SMART GREEN HOUSE MANAGEMENT

Minor project report submitted

In partial fulfilment of the requirement for award of the degree of

Bachelor of Technology

In

Electronics and Communication Engineering

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SRIKAKULAM-532410 FEBRUARY 2023

Certificate

This is certify that the work entitled " **Smart Green House Management using Arduino**" is a bonafide record of authentic work carried out by S180241, S180322, S180772, S180135, S180272 under my supervision and guidance for the partial fulfilment of the requirement of the award of the degree of Bachelor of Technology in the department of Electronics and Communication Engineering at **RGUKT-SRIKAKULAM**

The results embodied in this work have not been submitted to any other university or institute for the award of any degree or diploma. This certifies, in our opinion, is worthy of consideration for the award of the degree of Bachelor of Technology in accordance with the regulations of the institute.

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Acknowledgement

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Electronics and communication Engineering IIITSRIKAKULAM

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ABSTRACT

Monitoring and control of greenhouse environment play a significant role in greenhouse production and management. To monitor the greenhouse environment parameters effectively, it is necessary to design a control system. There we can control the activities through PC and send to controller back which is in greenhouse environment. The System comprises various modules, including temperature and humidity sensors, soil moisture sensors, a light sensor, and an LCD screen. The sensors measure the environmental parameters, and the Arduino Uno microcontroller processes the data to control the actuators, including fans, heaters, water pumps, and lights. The system provides real-time feedback to the user via a LCD display, which displays the environmental data and allows the user to adjust the parameters to achieve optimal plant growth. The objective also implies a focus on developing a system that is affordable and practical for small-scale and home-based agriculture.

Technology: Arduino IDE (Integrated Development Environment) is also known as Arduino Software contains a text editor for writing code.

Keywords: Arduino UNO module, Arduino IDE, LCD Display module, Keypad, Breadboard and wires.

CHAPTER-1
INTRODUCTION

In this time and day, everything can be monitored and controlled automatically. Unfortunately, in an important sector like agriculture, the manual process is still very active, meaning the automatic monitoring and control of a greenhouse system hasn't completely scaled through just yet, especially when it comes to small scale farming. The reason whereby the automation of a greenhouse system hasn't been put to a full-fledged use may be in view of several reasons, such as the absence of technical knowhow, high cost and the requirement of high maintenance. To overcome these challenges we are designed a Greenhouse Management System using Arduino Uno that aims to create a controlled environment within a greenhouse to optimize plant growth. In traditional greenhouse farming, growers need to manually monitor and adjust environmental conditions such as temperature, humidity, soil moisture, and light levels. This process can be time-consuming and labour-intensive, leading to inefficiencies and inconsistencies in plant growth.

To address these challenges, we designed the Greenhouse Monitoring system using Arduino Uno microcontroller along with various sensors and actuators to automate the monitoring and control of environmental conditions within the greenhouse. The system can measure temperature and humidity levels, soil moisture, and light levels using sensors and then use actuators like fans, heaters, water pumps, and lights to control the environmental conditions based on the set parameters. The system provides real-time feedback to the user via a graphical user interface, allowing the user to monitor and adjust the greenhouse environment. This feedback can include environmental data such as temperature, humidity, soil moisture, and light levels, as well as control options to adjust the settings of the actuators based on the environmental conditions. The system can also help to reduce energy consumption by optimizing the use of resources such as water and electricity. Additionally, by maintaining optimal environmental conditions, the system can improve plant growth and yield, leading to increased productivity and profitability.

1.1. Purpose:

The purpose of our project is to create an automated and optimized environment within a greenhouse for efficient and sustainable plant cultivation. The ultimate goal of the project is to provide a sustainable and efficient solution for greenhouse farming that maximizes yields, reduces labour costs, and minimizes waste.

1.2. Scope:

The scope of the project is to provide a comprehensive solution for managing a greenhouse environment using automation technology. The system will be able to monitor and control critical environmental parameters within the greenhouse, such as temperature, humidity, soil moisture, and light levels, to optimize plant growth and yield.

1.3. Literature Review:

- Overview of greenhouse management systems and their importance in modern agriculture Introduction to Arduino Uno microcontroller and its features.
- Review of related literature on various aspects of greenhouse management such as temperature control, humidity control, soil moisture monitoring, etc.
- Discussion of the advantages and limitations of Arduino Uno in greenhouse management systems

1.4. PROJECT REQUIREMENTS:

We used to design this project using Arduino Uno development board as the main component along with some sensors like humidity, light, irrigation, temperature and other accessories. The Arduino IDE software is used to write the code.

1.41. Hardware Tools:

1.42. Arduino Uno ATmega328P microcontroller:

The Arduino Uno is a microcontroller board that is designed to be easy to use and programmable for a wide range of electronic projects. The Uno is based on the ATmega328P microcontroller from Atmel, which is an 8-bit AVR microcontroller with 32KB of flash memory and 2KB of SRAM. The ATmega328P is a low-power, high-performance microcontroller that is commonly used in a variety of electronic devices.

The Arduino Uno board has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and an ICSP header. The digital pins can be used as inputs or outputs and are capable of providing a maximum current of 40mA. The analog inputs can be used to read voltage levels between 0 and 5 volts.

One of the key features of the Arduino Uno board is its simplicity and ease of use. It can be easily programmed using the Arduino integrated development environment (IDE), which is a free software tool that provides a simple and user-friendly interface for writing, compiling, and uploading code to the microcontroller. The Arduino community has also developed a large number of libraries and examples that can be used to quickly and easily implement a wide range of projects on the Uno board.

Specifications:

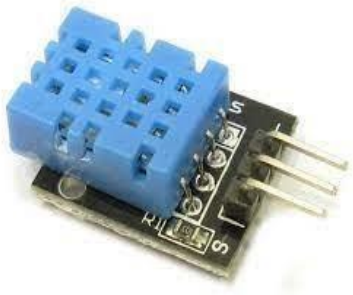
- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- In out Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED_BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

1.5. CONTROLLERS:

In this system controllers are mainly used for monitoring environmental factors such as temperature, humidity, light levels, and soil moisture. These sensors provide real-time data on the conditions inside the greenhouse, which allows growers to make informed decisions about how to adjust the environment to optimize plant growth and yield.

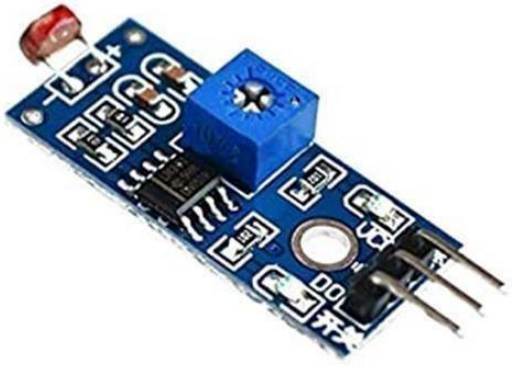
1.51.Humidity Controller:

Humidity sensors work by measuring the amount of moisture in the air, typically expressed as a percentage of the maximum amount of moisture the air can hold at a given temperature. In this project we mainly used capacitive humidity sensor. It consist of a thin film capacitor with a hygroscopic polymer dielectric material, which absorbs or releases moisture from the surrounding air based on changes in humidity. The change in the dielectric constant of the polymer material due to moisture absorption or release causes a change in the capacitance of the sensor, which is measured and convert into a digital output.



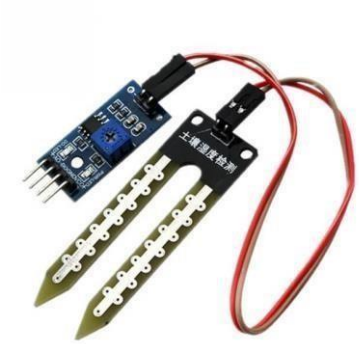
1.52. Light Controller:

Light sensors work by measuring the intensity of light in the greenhouse. In this project we mainly used a photodiode. A photodiode is a type of semiconductor device that produces a small electrical current when exposed to light. The current produced by the photodiode is proportional to the intensity of the light that is detected. Light sensors typically have a built-in amplifier that increases the sensitivity of the sensor and converts the small electrical current into a more useful voltage or current signal.



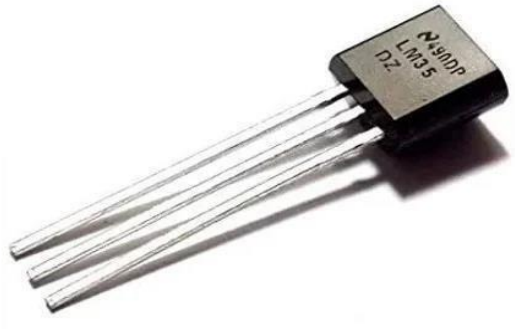
1.53.Irrigation Controller:

Irrigation sensors work by measuring the moisture content of the soil in the greenhouse. In this project we mainly used a soil moisture sensor it typically use two electrodes that are inserted into the soil, and a small electrical current is passed between them. The resistance between the electrodes is then measured, which is proportional to the amount of moisture in the soil. The output signal from the soil moisture sensor is then transmitted to a microcontroller or data logger, which processes the data and displays it to the grower in real-time.



1.54. Temperature Controller:

Temperature sensors work by measuring the temperature in the greenhouse. In this project we mainly used a thermistor. A thermistor is a type of resistor that changes its resistance in response to changes in temperature. As the temperature in the greenhouse changes, the resistance of the thermistor changes as well. The change in resistance is then measured and converted into a voltage or current signal by the sensor's built-in amplifier.



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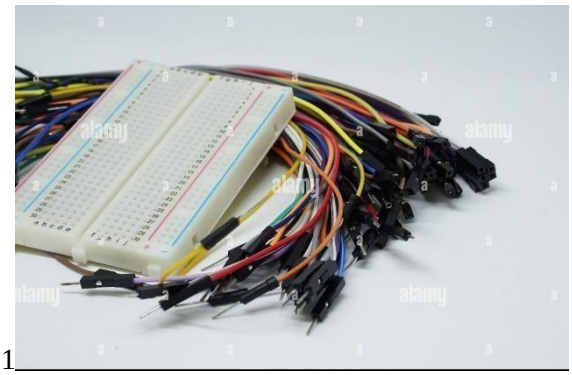
1.55. Bread board and Jumper wires:

A breadboard is a type of solderless prototyping board. We used this in order to test the circuit and jumper wires are used to make connections between different components on the breadboard.



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1.6.Software Tools:

We used Arduino Integrated Development Environment (IDE) software application to write the code. It provides a simple and easy to use interface for writing and uploading firmware to an Arduino board.

CHAPTER-2

PROJECT DEFINITION

Introduction:

Traditional farming practices can present a range of challenges and difficulties for farmers, which can limit their ability to earn a living, improve their livelihoods, and adapt to changing environmental conditions.

2.1.Existing System:

There are several existing greenhouse monitoring systems available in the market, they mainly uses **Raspberry Pi and Beagle Bone boards** these boards having specialized controllers such as programmable logic controllers (PLCs) or dedicated greenhouse controllers and dedicated software tool to write the code.

Harvest: It is a smart indoor garden system that can monitor and control environmental conditions for plants. It comes with sensors for temperature, humidity, light, and water levels and can be controlled through a smartphone app.

Robot: It is a modular greenhouse automation system that can monitor and control various environmental parameters such as temperature, humidity, CO2 levels, and more. It can be integrated with other devices such as grow lights, fans, and irrigation systems.

Grow link: It is a greenhouse automation system that can monitor and control environmental parameters such as temperature, humidity, CO2 levels, and more. It comes with a user-friendly interface that allows growers to monitor and control their greenhouse remotely.

Disadvantages:

- Compared to simpler microcontrollers, Raspberry Pi and Beagle Bone boards can be more expensive and consumes more power.
- Setting up and configuring Raspberry Pi and Beagle Bone boards can be complex, especially for those without programming or electronics experience
- Raspberry Pi and Beagle Bone boards can be more expensive. This can be a concern for farmers with limited budgets or resources.

2.2. PROPOSED SYSTEM:

Arduino-based greenhouse monitoring system can provide farmers with a cost-effective, flexible, and easy-to-use solution for monitoring and controlling environmental conditions in their greenhouse. One of the key advantage of Arduino is it is an open source platform, don't have a dedicated software and larger community to help out from any kind of problem. Arduino has its own integrated development environment (IDE) and a large community of users who contribute libraries and code examples. Other boards may require different IDEs or software tools to program them, and may have a smaller community of users and available resources. It is generally affordable and widely available, other boards may be more expensive or harder to find. Because Arduino is an open-source platform, it's possible to modify and customize the hardware and software to suit specific needs. Other boards may have less flexibility in terms of customization. Compatibility. Is high in Arduino boards.

Advantages:

- Arduino boards are relatively inexpensive, making them a cost-effective option for farmers.
- Easy to use and program, even for those with limited technical experience.
- Easily integrated with other systems.
- Wide range of sensors are available.

2.3. Research Papers:

- https://www.researchgate.net/publication/340920556_Greenhouse_Monitoring_and_Automation_Using_Arduino_a_Review_on_Precision_Farming_and_Internet_of_Things_IoT
- https://www.engineersgarage.com/green-house-monitoring-using-arduino/
- https://www.researchgate.net/publication/340121205_Greenhouse_Monitoring_and_Control_System_with_an_Arduino_System
- https://www.researchgate.net/publication/361495279_Design_and_Implementation_of_An_Arduino- Based_Greenhouse_Monitoring_System_Using_IoT
- https://projectabstracts.com/16904/construction-and-development-of-anautomated-greenhousesystem-using-arduino-uno.html

CHAPTER-3

PROJECT DESCRIPTION

3.1. Explanation to greenhouse technology:

Greenhouse technology is a method of controlled environment agriculture (CEA) that allows for the cultivation of crops in an enclosed structure designed to maintain optimal growing conditions. The greenhouse structure is typically made of glass or plastic walls and a roof that allows sunlight to enter while trapping heat inside.

The primary goal of greenhouse technology is to provide a stable environment for plant growth by controlling environmental factors such as temperature, humidity, light, and air quality. This allows for year-round cultivation of crops, protection from pests and harsh weather conditions, and the ability to grow plants that are not native to the local climate.

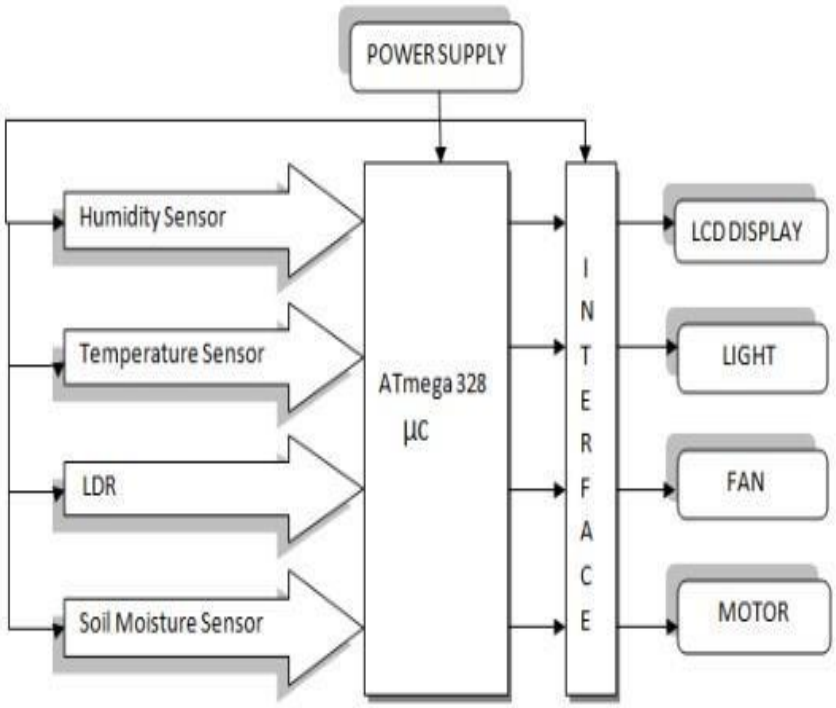
3.2. Need of greenhouse management:

- Environmental control: Greenhouse management allows for the monitoring and control of environmental factors such as temperature, humidity, light, and air quality. This helps to create an optimal growing environment for plants and minimizes environmental stresses.
- Pest and disease control: Greenhouse management allows for the early detection and prevention of pest and disease outbreaks. This can help to minimize crop damage and reduce the need for pesticides.
- Water and nutrient management: Greenhouse management allows for the precise control of water and nutrient inputs, reducing water usage and minimizing nutrient leaching.
- Yield optimization: Greenhouse management allows for the optimization of plant growth and yield by providing plants with the ideal growing conditions and managing resources efficiently.
- Labour management: Greenhouse management allows for the efficient use of labour resources by automating tasks such as irrigation, fertilization, and environmental control.

3.3. System layout:

This system consists of various sensors, namely soil moisture, temperature, humidity and light sensors. These sensors sense various parameters and are then sent to the microcontroller. Here, Atmega328 MCU is used which controls the greenhouse. To implement greenhouse environment, soil moisture sensors, temperature sensors, LDR, humidity sensors are studied. After studying these, the program has been written on to the microcontroller for specific environment conditioning. The desired

temperature and humidity are maintained by turning on heater/cooler. The moisture level within soil is also be controlled by turning the water valve on/off. Desired light intensity for that environment can also be controlled by emergency lights when necessary. Hence, the greenhouses' environment is controlled automatically.



Block Diagram of Proposed system

The above block diagram of greenhouse automation system design with its hard ware components involved and connections. Here the main component is the microcontroller (At mega 328). Four sensors have been used to feed the input parameters at AT mega 328. It reads this sensor output and can generate output according to the program written into it. It can read both digital and analog inputs and can generate digital output. For example, AT mega 328 reads analog data from humidity sensor and then generates digital high/low output according to the threshold value which is written in the program, if it reads digital data from the moisture sensor then it can generate digital high/low output according to the internal logic written into the program. The microcontroller constantly monitors the digitized parameters of the various sensors and verifies them with the predefined threshold values and checks if any corrective action is to be taken for the condition at that instant. In case if such a situation arises, it activates the actuators to perform a control operation. An array of actuators can be used in the system such as relays, contactors, and change over switches etc. They are used to turn on AC devices such as motors, coolers, pumps etc.

3.4. Benefits:

- Increased crop yield: Greenhouse management provides plants with optimal growing conditions, including controlled temperature, humidity, light, and air quality. This results in increased crop yield compared to traditional open-field farming.
- Extended growing season: Greenhouse management allows for year-round cultivation of crops, regardless of weather conditions. This increases the potential for multiple harvests per year, leading to higher profits for farmers.
- Reduced water usage: Greenhouse management allows for precise control of water inputs, reducing water usage compared to open-field farming. This can lead to cost savings for farmers and is also beneficial for water conservation efforts.
- Reduced pesticide use: Greenhouse management allows for the early detection and prevention of pest and disease outbreaks, reducing the need for pesticides. This is beneficial for the environment and can also lead to cost savings for farmers.
- Efficient use of resources: Greenhouse management allows for the efficient use of resources such as labour, water, and nutrients. Automation of tasks such as irrigation and fertilization reduces the need for manual labour, while precise control of inputs reduces waste and minimizes environmental impact.
- Consistent quality: Greenhouse management allows for consistent growing conditions, resulting in consistent crop quality. This is beneficial for farmers who can sell their crops at a premium price and for consumers who can rely on consistent quality.

3.5. Limitations:

- Limited memory: Arduino Uno has limited memory, which can be a challenge if the project requires storing large amounts of data or running complex programs.
- Limited number of pins: Arduino Uno has a limited number of input and output pins, which can limit the number of sensors or actuators that can be connected to the system.
- Limited connectivity: Arduino Uno has limited connectivity options, such as USB and serial communication. This can limit the ability to integrate with other systems or devices.
- Limited battery life: If the project requires running the system on battery power, Arduino Uno's limited power management capabilities can limit the battery life.
- Limited scalability: If the project needs to be scaled up for larger greenhouse systems, Arduino Uno's limited processing power and memory may become a bottleneck.
- Limited processing power: Arduino Uno has a limited processing power, which can be a limiting factor if the monitoring system requires complex algorithms or real-time data processing

3.6. Project Outcomes:

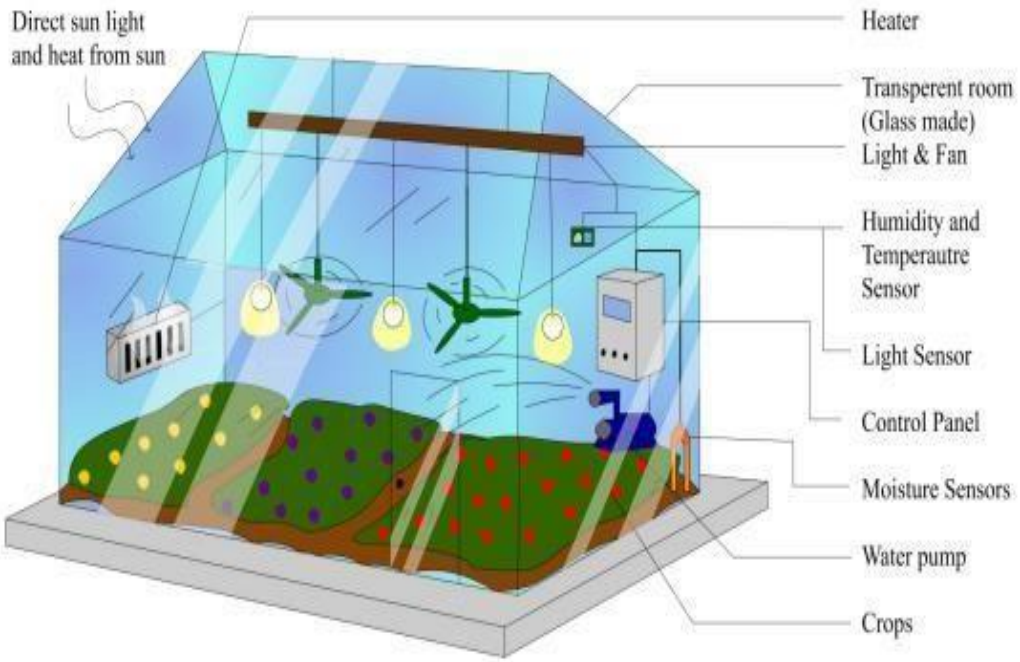
- **Increased crop yields:** By providing optimal growing conditions and using precision agriculture techniques, greenhouse management projects can lead to increased crop yields and improved plant quality**.**
- **Improved sustainability:** Greenhouse management projects can reduce the use of resources, such as water and energy, and minimize waste, leading to more sustainable growing practices.
- **Cost savings:** Automated greenhouse systems and precision agriculture techniques can reduce labour costs and improve resource utilization, leading to cost savings for the grower.
- **Food security:** By providing a controlled environment for growing crops, greenhouse management projects can help increase food security in regions with unfavourable growing conditions.

CHAPTER-4

SYSTEM ANALYSIS

4.1. Design and development:

The greenhouse monitoring system using Arduino Uno works by collecting data from various sensors and controlling various actuators to maintain the ideal environment for plant growth. The sensors measure different environmental factors such as temperature, humidity, light intensity, and soil moisture. The data collected by the sensors is then processed by the Arduino Uno board using the programmed code. Based on this data, the system controls the various actuators such as fans, heaters, and water pumps to adjust the environmental conditions inside the greenhouse.



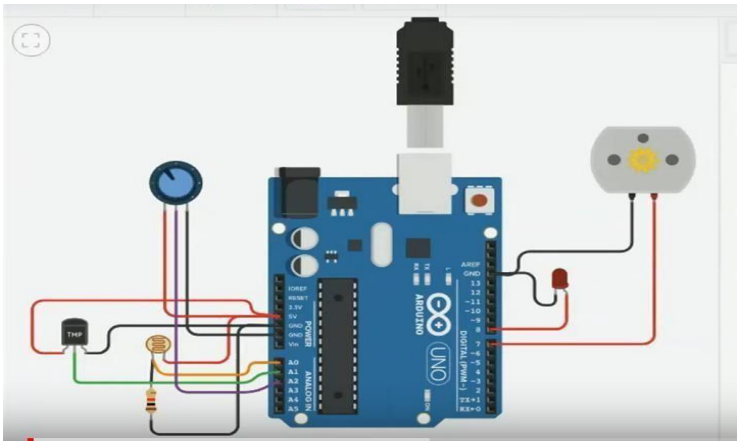
For example, if the temperature inside the greenhouse is too high, the system will activate the fan to bring down the temperature. If the soil moisture level is too low, the system will activate the water pump to provide water to the plants.

The system continuously monitors the environmental conditions and makes adjustments as necessary to ensure that the plants have the best possible growing conditions. By automating this process, the system helps optimize greenhouse management and increase crop yields.

4.2. Technology used:

- Arduino Uno board: This is the main component of the system, used for processing the data from the sensors and controlling the actuators.
- Sensors: The system uses various sensors to measure different environmental factors, including temperature, humidity, light intensity, and soil moisture. These sensors are connected to the Arduino Uno board and provide input data to the system.
- Actuators: The system uses various actuators, such as fans, heaters, and water pumps, to control the environmental conditions inside the greenhouse. These actuators are also connected to the Arduino Uno board and are controlled by the system based on the input data from the sensors.
- Circuit Design: The system also involves the design of an appropriate circuit that connects the sensors and actuators to the Arduino Uno board.
- Programming: The Arduino IDE and C/C++ programming language are used to program the Arduino Uno board to read data from the sensors and control the actuators.

4.3. CIRCUIT IMPLEMENTATION:



Sensors are placed in the greenhouse to measure environmental parameters such as temperature, humidity, light, and soil moisture. These sensors are connected to the Arduino Uno using wires .The Arduino Uno reads the sensor data and stores it in its memory. It then processes the data using decision rules that we are mentioned in chapter 1 based on the conditions we are designed it determine whether any action needs to be taken to maintain optimal growing conditions for plants. Based on the sensor data and processing results, the Arduino Uno sends commands to various actuators such as fans, heaters, and water pumps to adjust the environmental conditions in the greenhouse. The Arduino Uno also communicates with serial monitor to provide real-time information about the greenhouse conditions and system performance.

4.4. OUTPUT:


Code
Start Simulation
Send To
Text
1 (Arduino Uno R3)
void loop()
{
x=analogRead(A0);
Serial.print("light:");
Serial.print(x);
if(x<100)
{
Serial.print("LED ON");
digitalWrite(8,HIGH);
}
else{
Serial.print("LED OFF");
digitalWrite(8,LOW);
}
z=analogRead(A2);
Serial.print("Moisture:");
Serial.print(z);
if(z<400)
{
Serial.print("PUMP ON");
digitalWrite(7,HIGH);
}
else{
Serial.print("PUMP OFF");
Serial Monitor
light:6LED ONMoisture:737PUMP OFFTemperature:153
light:6LED ONMoisture:737PUMP OFFTemperature:153
light:6LED ONMoisture:737PUMP OFFTemperature:153
light:6LED ONMoisture:737PUMP OFFTemperature:153
light:6LED ONMoistur

CHAPTER-5
CONCLUSION

In conclusion, using Arduino in greenhouse management can provide numerous benefits, including cost-effectiveness, user-friendliness, automation, data collection and analysis, remote monitoring and control, and scalability. This greenhouse technology improves the crop quantity, reduces the energy efficiency and increases the crop yield. Regardless of seasonal changes the farmers can cultivate different crops throughout the year. Using this technology the farmers get benefited and they earn more profits with less investment and human afford.

5.1. Future scope:

The future scope of the greenhouse monitoring system project using Arduino Uno is vast, and with continued development and innovation, it has the potential to revolutionize the agriculture industry and improve food production and sustainability.

Machine learning algorithms can be used to analyse the data collected by the system and provide insights into the ideal environmental conditions for specific plant species. This can help optimize crop yields and increase the efficiency of greenhouse management.

5.2. References:

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- https://www.sparkfun.com
- http://engineeringfunda.co.in
- www.engineering greeks.com
- https://www.youtube.com/channel/UCdlnqMpRrMcClK2fT6z8EEw
- www.tinkercad.com