Automated Greenhouse Farming System

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Abstract—**The greenhouse automated farming system is a transformative approach to modern agriculture, leveraging technology to create controlled environments for optimal crop growth. By integrating sensors, actuators, and advanced control systems, this system automates the monitoring and regulation of critical factors such as temperature, humidity, light, irrigation, and nutrient delivery. Sensors collect real-time data on environmental conditions, which is processed by a central control system to trigger automated responses, such as adjusting ventilation, activating irrigation, or supplementing light. This precision ensures consistent growing conditions, enhancing crop yields and quality while minimizing resource waste.**

Key features of the system include climate control, automated irrigation, and remote monitoring capabilities, enabling farmers to manage operations efficiently from anywhere. The use of artificial intelligence and data analytics further optimizes decision-making, predicting plant needs and improving resource efficiency. Benefits of automated greenhouse farming include increased productivity, reduced labor costs, year-round crop production, and sustainable resource use

I. INTRODUCTION

An automated greenhouse farming system is a technologically advanced approach to agriculture that integrates automation, sensors, and control systems to optimize plant growth and resource management. This system creates a controlled environment where factors such as temperature, humidity, light, irrigation, By leveraging automation, it minimizes human intervention, reduces labor costs, and enhances productivity, making it a sustainable solution for modern agriculture. In recent years, the global demand for food has increased significantly due to population growth, urbanization, and climate change. To address these challenges, sustainable agricultural practices are crucial, and one promising solution is the adoption of automated greenhouse farming systems.

A greenhouse, by providing a controlled environment, offers the ability to grow crops year- round, independent of external weather conditions. However, traditional greenhouse management requires considerable manual labour, which can lead to inefficiencies in resource use and abour costs.

The objective of this project is to design and implement a greenhouse automation system that can autonomously manage the internal environment, reduce resource waste, and improve crop yields. The system will leverage temperature, humidity, soil moisture, and light sensors to gather real-time data, which will be processed by the Arduino microcontroller. Based on this data, actuators (e.g., water pumps, fans, lights) will be triggered automatically, ensuring that the greenhouse operates efficiently with minimal human intervention

Ease Of Use

The automated greenhouse system is designed to monitor and regulate humidity, water levels, and light intensity. The components used include a DHT11 sensor for humidity measurement which controls humidifier, a water level sensor which controls water pump, and an LED controlled by an LDR sensor. These components are connected to ARDUINO UNO R3(Microcontroller) for data processing and decision-making.

Dht11:
- The DHT11 sensor continuously monitors the greenhouse's humidity.
- If the humidity drops below the set threshold, the microcontroller signals the humidifier to operate until the desired level is restored.
- The system periodically checks humidity levels to maintain stability.

Water Level Sensor:
- The water level sensor sends real-time data to the microcontroller.
- If the water level drops below a critical limit, an alert is triggered, preventing the hydroponic to run dry.
- The water pump is activated based on the plant's soil moisture requirements.

Light Intensity Control:
- The LDR sensors measures ambient light intensity and transmit the data to the microcontroller.
- When light levels fall below the required threshold, the microcontroller turns on the LEDs to ensure adequate illumination for photosynthesis.
- The LEDs are switched off automatically when natural light becomes sufficient.
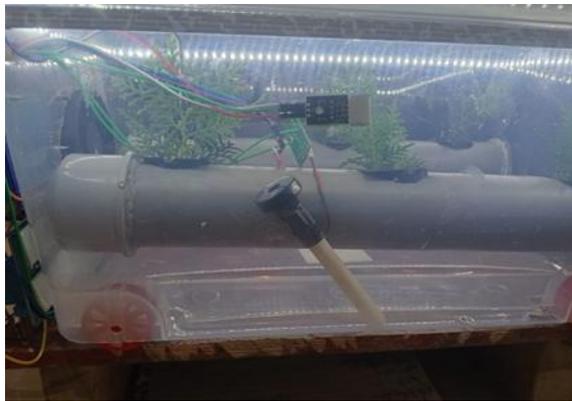

fig.1.Automated greenhouse system (which is displaying humidifier, water level sensor, DHT11 sensor)
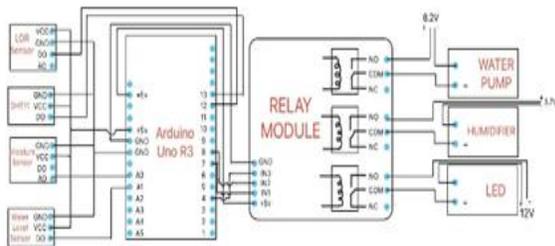
System design

Fig.2.system design

1. Initialize Components:
- Include the necessary libraries for DHT sensor and LCD (Wire.h, LiquidCrystal_I2C.h, and DHT.h).
o Create an LCD object and a DHT sensor object.
o Define pin configurations for inputs (water level, moisture, light sensor) and outputs (humidifier, water pump, LED).

2. Setup Phase:
o Set up the pins for input and output modes:
▪ Pins 13 and 12 for input sensors.
▪ Pins 8, 7, and 2 for output actuators.
o Begin serial communication for debugging.
o Initialize the DHT sensor and LCD display.
o Turn on the LCD backlight.

3. Main Loop (Repeated Execution):
o Read Sensor Values:
▪ Read the water level sensor value(A1).
▪ Read the light sensor value (pin 13).
▪ Read the soil moisture sensor value (A0).
▪ Read humidity and temperature from the DHT sensor.
o Check for valid DHT sensor readings. If invalid, print an error message and return.

4. Display Data on LCD:
o Display temperature and humidity readings on the first row of the LCD.
o Display water level status (*,** or blank) based on sensor value.
o Display soil moisture value on the second row of the LCD.
o Indicate light condition (DAY or Cloudy) on the second row based on the light sensor reading.

5. Control Actuators Based on Conditions:
o Lighting System:
▪ If the light sensor detects daylight (led == 0), turn off the LED.
▪ If the light sensor detects cloudy conditions (led == 1), turn on the LED.
o Humidity Control:
▪ If humidity exceeds 80%, turn off the humidifier.
▪ If humidity drops below 60%, turn on the humidifier.
o Water Level Monitoring:
▪ If water level is above 600, turn off the water pump.
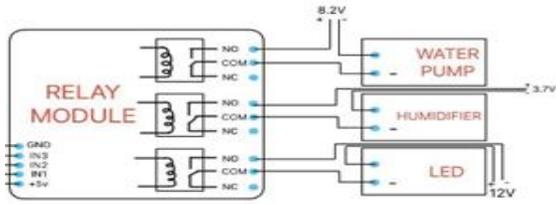▪ If water level is below 300, turn on the water pump.

fig.3.actuators

6. Repeat the Loop:
o Continuously monitor sensor inputs, update the LCD display, and control the actuators in real-time.
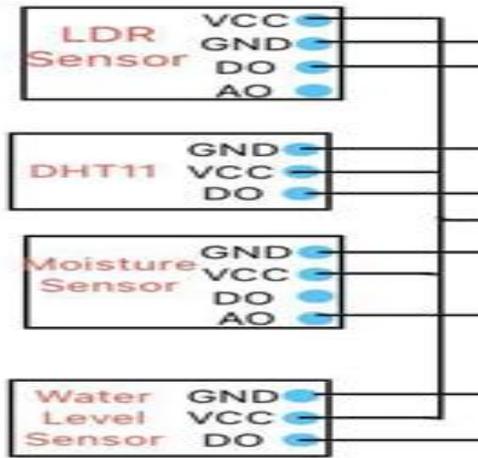

Fig.4.Sensors

II. RESULT AND DISCUSSION

1. Arduino Uno:
Arduino Uno is a microcontroller boar- d based on ATmega328P (datasheet). It has 14 digital I/O pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

2. Dht11 Sensor:
• Temperature Measurement Range: 0°C to 50°C (32°F to 122°F)
• Temperature Measurement Accuracy: ±2°C.
• Resolution: 1% RH (Humidity), 1°C (Temperature)
• Operating Voltage: 3.3V to 5V DC.

3. Ldr Sensor:
• Operating Voltage: 3.3V to 5V DC.

• Operating Current: 15ma.
• Output Digital - 0V to 5V, Adjustable trigger level from preset.
• Output Analog - 0V to 5V based on light falling on the LDR.
• LEDs indicating output and power.
• LM393 based design.

4. Water Level Sensor:
• Working Voltage 3V - 5V DC• Working Current < 20mA
• Sensor Type - Analog
• Working Temperature - 10°C - 30°C

5. Soil Moisture Sensor:
• Operating Voltage: 3.3V to 5V DC
• Operating Current: 15mA
• Output Digital - 0V to 5V, Adjustable trigger level from preset
• Output Analog - 0V to 5V

6. Relay Module (5v 4 Channel):
• Supply voltage – 3.75V to 6V
• Trigger current – 5mA
• Current when the relay is active - ~70mA (single), ~300mA (all four)
• Relay maximum contact voltage –250VAC, 30VDC
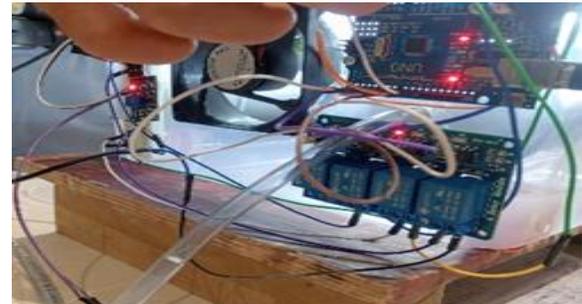• Relay maximum current – 10A

Fig.5.Aurdino uno, relay module, fan,LDR sensor

7. Lcd Display (16x2 With I2c MODULE):
• Operating Voltage: 3.3V/5V
• Interface: I2C
• Display Size: 16x2 character
• Backlight: Blue

8. FAN (12V):
• Rated voltage: 12V
• Rated speed: 8000rpm
• Maxima air flow: 3.86cfm

9. Humidifier (5v):
• Work Voltage: DC 4.5V~5.0V
• Work Power: 2W
• Work Frequency: 108KHz(+/-3KHz)
• Come with a driver

10.Led Light Strip (12v):
• LED Quantity: 120 LEDs per Meter (2835 8mm LEDs)
• Colour Temperature: White Light +
Warm Light+ Warm white
• Power Consumption: 10W per meter
• IP Rating: IP20 (Indoor Use)

11. Submersible Water Pump(3-6v):
• Voltage: 2.5-6V
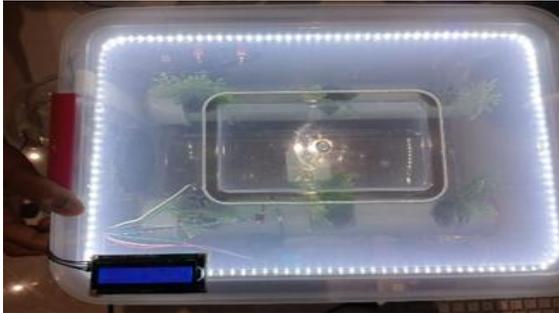• Maximum lift: 40-110cm
• Flow rate: 80-120L/H

fig.6.led light strip, switch board, LCD display

III. CONCLUSION

Automated greenhouse farming represents an advancement in agricultural technology that enables better crop production, better yields, and better environmental management for better productivity. It ensures sustainability by monitoring and controlling factors such as temperature, humidity, and light levels, minimizing and maximizing productivity. It is useful in modern farming days to meet the increasing food demand while reducing environmental impact.

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