiency and sustainability (Pitakphongmetha et al., 2016; Siregar et al., 2017; Wijayanti, 2022). These advancements demonstrate that IoT-enabled greenhouse monitoring can provide more reliable crop data and improve decision-making in modern agriculture.

Literature Review

Author	Title	Aim	Components
AlShrouf, 2017	Automated Green house temperature and soil moisture control	To analyise the possibility of a greenhouse temperature being maintained in a desired range for optimum crop yields, investigate the reliability of the water system	1.Temperature sensor 2.Soil moisture sensor 3.Arduino
Srbinovska et al., 2015	IOT Based smart Agriculture	Smart irrigation with smart control and intelligent decision making based on accurate real time field data Smart warehouse management which includes temperature, humidity maintenance and theft detection in the ware house	1.IOT 2.DHT 11 sensors, 3.Wi-Fi module
Gondchawar & Kawitkar, 2016	IOT Based Green House Monitoring System	Soil moisture and temperature sensor have been integrated with the proposed control system	1.Soil moisture sensor 2. Temperature sensor 3.WI-FI module 4.IOT

Design and Implementation

General Block Diagram of the Project

A simple block diagram of the project circuit is shown in Figure 1.The main electronic components used in each sections are also mentioned near to each block

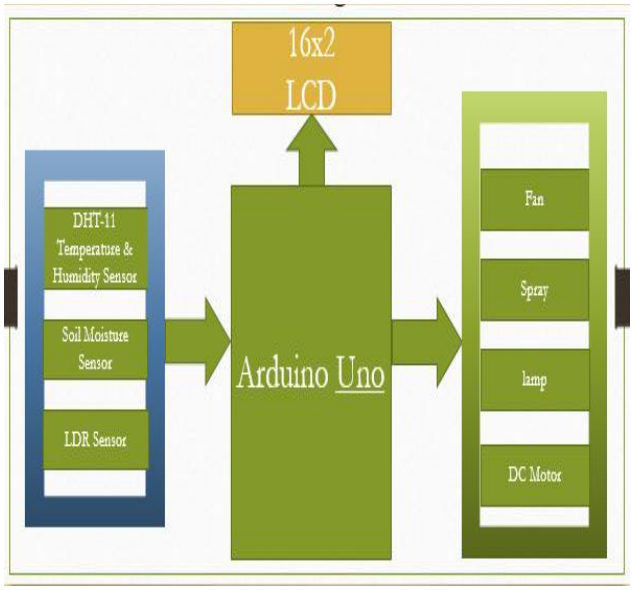


Fig. 1: Block Diagram of the Project

The block diagram consists of six components, namely:

- Soil moisture sensors measure the moisture content of soil by using metal probes that create a circuit with the soil. The moisture in the soil affects the electrical conductivity or capacitance between the probes, which is measured and used to determine the moisture content. They help optimize irrigation and prevent over or under watering of plants.
- LDR: LDR can be used in the greenhouse to monitor the amount of light that plants receive in the greenhouse. The amount of sunlight that plants receive can directly affect their growth, so we must ensure that plants receive the appropriate amount of light for their stage of growth.
- Arduino UNO: Is a device use to connect each component together and control it, take information from LDR, DHT11 & soil moisture sensors and then send information to DC motor, LED lamp, Spray & fan to monitoring the parameters for make good condition of growth of the plants
- DHT11: To sense the both temperature & Humidity using Negative temperature co-efficiency
- LCD: The crystal is a device used to display information or massage on machines and convert the light into reveal an image, symbols or sign.
- DC motor: Is use to pump the water using energy conversion principle.

The soil moisture sensors, LDR and DHT11 are measured all parameters that required to safe growth of the plants like Temperature, Humidity & sunlight and water content in soil. When the soil gets dry the soil moisture sensor send information to Arduino, which apply the DC motor to work as water pump to watered the plant until the soil moisture sensor send information once again to Arduino to switch off the DC motor when the soil got wet. The DHt11 sensor senses the both temperature & Humidity. During hot weather, the temperature increased so the DHT11 will send data to Arduino to switch ON the fan for reducing the hot, when the temperature decreased, again DHT11 will send data to Arduino to stop fan. In same time DHT11 sensor will sense the Humidity, when the air content less moisture, DHT11 sends data to Arduino to apply the water spray for increasing the humidity until it reaches to the suitable amount of the humidity. LDR sensor will measure the sunlight amount, during daytime, LDR will send data to the Arduino to switch OFF the lamp, but during nighttime the LDR send data to Arduino to Switch ON the lamp. All these data will display in LCD 16*2. The project managing and monitoring all these parameters to maintain the good condition for saving growth of the plants.

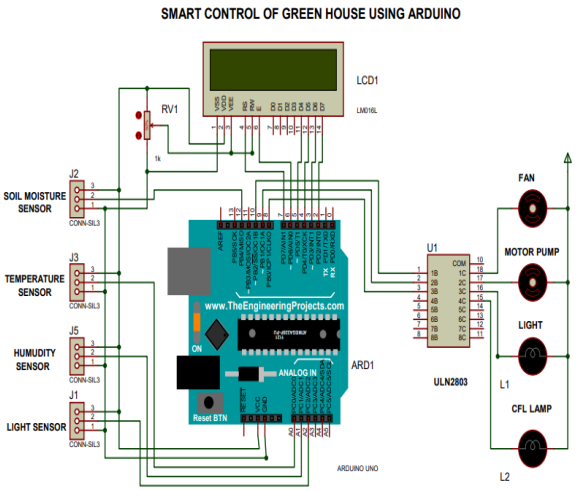


Fig. 2: Circuit Diagram of the Project

Operation of the Project

The soil moisture sensors, LDR and DHT11 are measured all parameters that required to safe growth of the plants like Temperature, Humidity & sunlight and water content in soil. When the soil gets dry the soil moisture sensor send information to Arduino, which apply the DC motor to work as water pump to watered the plant until the soil moisture sensor send information once again to Arduino to switch off the DC motor when the soil got wet. The DHt11 sensor senses the both temperature & Humidity. During hot weather, the temperature increased so the DHT11 will send data to Arduino to switch ON the fan for reducing the hot, when the temperature decreased, again DHT11 will send data to Arduino to stop fan. In same time DHT11 sensor will sense the Humidity, when the air content less moisture, DHT11 sends data to Arduino to apply the water spray for increasing the humidity until it reaches to the suitable amount of the humidity. LDR sensor will measure the sunlight amount, during daytime, LDR will send data to the Arduino to switch OFF the lamp, but during nighttime the LDR send data to Arduino to Switch ON the lamp. All these data will display in LCD 16*2. The project managing and monitoring all these parameters to maintain the good condition for saving growth of the plants.

Preliminary Work and Simulations

An exclusive tool set for automating electrical design is called the Proteus Design Suite. The program is primarily used by technicians and electronic design engineers to develop schematics and electronic prints for printed circuit board production.

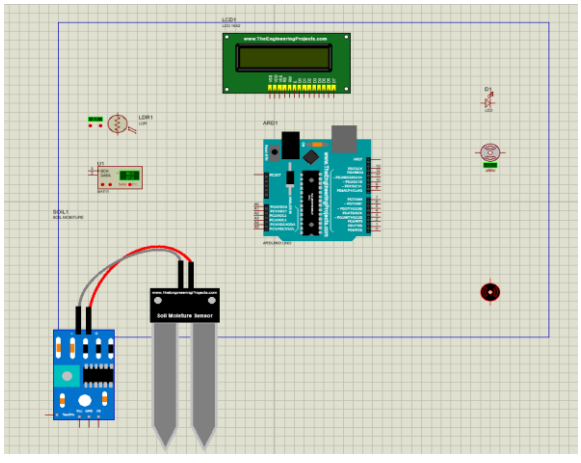


Fig. 3: Breadboard Connection

The last we connected all components to gather.

Project Development

All the components are procured, some from college and those which not available were purchased from outside. For testing these components whether working or not we have tested it by connecting it on breadboard.

Results and Discussions

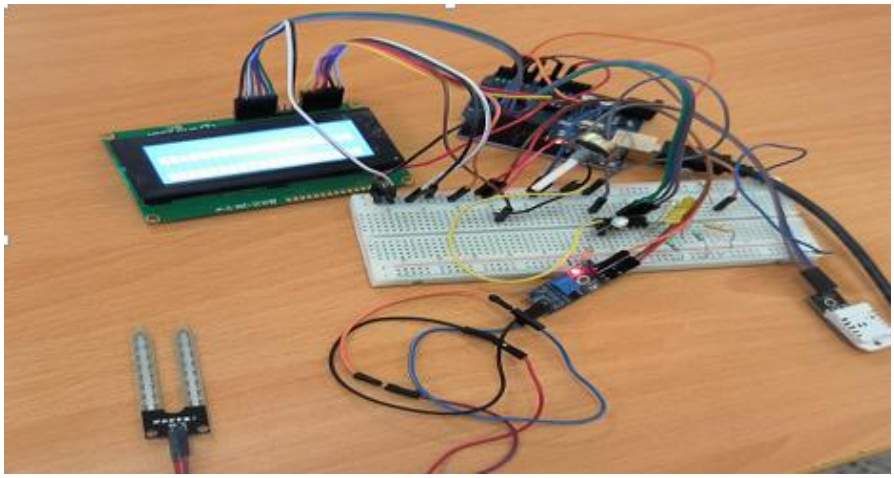


Fig. 4: Circuit Prototype on Bread Board

In our system we are used to controlling the parameters inside greenhouse, we use temperature, humidity, light and soil moisture as input and LCD to show output. The components that we used are DHT.11, LDR, soil moisture sensors, DC Motor, LCD 16*2 and arduino UNO.

Performance Test Analysis

Table :1 Sensors Like Temperature, Humidity, Light and Soil Moisture Sensors are Controlled by Arduino Uno

Parameters	Arduino	LDR	Soil Moisture Sensor	Humidity & Temperature Sensor	Dc Motor
Temperature	On	Off	Off	On	Off
Humidity	On	Off	Off	On	Off
Light	On	On	Off	Off	Off
Soil Moisture	On	Off	On	Off	On

Conclusion

The use of Arduino to regulate a greenhouse intelligently has a wide range of possible uses. To maintain and manage the habitat for different plant species, particularly rare and endangered plants, this technology may be used in botanical gardens, for example. Additionally, it may be utilized in industrial greenhouses to control the temperature, humidity, and other environmental conditions to enhance crop quality and output. Additionally, rooftop gardens that may be vulnerable to adverse weather conditions might utilize smart greenhouse control utilizing Arduino to maintain and control the climate for plants growing there. It may also be used to regulate the environment for plants produced in hydroponic systems or indoor gardens, which may need precise control over temperature, lighting, and nutrient levels. Last but not least, the technology may be applied in research labs to provide a controlled environment for plant experimentation as well as to track and collect environmental data. This can result in more precise and trustworthy data for researchers to evaluate, as well as an improved method of carrying out tests.

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