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Vellore Institute of Technology

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Internet of Things

CSE 3009

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TITLE:

IOT Based Smart Agriculture System using Arduino

Project Report by:

Lakshmi Priya 19BCI0203

Ankitha Giyal 19BCI0210

Nilophar Joglekar 19BCE2482

BatchID - D4

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1. ABSTRACT

Farmers fail to get good profits from agricultural systems like greenhouse as they are unable to manage various factors that affect the plant growth and productivity. Greenhouses help maintain climatic conditions which are protected by a roof, and these arrangements are used for cultivating crops which require a certain level of temperature, moisture. It is essential to ensure that the temperature does not fall beyond a certain degree as increase in humidity can lead to crop transpiration, condensation of water vapor and water evaporation from the humid soil. To overcome these challenges, the smart agriculture monitoring system can be employed. The tools used are Tinkercad, Arduino and Proteus software to complete this project. Temperature, soil moisture, lightning, and security gate system are designed using Arduino and Proteus in Tinkercad. This project has been designed to monitor, control and maintain the appropriate conditions in the greenhouse.

2.INTRODUCTION

Smart agriculture system that collects data on temperature, humidity, and light, all of which are continuously monitored and regulated with our project to optimize the output of crops and the generation of new plants. We can solve the problem of overheating in an agricultural system like a greenhouse by using ventilation. When the temperature rises, ventilation offers fresh air to the plants as well as a pleasant ambiance. If the plant's soil humidity is low, the water pumping system will automatically give water. If the light intensity falls below a certain threshold, the lighting system will activate using information from the photoresistor. We also include a security system to keep the greenhouse safe.

The complexity of humidity, soil moisture, soil pH, temperature, and other factors influence plant growth. Existing systems simply monitor and regulate one parameter at a time, rather than multiple parameters at the same time. Multiple parameters are monitored and controlled simultaneously by the suggested systems using mobile acquisition technology. It boosts productivity, dependability, and skilled labour.It allows for maximum as well as best growth of the plants

This technology aids in the monitoring and control of climatic conditions conducive to the cultivation of a specific plant. Regardless of the weather conditions, this technique can promote crop growth while also maximizing yield. This project should be improved to track and control pesticide levels.

3.EXISTING WORK

There are various existing technologies including smart agriculture gadgets, farmers have gained better control over the process of raising livestock and growing crops, making it more predictable and improving its efficiency. Smart agriculture sensors have been designed to monitor the state of crops, farmers can define exactly how many pesticides and fertilizers they have to use to reach optimal efficiency. The same applies to the smart farming definition. Drones are better able to collect agricultural data than planes and satellites.

Drones are better equipped than airplanes and satellites to collect agricultural data. Apart from surveillance capabilities, drones can also perform a vast number of tasks that previously required human labor: planting crops, fighting pests and infections, agriculture spraying, crop monitoring, etc.

Crop Performance platform helps farmers access the volume and quality of yields in advance, as well as their vulnerability to unfavorable weather conditions, such as floods and drought. It also enables farmers to optimize the supply of water and nutrients for each crop and even select yield traits to improve quality.

crop management devices that are placed in the field to collect data specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health.Thus, the crop growth can be monitored and any anomalies to effectively prevent any diseases or infections that can harm the yield can be detected.

Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect various data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity.

Farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.In addition to sourcing environmental data, weather stations can automatically adjust the conditions to match the given parameters. Specifically, greenhouse automation systems use a similar principle.

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly relevant real-time data, the use of data analytics helps farmers make sense of it and come up with important predictions: crop harvesting time, the risks

of diseases and infestations, yield volume, etc. Data analytics tools help make farming, which is inherently highly dependent on weather conditions, more manageable, and predictable

4.OBJECTIVES

We aim to implement a Smart agriculture system that collects data on temperature, humidity, and light, all of which are continuously monitored and regulated with our project to optimize the output of crops and the generation of new plants.

We can solve the problem of overheating in an agricultural system like a greenhouse by using ventilation. When the temperature rises, ventilation offers fresh air to the plants as well as a pleasant ambiance.

If the plant's soil humidity is low, the water pumping system will automatically give water. If the light intensity falls below a certain threshold, the lighting system will activate using information from the photoresistor. Also we include the security system to protect the greenhouse

5.LITERATURE REVIEW

Title	Year	Methodology	Limitations
IoT Based Automated Greenhouse Monitoring System by M. Danita, B. Mathew, Nithila Shereen, N. Sharon, J. Paul	June 2018,Second International Conference on Intelligent Computing and Control Systems (ICICCS),	The paper combines IoT and embedded technology to helped increase yeild of plants to many of the existing practical problems over the years. The sensors used here are YL69 moisture sensor and DHT11 (Temperature & Humidity sensor). From the data's received, Raspberry PI3 automatically	This project doesn't account for the the amount of oxygen reaching the plants which is a major factor to be considered. Only sends the data received from the sensors near the plants to the front end website and a human is required to act on the information.This process can

		controls Moisture, Temperature, Humidity efficiently inside the greenhouse by actuating an irrigating pipe, cooling fan, and sliding windows respectively according to the required conditions of the crops to achieve maximum growth and yield. The recorded temperature and humidity are stored in a cloud database (ThingSpeak), and the results are displayed in a webpage, from where the user can view them directly	automated in such a way that measures are automatically taken based on the data recived from the greenhouse
IoT Based Greenhouse Environment Monitoring and Controlling Using Arduino by Pranshu Dubey, Manish Mishra, Naman Bansal, Laksh Singhal, Khyati Kandpal	2021,International Journal of Research in Engineering and Science (IJRES)	The project uses Arduino based framework to screen the upsides of ecological boundaries and that are constantly refreshed and controlled to accomplish ideal plant development and yield.DHT11 sensor, Soil Moisture Sensor, LDR sensor, and pH sensor are the main principle sensors utilized in this task which give the specific worth of temperature,	It uses a SMS system to deliver alerts when any of the sensors detect a value beyond the threshold but the SMS charges are applied for each alert instead using an app or online based platform would be more cost effective. The user can't the see the sensor values and is only notified if a threshold value is reached instead it would be better if the user can see the real time values on all the

		stickiness, water content, light force, and soil pH individually. All the natural boundaries are shipped off by android cell phones through Ethernet on the web. A GSM modem is utilized to send SMS (Short Message Service) which shows the current status of the ecological boundaries. The SMS is shipped off the client when the sensor esteem surpasses a characterized level.	sensors continuously
IOT Based Monitoring System in Smart Agriculture by S. R. Prathibha; Anupama Hongal; M. P. Jyothi	2017, International Conference on Recent Advances in Electronics and Communication Technology (ICRAECT)	The paper aims to make use of evolving technology i.e. IoT and smart agriculture using automation. Monitoring environmental factors are the major factor to improve the yield of efficient crops. The feature of this paper includes monitoring temperature and humidity in agricultural fields through sensors using CC3200 single chip. The camera is interfaced with CC3200 to capture	One of the limitations is that this system can only be used for small spaces. For further enhancement, this system should be modified to be used for large acres of land. Also, the system can be integrated to check the soil nutrient and crop growth in each soil. Furthermore, the system can be further improved by adding machine learning algorithms, which are able to learn and understand the requirements of the

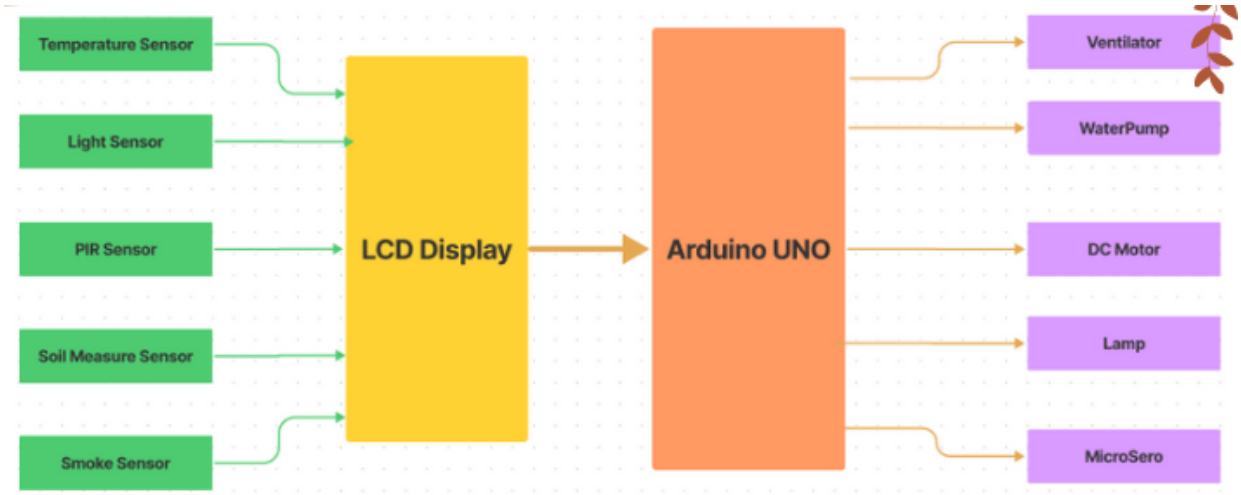
		images and send that pictures through MMS to farmers mobile using Wi-Fi.	crop, this would help the field be an automatic system.
Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies by Othmane Friha, Mohamed Amine Ferrag, Lei Shu	2021, IEEE/CAA Journal of Automatica Sinica	This paper presents a comprehensive review of emerging technologies for the internet of things (IoT)-based smart agriculture. Surveys on existing technologies are done including aerial vehicles, wireless technologies, software defined networking etc. A taxonomy and a side-by-side comparison of the state-of-the-art methods toward supply chain management based on the blockchain technology for agricultural IoTs is provided in this paper.	One of the major limitation is that building IoT systems in open fields plantations requires a lot more sensors to monitor the wild environment, as well as the growing crops; to ensure efficiency, mobile sensors and UAVs have great potential for data collection in the agricultural field. One of the factors that limit the life time of IoT installations is power drain. Renewable sources of energy harvesting solutions, such as solar power and wind, could also be used in IoT-based smart agriculture systems.
Smart Agriculture: IOT based smart sensors agriculture by Anand Nayyar and Er. Vikram Puri	November 2016, Conference: The International Conference on Communication and Computing Systems (ICCCS-2016)	This paper describes the Internet of Things (IOT) technology that has brought a revolution to each and every field of the common man's life by making everything smart and intelligent. The aim/objective of this paper is to	This Paper can focus more on increasing Sensors on this stick to fetch more data, especially with regard to Pest Control And also integrating GPS module in this IoT Stick to enhance this Agriculture IOT Technology to

		propose a Novel Smart IOT based Agriculture assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environment monitoring which will enable them to do smart farming and increase their overall yield and quality of products and bring insights to construct a framework for robust working on fields and easy for farmers. One of the main areas where IOT based research is going on and new products are launching on an everyday basis to make the activities smarter and efficient towards better production is "Agriculture".	full-fledged Agriculture Precision-ready product.
SMART e-AGRICULTURE MONITORING BASED ON ARDUINO USING IOT Prof. Caroline El Fiorenza, 2Sushmita Sharma, 3Soumya Ranjan, 4Shashank	October 2018, International Journal of Scientific Development and Research (IJSDR) |Volume 3, Issue 10	This Paper deals with better production and canceling out all factors leading to crop failure. The given results are based on the necessity of the crops, which will help to deal with the requirement and crisis faced during crop productivity. In this paper, also	High sensitivity sensors can be implemented for large areas of agricultural land. Monitoring efforts should be broadly conceptualized so that they incorporate not only farm production and productivity, but also natural resource The System should

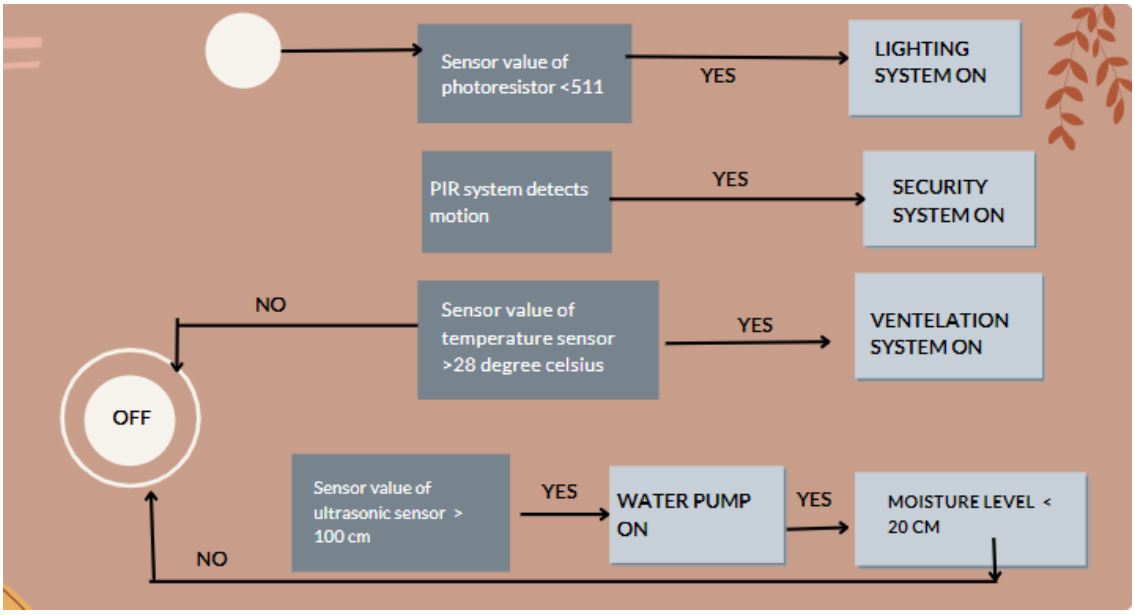
		measure temperature to deal with crops which cannot bear high or low temperature in which some crops fail due to humidity, It also Estimates water level so to check if the crops don't get submerged in water and get damaged as well as display the reading in the system for user to find the optimal solution for the better production.	also be easy for upgradation so as to simplify integrating components with enhanced features. A monitoring system is a subsystem of a management information system and has several distinguishable components. The technological rationale for precision suggests farms should continue to consolidate.

6.PROPOSED MODEL FOR THE SYSTEM

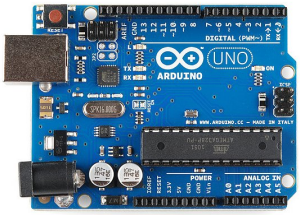
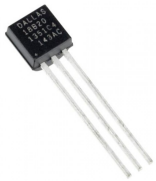
Architecture Diagram

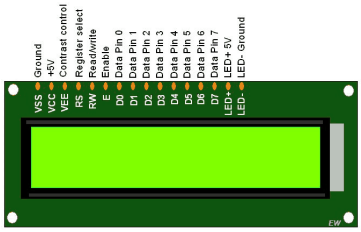
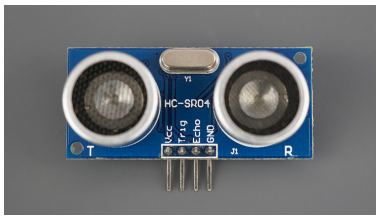


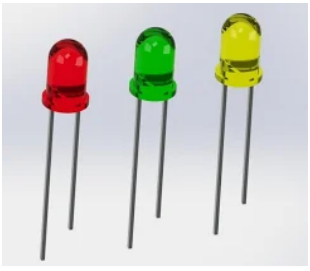
State Chart



7.COMPONENTS

Components Name	Details
Arduino UNO 	The Arduino UNO is a microcontroller board that uses the ATmega328P microcontroller. A programmable board, we can use to build interactive circuits
Temperature Sensor 	A device use to measure temperature
Photoresistor 	Light-sensitive devices that are commonly used to detect the presence or absence of light, as well as to measure the intensity of light.
LCD Display	A 16x2 LCD display is a relatively basic module that can be found in a variety of

	devices and circuits. A 16x2 LCD can display 16 characters per line on each of its two lines.
Dc Motor 	A DC motor is a type of electric motor that converts electrical energy into mechanical energy using direct current. By using this,(i).Ventilation system - Whenever the house is heated the motor is on and gives the cooling air to the house.(ii).Water pumping - Whenever the plants get low moisture then the motor is on to provide the water.
PNP Transistor 	Acting as a switch to the Dc motor
Ultrasonic sensor 	An instrument that measures the distance to an object using ultrasonic sound waves which can be used to measure the soil of moisture in plants
Potentiometer 	A three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.
9V Battery	

	A common battery for high power applications like motor
LED 	light-emitting diode: a semiconductor diode that emits light when conducting current and is used in electronic displays, indoor and outdoor lighting, etc.
Micro Servo 	A motor whose position can be controlled using a microcontroller
Piezo 	A type of buzzer that make noise at different frequencies and can be use as a motion detected alarm
PIR Sensor 	A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They are most often used in PIR-based motion detectors.
LED-RGB	A type of LED that combines Red,Green, Blue to produce any color and it can be used for security system indication

8.TOOLS

TinkerCad

Tinkercad is a free-of-charge, online 3D modeling program that runs in a web browser.It contains all the different components and connections required for circuits and can simulate circuits very close to real life

We will be simulating the circuit in tinkercad to show the different environmental conditions .

9.PROJECT GOALS

1. All parts of the system should be controlled by Arduino.

2. There should be light intensity, soil moisture level, room temperature threshold value set.

3. For the lighting system the light intensity will be measured by a photoresistor, if the light intensity is very low the lighting system should activate after being detected by the photoresistor.

4. The ventilation system, the temperature sensor measures the temperature level, if the temperature is too high it will result in air not moving freely in the greenhouse, so the ventilation system will activate to ensure sufficient air flow.

5. In the water pumping system, the soil moisture distance will be measured by the ultrasonic sensor . If the moisture level is low , then the water pumping system will automatically switch ON until the flow of the water and the moisture level becomes normal then the motor is switched OFF.

6. For the security system, the PIR sensor detects the motion. t]The system is OFF smode usually but it should activate if needed. If the PIRsensor detects any motion of either humans and animals or birds the servo motor gate will automatically close.

7. In the fire indication system, we should fix the temperature level at max room temperature. If the temperature is going above that, the alarm system is on.

10.CONNECTIONS

1. The lighting system LED connected to the Photo resistor.

2. The ventilation motor is connected to the Temperature sensor.

3. The water pumping system is connected to the Ultrasonic sensor.

4. The security system is connected to the PIR sensor.

5. The LCD display and all connections are connected to Arduino Uno.

11.SYSTEM WORKING

1. Initially all systems are in OFF stage, if any changes occured in the weather, moisture, then the systems will automatically get ON stage.

2. If the sensor value of the photo resistor is less than 511, then the Lighting system will get ON stage. Otherwise the system should be OFF stage.

3. If the sensor value of temperature sensor is greater than 28

Celsius, then the Ventilation system will get ON stage. Otherwise the system should be OFF stage.

4. If the sensor value of the ultrasonic sensor is greater than 100 cm the water pump system will get ON stage. After this when the moisture level becomes below 20 cm the system will get OFF stage.

5. If the PIR sensor detects any motion (Red LED Glowing) then the ServoGate will close. Otherwise it is in OFF (Green LED Glowing) stage. The activation of the system would be controlled by a Switch.

12.CODE

```
// C++ code
//
#include <LiquidCrystal.h>
#include <Servo.h>
LiquidCrystal lcd(7,6,A2,A3,A4,A5); //pins for lcd
Servo servo1;
Servo servo2;
const int pingPin = 11; //pin for ultrasonic
int tempsensor= A0; //temperature sensor
int photoresistor= A1; //LDR sensor
//initial variables:
int sensorValue = 0;
char degree = 180;
//acuators
int motor=8; //connect water pump motor on pin8
int ventilator=9; //connect ventilator motor on pin9
int ledPin=10; //connect led on pin10
char a=digitalRead(12);
char b =digitalRead(13);

void setup()

{
// initialize serial communication:
Serial.begin(9600);
lcd.begin(16,2);
pinMode(13, INPUT); //motion sensor
pinMode(5, OUTPUT);
pinMode(4, OUTPUT);
pinMode(3, OUTPUT);// red led
pinMode(2, OUTPUT);// GREEN led
pinMode(12, INPUT); //switch
pinMode(motor, OUTPUT);
pinMode(ventilator, OUTPUT);
pinMode(ledPin, OUTPUT);
pinMode(photoresistor, INPUT);
```

```
pinMode(tempsensor,INPUT);
servo1.attach(4);
servo1.write(90);
servo2.attach(4);
servo2.write(90);
delay(20);
}
void loop() {
///////////////temperature sensor
int tmp =analogRead(tempsensor);//Reading data from the sensor.This voltage is stored as a 10bit number.
float voltage = (tmp * 5.0)/1024;//(5*temp)/1024 is to convert the 10 bit number to a voltage reading.
float milliVolt = voltage * 1000;//This is multiplied by 1000 to convert it to millivolt.
float tmpCel = (milliVolt-500)/10 ;//For TMP36 sensor. Range(-40°C to +125°C)
lcd.setCursor(0,1);
lcd.print("TEMP:");
lcd.setCursor(6,1);
lcd.print(tmpCel);

if (a == HIGH && b == HIGH)
{
tone(5,440);
delay(100);
noTone(5);
servo1.write(90);
servo2.write(90);
digitalWrite(3,HIGH);
digitalWrite(2,LOW);
}
else if (b == HIGH)
{
//servo1.write(90);
digitalWrite(3,LOW);
digitalWrite(2,HIGH);
delay(10);
}
else if (a == LOW && b == LOW)
```

```
delay(10);
}
else if (a == LOW && b == LOW)
{
digitalWrite(3,LOW);
digitalWrite(2,HIGH);
servo1.write(0);
delay(10);
}
else
{
delay(100);
servo1.write(90);
}
if(tmpCel>28)
{
digitalWrite(ventilator,HIGH);
lcd.setCursor(8,0);
lcd.print(" VEN ON ");
}
else{
digitalWrite(ventilator,LOW);
lcd.setCursor(8,0);
lcd.print(" VEN OFF");
}
/////////////// LDR sensor code
sensorValue =analogRead(photoresistor);
if(sensorValue<=511)
{
digitalWrite(ledPin,HIGH);
}
else {
digitalWrite(ledPin, LOW);
}
//////////////////////code for ultrasonic
long duration, cm;
```

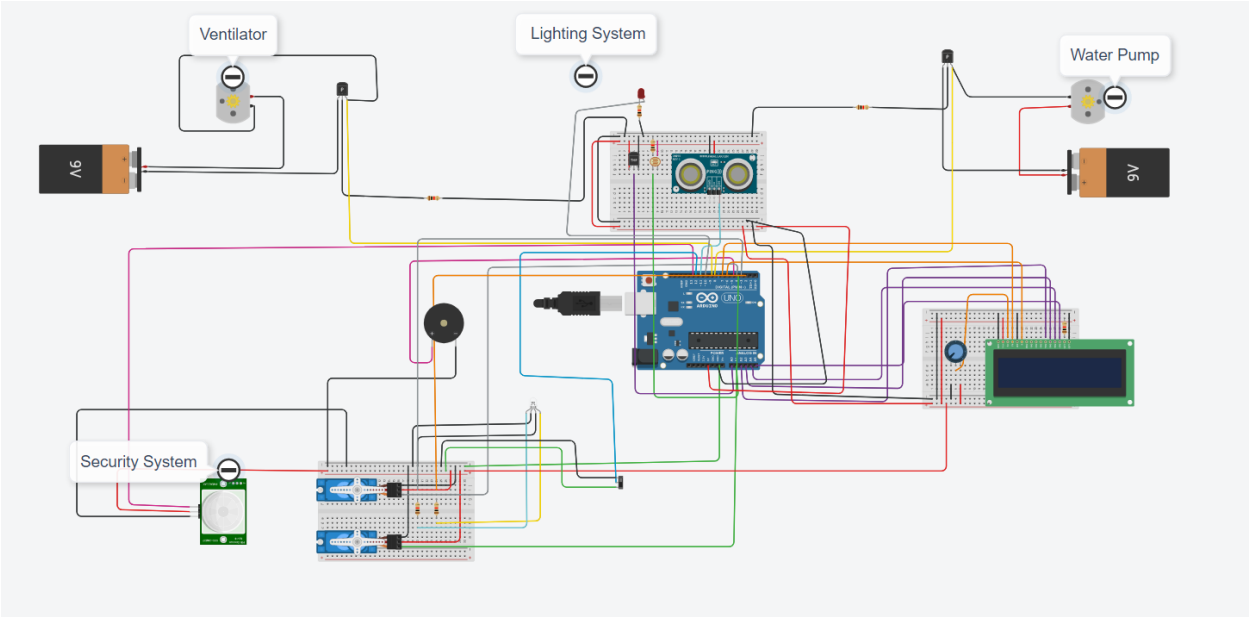
```
long duration, cm;
pinMode(pingPin, OUTPUT);
digitalWrite(pingPin, LOW);
delayMicroseconds(2);
digitalWrite(pingPin, HIGH);
delayMicroseconds(5);
digitalWrite(pingPin, LOW);
pinMode(pingPin, INPUT);
duration = pulseIn(pingPin,LOW);

 // convert the time into a distance
cm = microsecondsToCentimeters(duration);
// Print the distance
Serial.print("Distance: ");
Serial.print(cm);
Serial.print("cm");
Serial.println();
// Turn on the LED if the object is too close:
if(cm > 100) {
digitalWrite(motor, HIGH);
lcd.setCursor(0,0);
lcd.print("PUMP ON ");
}
if(cm < 20)
{
digitalWrite(motor, LOW);
lcd.setCursor(0,0);
lcd.print("PUMP OFF");
}
delay(100);
}
////////////////////////////////////////////////////////////////////////////////
long microsecondsToCentimeters(long microseconds) {
return microseconds / 29 / 2;
}

```

13.IMPLEMENTATION

Simulation circuit



The pump and vent conditions can read through the LCD screen

Perfect conditions

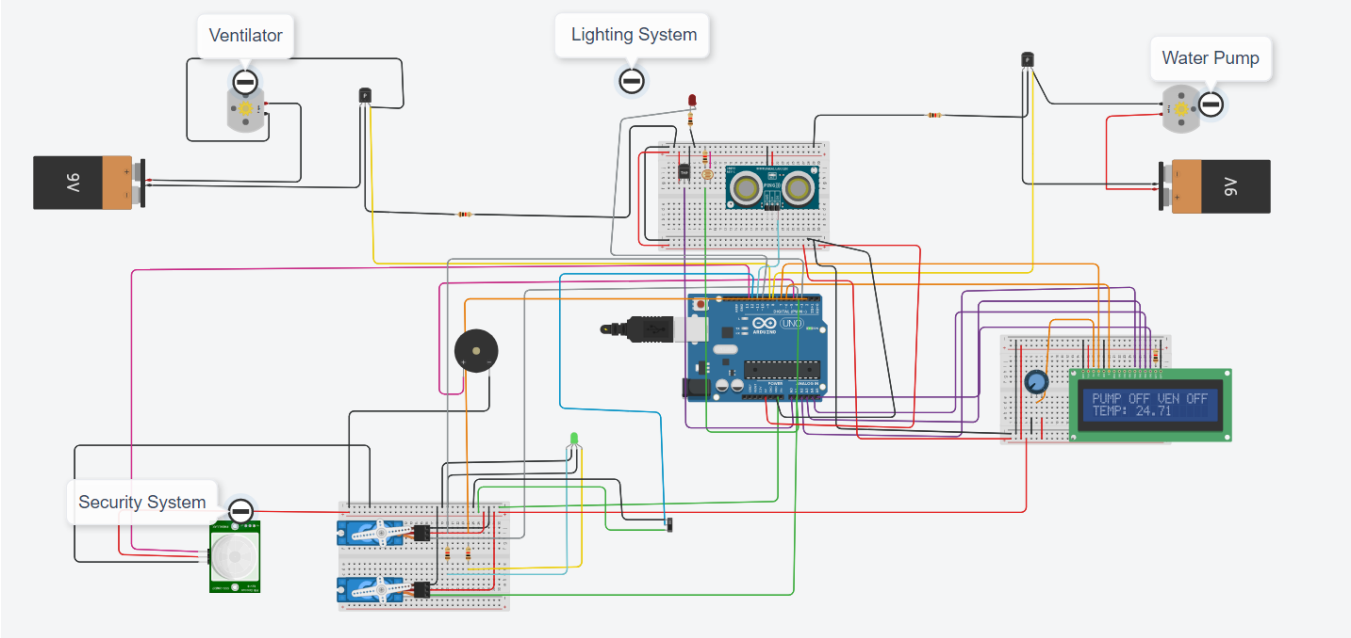
All systems are off

Water Pump system:off

Ventilator System:off

Security system:off

Lighting system:off



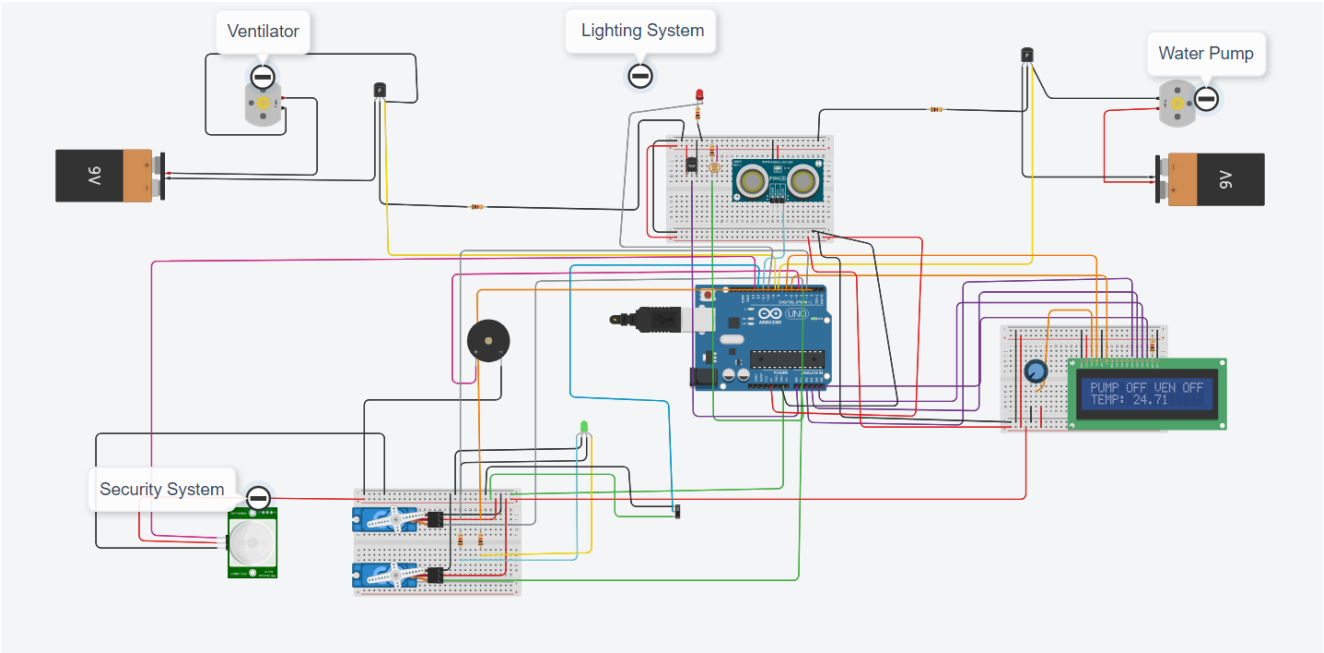
<u>The lighting is less(The photoresistor sensor value is less than 511)</u>

Water Pump system:off

Ventilator System:off

Security system:off

Lighting system:on ,the led lights up which can be seen in the below pic



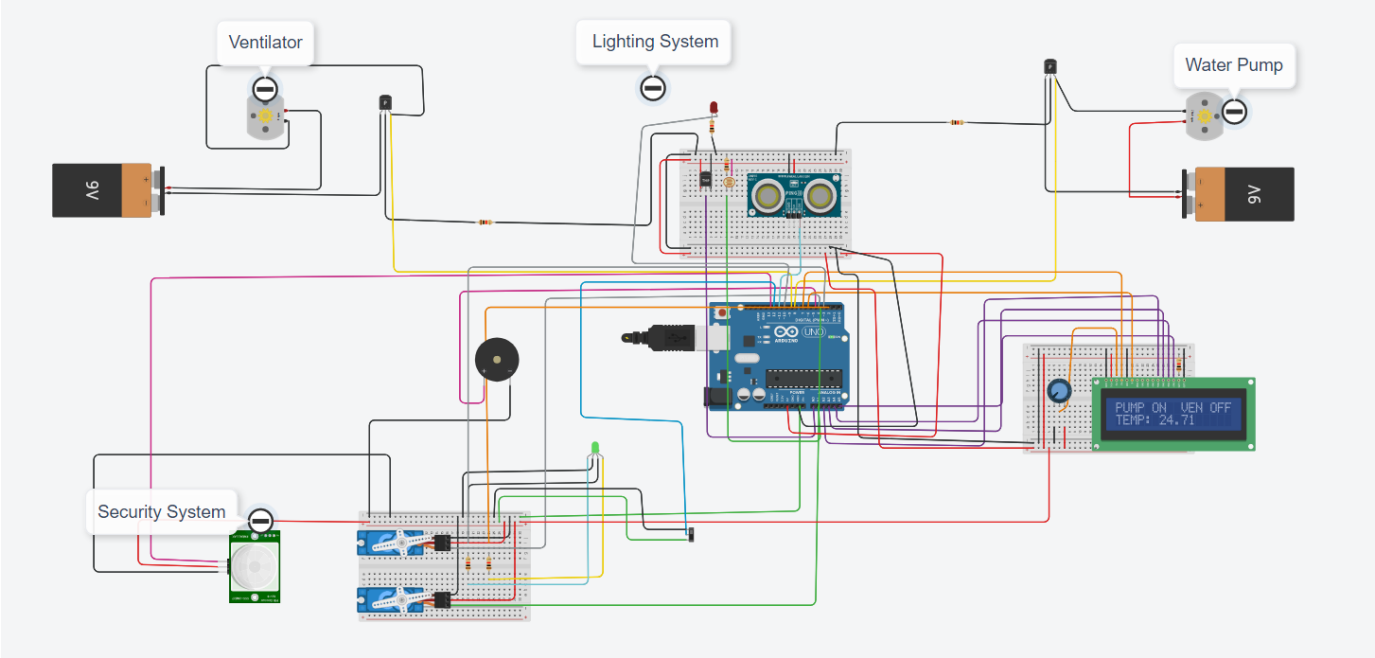
The moisture level of soil is less(the ultraviolet sensor detects the water greater than 100 cm away)

Water Pump system:on which can be seen in the below pic in the LCD screen

Ventilator System:off

Security system:off

Lighting system:off



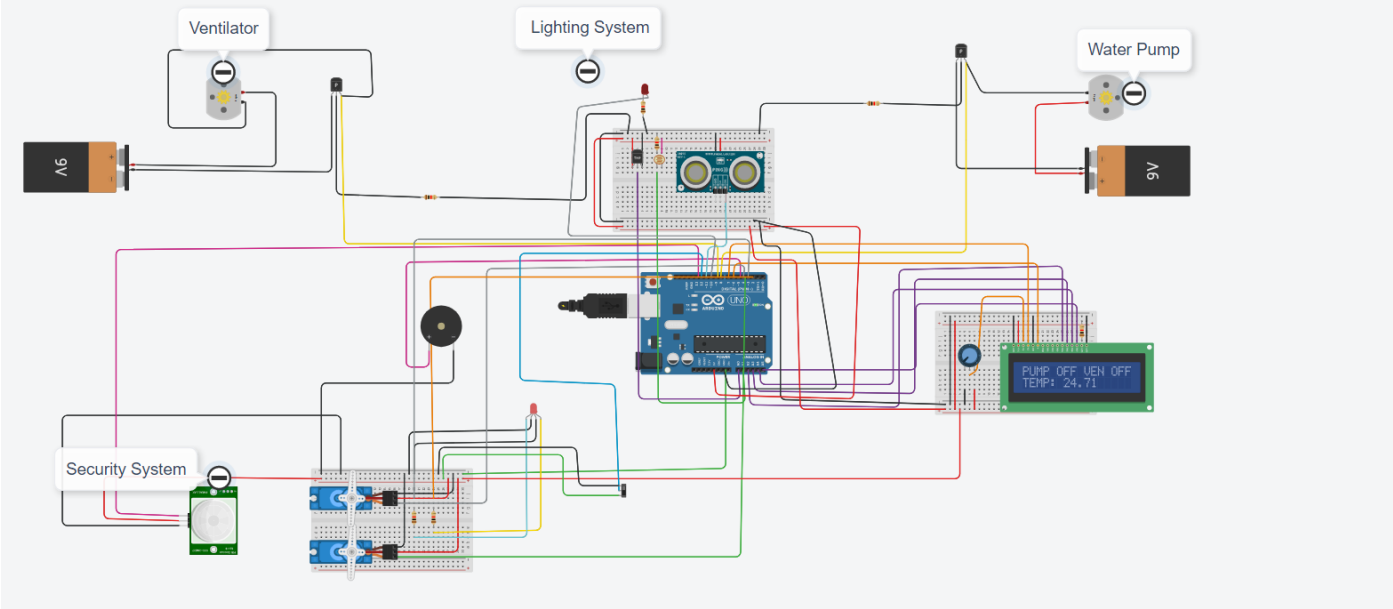
There is movement nearby(The PIR sensor detects motion)

Water Pump system:off

Ventilator System:off

Security system:on,the green led of the security system changes to red and the motorservo gates are closed as seen in the below pic.An alarm is also rung

Lighting system:off



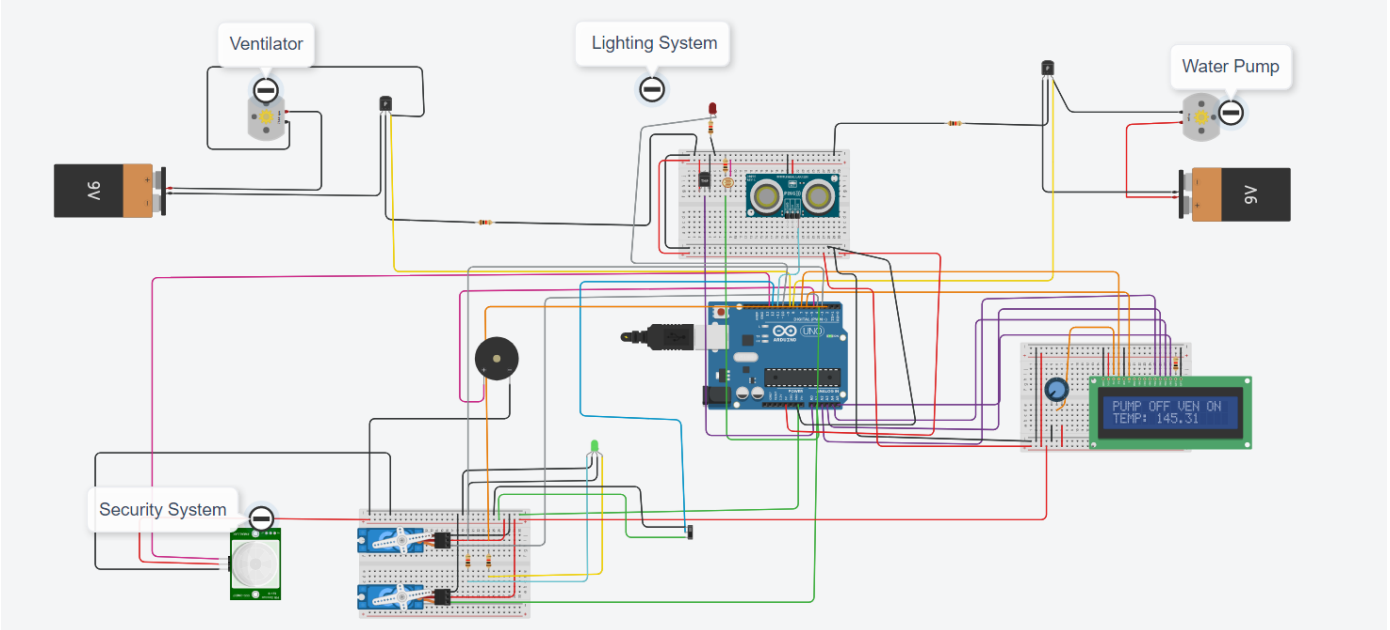
When the temperature is high(the value of temperature sensor is greater than 28)

Water Pump system:off

Ventilator System:on,The ventilator system is turned on as can be seen in the LCD screen in the image below

Security system:off

Lighting system:off



14.RESULTS

- The systems are activated and the output pictures is attached in Implementation heading
- The Lighting system is activated when the light intensity is low.
- The Ventilation system is activated when the temperature is greater than threshold value.
- The Security system is activated when the Motion sensor detect the motion. And the gate is closed.
- The Water Pump system system is activated when the Soil moisture is less than threshold value

15.APPLICATIONS

- This project can be used by anybody who owns a greenhouse either commercially or personally.
- It can also be used by wine producers to grow grapes in the perfect conditions for best wine.
- It can be applicable for floriculture enthusiast or commercial florists as flowers require very specific conditions to grow in and are very difficult to cultivate
- It can be used to by rare book collectors also as the books have to be stored in very specific conditions to preserve them

16.CONCLUSION

Our proposed system monitors temperature and humidity, as well as soil moisture, and takes appropriate action based on the findings. Human engagement is not required by the systems. It also comes with a database that may be used for future research and reports. This technology is well suited for deployment in regions like the North Pole and countries with harsh winters, where people dwell but plants do not thrive. Due to its efficient use of time and automatic controlling ability, if this method is utilised in those nations, one person may manage numerous Greenhouses to grow a large number of plants. That individual will only be responsible for monitoring the state of the green houses and repairing anything that cannot be corrected by the suggested system, such as cutting off any infected plant leaves, uprooting any infected trees, and so forth.

17.FUTURE WORK

Our system in the future will be connected to the cloud using thinkspeak and the data collected will be stored in it .This data can be used as a dataset and machine learning algorithms can be created to help the system automate in a way that anticipates the plant's needs rather than waits for the plant to show any sign by anticipating the plant's needs using the collected data.

We will work on expanding this project to work on plants in external conditions rather than a controlled closed room to environment .This will majorly help farmers increase efficiency and subsequently their yield.

We will also work on modifying the code of arduino to have specific modes for specific plants and the farmer can select the mode according to the crop he is growing.For example grapes require less water so the system for grapes will be in such a way that plants are watered less

18.REFERENCES

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