Mini Project Report on

"Greenhouse Monitoring System"

Submitted by

PD-20 Gauri Godghase ERP Number: 1032180427
PD-28 Aishwarya Gautam ERP Number: 1032180710

Under the Guidance of

Prof. B. N. Jagdale

At

MIT World Peace University

Pune-411038

Abstract

The aim of this project is to design a greenhouse monitoring system based on the Internet of things (IOT). A greenhouse is a covered area where plants grow and cultivate. It is also known as land of controlled crops and plants. There are some important parameters to be monitored inside the greenhouse are temperature, relative humidity and carbon-di-oxide.

Pervasive computing technology is invading our greenhouses. They are representing the technology solution to automate and improve the management of greenhouse. Internet of things (IOT) was developed for connecting a billion of devices into an internet. A huge amount of information is transferred between the electronic devices. It is a new way to interact between device and people. This shows that how the embedded wireless system has been for future vision in the monitoring system. Internet of things (IOT) will play a major role in day to day life in the future

A greenhouse is a steel-frame structure, covered by the anti-UV plastic sheet to protect the crops and environmentally controlled to maximize the crop's condition and productivity. Exposure to the extreme temperature during the hot season will affect the growth of the crops that influence the quality, yield, and profit per season. The Arduino software with Cisco Packet Tracer simulation is used to simulate the coding and the system. The environment of the greenhouse can be monitored, the temperature and humidity inside the greenhouse, the level of soil moisture and the level of water in the hydroponic tank. The system automatically executes the cooling, watering, lighting and warning notification features.

1. Introduction

A greenhouse is a Modern cultivating method that gives high yields during any season. This project shows the experimental, wireless embedded intelligent monitoring system for greenhouse which will improve crop growth and reduces cost and manpower. If monitoring is implemented using the wired networks, the cables connected to the devices need to be rearranged for every crop, so it wastes a lot of money and manpower. Therefore it needs to be replaced by the internet of things (IOT) because it provides a new method for accessing the farmland information.

1.1 Background

Greenhouse is widely used to shield crops from excess cold or heat, raining and unwanted pests. A greenhouse makes it possible to grow certain types of crops year-round. Fruits, vegetable and flowers are what a greenhouse most commonly grows. Good design and advance technology applied in the greenhouse industries helps farmers.

A greenhouse is essentially meant to permit at least a partial control of microclimate within it. The control of greenhouse environment means the control extreme of heat and humidity, soil moisture, nutrients and significant inputs of heat and light may be required

The maximum greenhouse temperatures should not exceed 30-35°C and the humidity should not be less than 60 percent. High temperature exposure in the greenhouse during sunny day may harm the crops inside. Therefore, the cooling technologies play an important role in the greenhouse industry. The heat trapped inside the greenhouse increases the temperature.

Therefore, as a solution to this problem, the automated greenhouse's controlling and monitoring system has been designed and developed by focusing on the reducing and maintaining the greenhouse temperature. The status of the greenhouse can be monitored from miles away including the temperature, humidity, soil moisture and others. The controlling system is designed to execute the Arduino coding to actuate the relay that controls the cooling system and watering system automatically

1.2 Motivation

The recent scenario of climate change and its effect on the environment has motivated the farmers to install greenhouses in their fields. But maintaining a greenhouse and its plantation is very labour intensive. Majority of the farmers perform vital operations intuitively. Also agricultural researchers are facing shortage of good quality of data which is crucial for crop development. Thus we have developed such a cost effective system using Internet of Things (IoT) technology which is focused on solving these particular problems. Our system automates the greenhouse maintenance operations and monitors the growth conditions inside the greenhouse closely.

Information is the key to making sound decisions. Some farmers are unaware of the availability of a suitable machine, tool, or implement that could aid in their usually tedious work. They might be secluded from the technology by natural barriers and socio-political boundaries. Some farmers are even lackadaisical and seemingly uninterested in mechanization.

According to Weiderhold (2007), Industry is rarely ready to accept an innovation when it first presented. There are many reasons for lack of acceptance: the two major ones he cites are:

- The innovation is not understood by industry because, as a by-product of the innovation new terms have been defined.
- The innovation is understood or at least understandable, but there are no resources at that time to try to develop and market the innovation,

Searles (2007) states that a subsistence farmer, which is the main target market for the greenhouses, cannot produce crops on a large scale if he does not know how to do so. It is hard to prevent problems such as soil erosion and degradation without knowing what to do to stop it.

She also stresses that there has been little effort towards education of the family farmers. In the cities there are resources available in order to educate a farmer but it is not accessible to many rural citizens. There has been no centralized effort to educate the majority of farmers on sustainable development issues.

Experience indicates that farmers are generally reluctant to changes in their farming activities for this is their way of life. They have the "wait-and-see" attitude. Like any new technology, greenhouse technology faces some of the same market problems as other innovations where few people would be willing to try out a new product. Most people would be unwilling to try out new innovative products such as greenhouse farming because they are uncertain of its success.

sites referred:

- **https://www.ukessays.com/**
- **https://www.appropedia.org/Greenhouses_literature_review**

3.1 Problem Definition

To design a greenhouse monitoring system based on the Internet of things (IOT) to monitor some important parameters inside the greenhouse such as temperature, relative humidity and carbon-di-oxide. Complexity involved in monitoring climatic parameters like humidity, soil moisture, illumination, soil pH, temperature ,etc . which directly or indirectly govern the plant growth. An IOT based monitoring and control system is designed to find implementation in the near future that will help Indian farmers.

3.2 Features:

- Maintain Ideal Micro-Climate Conditions
- Control Infection and Avoid Disease Outbreak
- Enhance Irrigation and Fertilization Practices
- Greatly reduce or eliminate labour and the potential for human error
- Saves time as similar plants can be grouped together and watered in single or multiple zones.
- Sensors can monitor how much water and fertilizer your plants are getting/needing.

3.3 Objectives:

- Our main objectives of this project are build greenhouse with automatic monitoring and controlling system.
- Constantly monitor and control environmental conditions in greenhouse.
- It focuses on saving water, increasing efficiency and reducing the environmental impacts on plants production.
- The user can see the atmospheric conditions of the greenhouse plants on website and control the greenhouse from faraway places.
- It is to increase the production of food stuff. To save water, power etc. to increase the production of medicinal plants.

3.4 Scope

- In future, apart from Android phones, the system can be connected to other communication devices like modems or satellite terminal for enabling remote data collection.
- The system performance can be further expanded by increasing operating speed, memory capacity and instruction cycle period of microcontroller. Also we can use Wi-Fi, so that the system can be directly connected to the internet.
- Moreover, Time bound administration of crop yielding materials like fertilizers, pesticides and insecticides can be introduced.
- To operate multiple greenhouses concurrently, a multi-controller system can be developed.

4.1 Software & Hardware Requirements

4.1.1 Hardware Requirements

- Temperature Sensor TMP 36
- H-bridge motor driver
- DC Motors
- Photoresistor
- LCD display
- Ultrasonic sensor HC-SRO4
- Buzzer
- Gas sensor
- Servo motor
- Arduino

4.1.2 Software Requirements

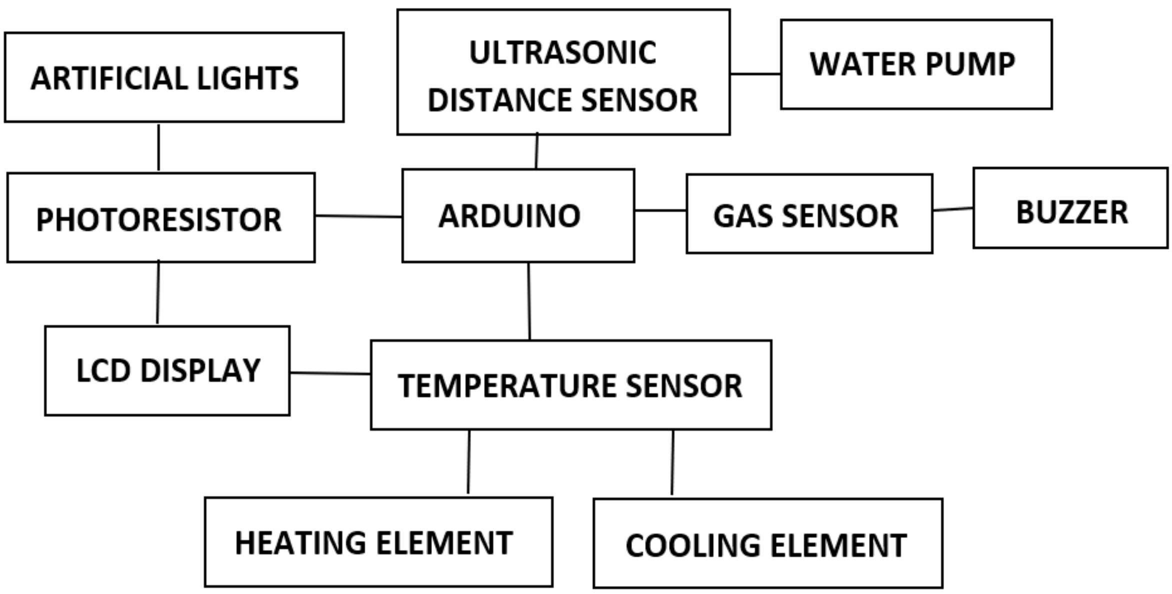
- **Data Collection Module :** This module collects and decodes the digital signals input from the sensor nodes and extracts the usable data.
- **Data Processing Module :** This module preprocesses the usable data for analytics to be done. Also, it uses this data for actuation purposes in timing and sensor based modes.
- **System Configuration Module :** This module is used to configure the system primarily for setting threshold values and preprocessing fine tuning.
- **IoT Cloud :** Being an IoT system on site we cannot load resource intensive the analytics code in the server thus using IoT cloud we can perform analytics and store the data collected for future use easily and efficiently.
- **End User Web Application :** This will the user interface of the system, this module will contain a control panel where the user can watch and control the system easily. For developing our software we have used python language as it is the most compatible with raspberry pi, also data preprocessing and web application development repositories are simple and efficient. As our cloud, we are using services of MathWorks® ThingSpeak™ and adafruit IO.

4.2 System Architecture

This project is implemented in green house to monitor soil moisture, humidity, temperature, presence of fire, colour of leaves and detection of toxic gases. The sensors have huge amount of implementations. This project can be used for any type of irrigation fields, in nursery, botanical gardens. This project can be implemented in any closed area which located remote places which need to be monitored without human presence, like research centre located in very high altitude.

The humidity sensor will sense the humidity of the value of the humidity. If the value is higher than the predefined value it will send a message to the owner that the humidity is high.

The temperature sensor will sense the value of the temperature and if the temperature is high the sensor will display it in the LCD monitor and send a message to the owner through GSM.



4.2.1 Scenario I

Measuring temperature

- The wireless greenhouse temperature monitoring system allows tracking the temperature levels in greenhouses. The system is monitoring environmental conditions for 24/7 and sending alerts in case the set temperature and humidity conditions fall out of optimal ranges.
- There is an option to select individual min/max parameters of the temperature range for each wireless sensor as well as setup allowed time of

violence out of recognized parameters. This feature helps to focus on severe cases, avoiding alerting many un-important events.

- The optimal temperature range is from 20℃ ..25℃ .
- Below 20℃ the MCU board sends analog signals to the temperature stabilizer heating element which starts to automatically warm up the environment keeping the plants healthy.
- Above 25℃ the MCU board sends analog signals to the temperature stabilizer cooling element which starts to decrease the temperature thus maintaining a sustainable environment.

4.2.2 Scenario II

Measuring Humidity

- The humidity sensor will sense the humidity of the value of the humidity. If the value is higher than the predefined value it will send a message to the owner that the humidity is high.

4.2.3 Scenario III

Measuring Light Intensity

- The most common type of photoconductive device is the Photoresistor which changes its electrical resistance in response to changes in the light intensity.
- If resistance is less than 100, then it is too bright and the owner will be notified of this change.
- If resistance is greater than 180, then it is too dark and automatically artificial lighting(LED) will start and the owner will be notified of this change.

4.2.4 Scenario IV

Measuring Water Depth

- Here we use an ultrasonic sensor to measure the depth of water in the water pump.
- If the measured distance is greater than 200 cm, it represents low water level in the tank and pump will automatically start.

- If measured distance is less it means water level is high and pump does not start.

4.2.5 Scenario V

Gas Sensing

- A gas sensor is a device which detects the presence or concentration of gases in the atmosphere. Over here it detects when the atmosphere gets toxic due to harmful gases.
- If smoke concentration is very high a buzzer is used to notify the owner.

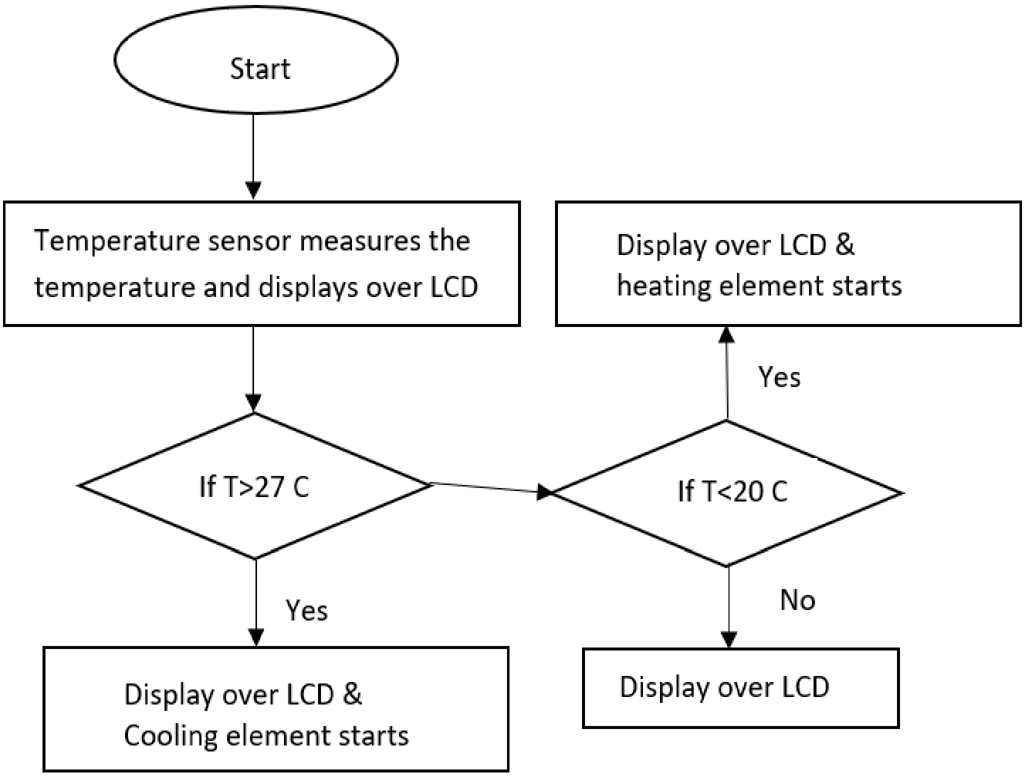
4.2.6 Scenario VI

IOT network for user notification

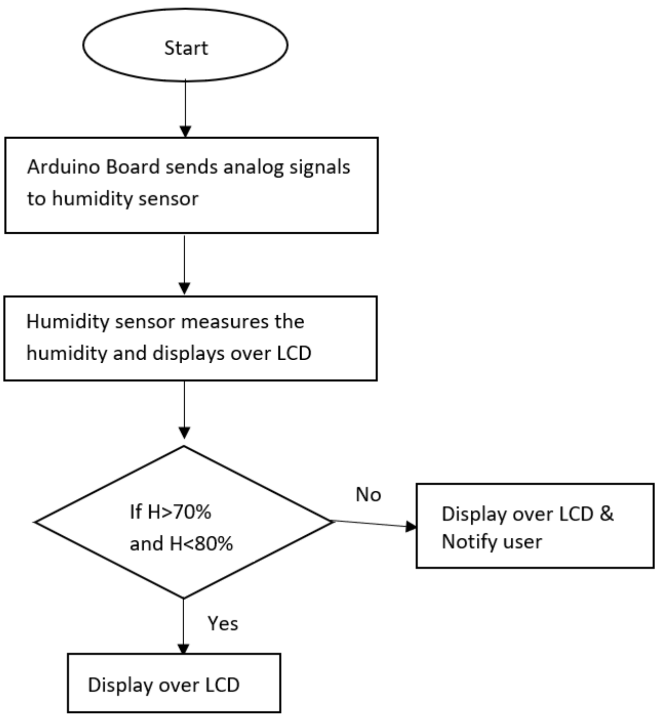
- The temperature and humidity values are continuously being displayed by the LCD monitors. It is displayed by the server and as well on the laptop.
- Any person or device who is connected in this network can get this data from anywhere. Online reporting software supports multi user environment with individual notification schedule.
- The wireless sensors have built-in battery that works up to 5 years.
- The sensors read environment parameters and deliver them to the online reporting software every 5 minutes.
- One data gateway supports up to 200 wireless humidity and temperature sensors within a radius of 150 m (or up to 500 m using signal repeaters), so you can monitor several greenhouses at the same time using one data gateway that reduces the cost of the system

4.3 Flow diagram

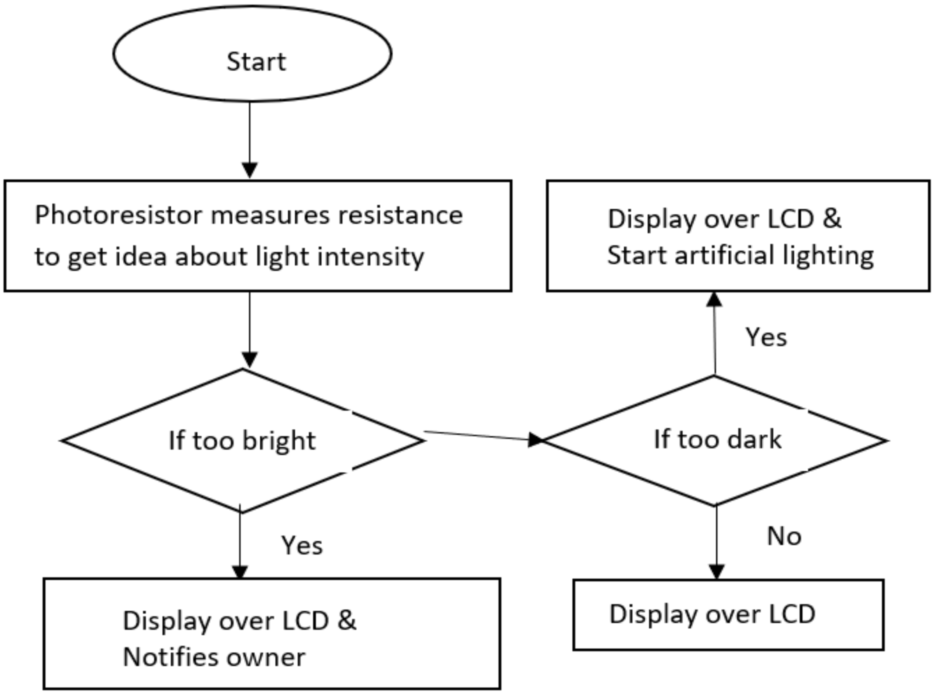
4.3.1 For Scenario I



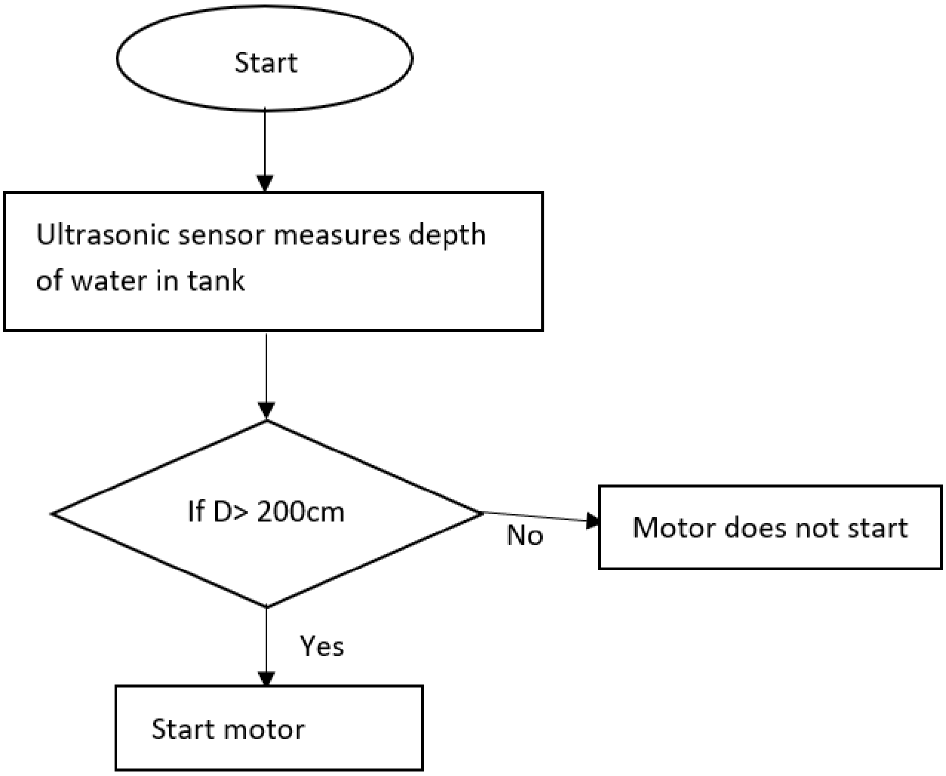
4.3.2 For Scenario II



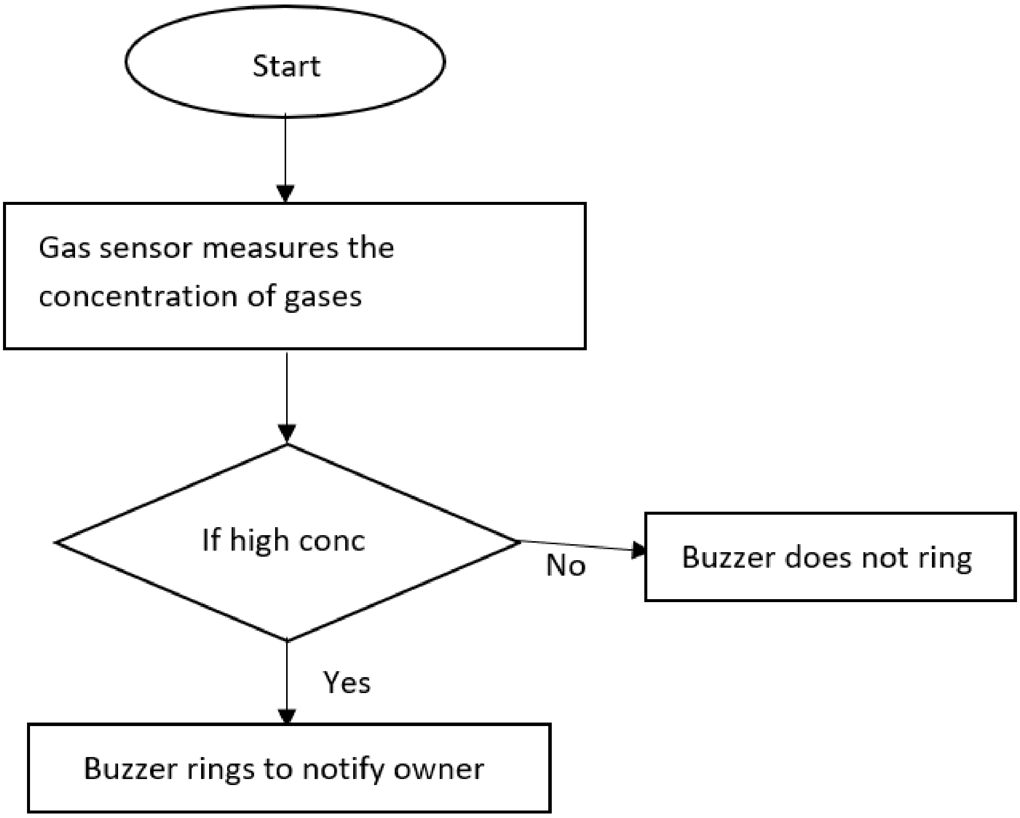
4.3.3 For Scenario III



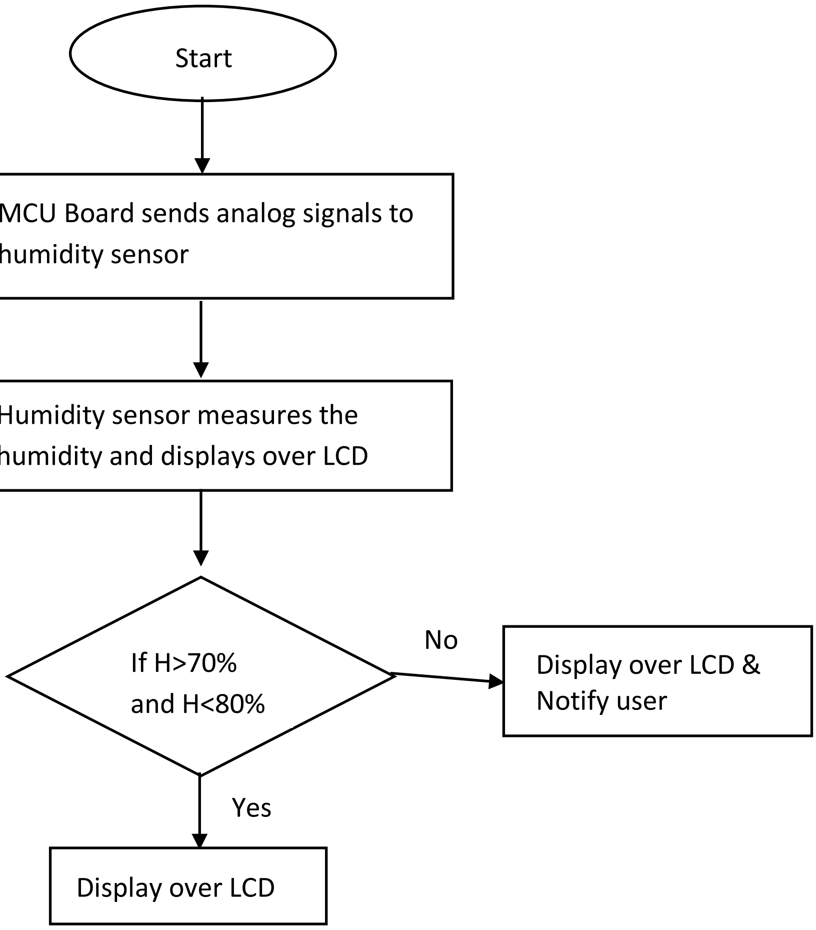
4.3.4 For Scenario IV



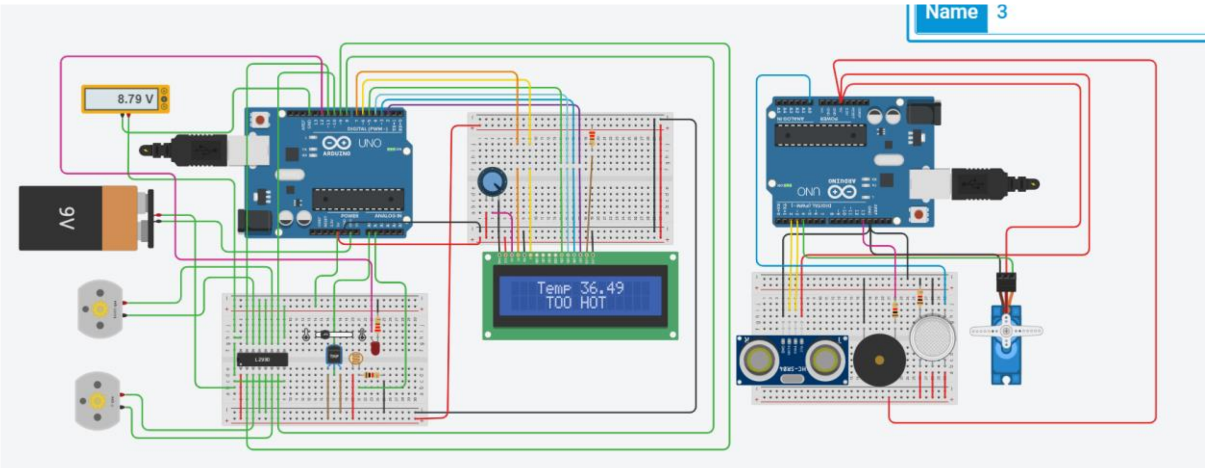
4.3.5 For Scenario V



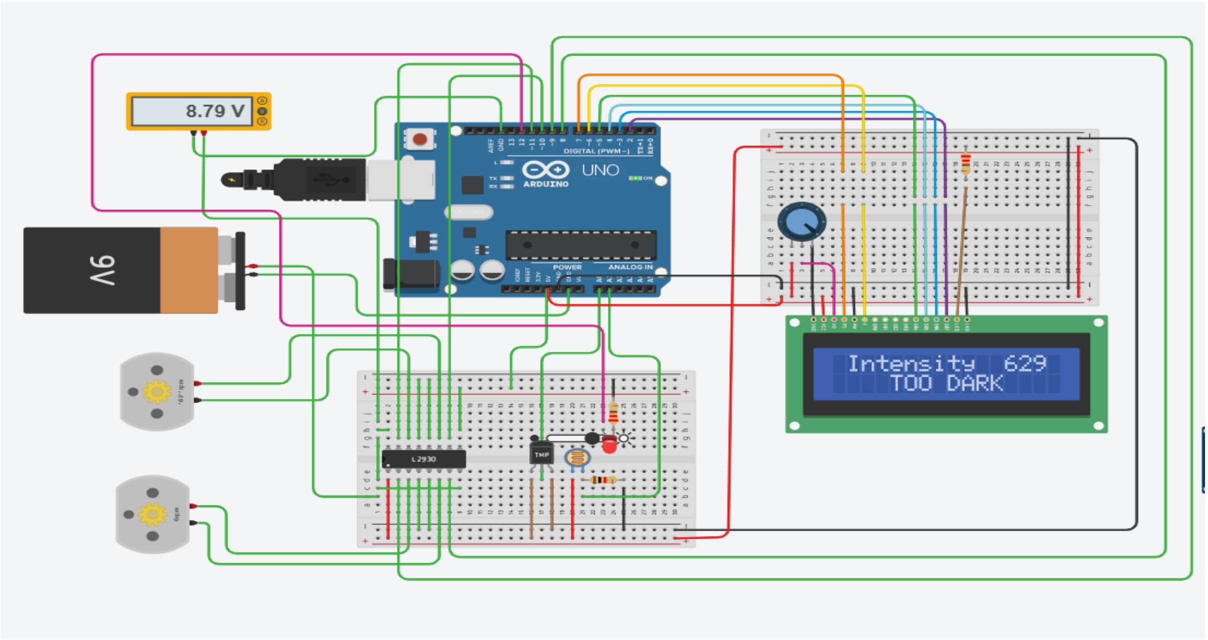
4.3.6 For Scenario VI



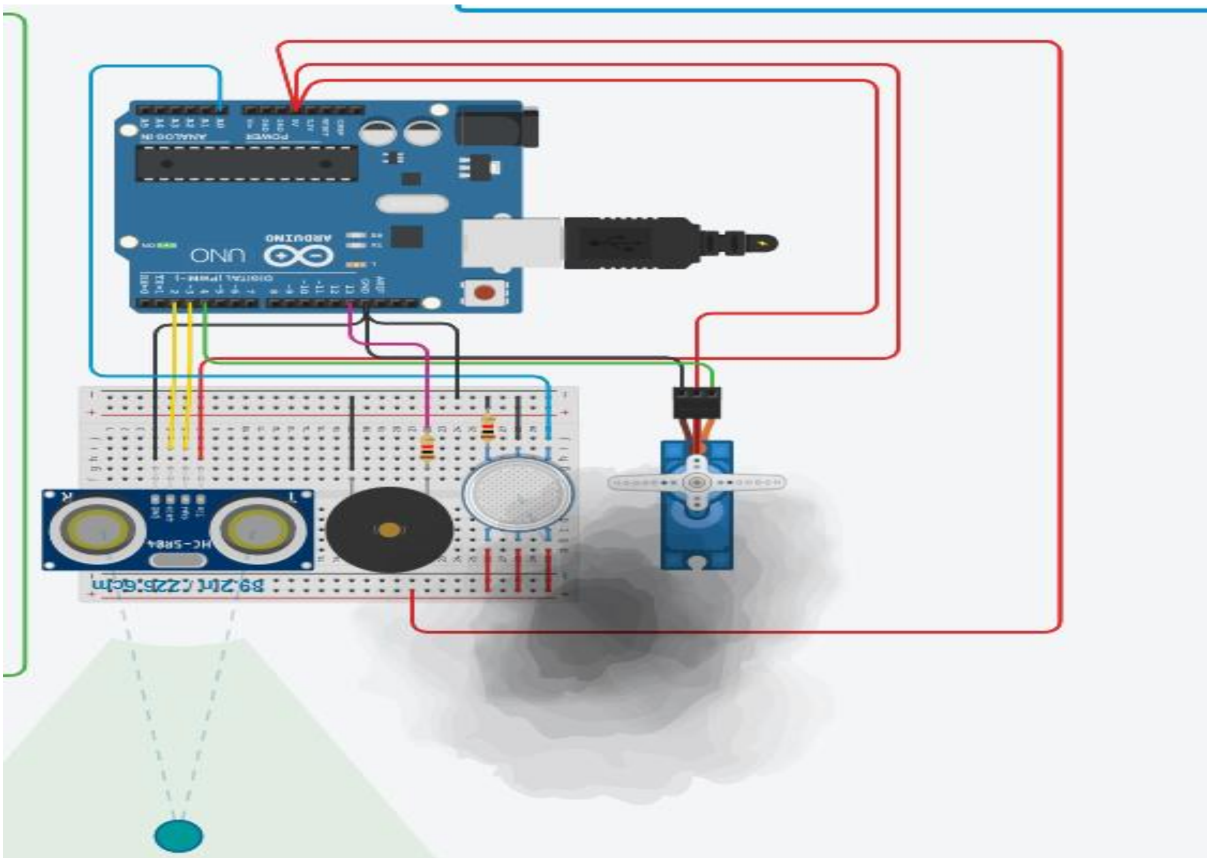
- The **temperature sensor** unit works as expected switching on the heating element when it is too cold and switching on the cooling element when it is too hot.



- The **photoresistor** senses the light intensity properly and when it is too dark automatically triggers the artificial lighting to start (here indicated by LED).

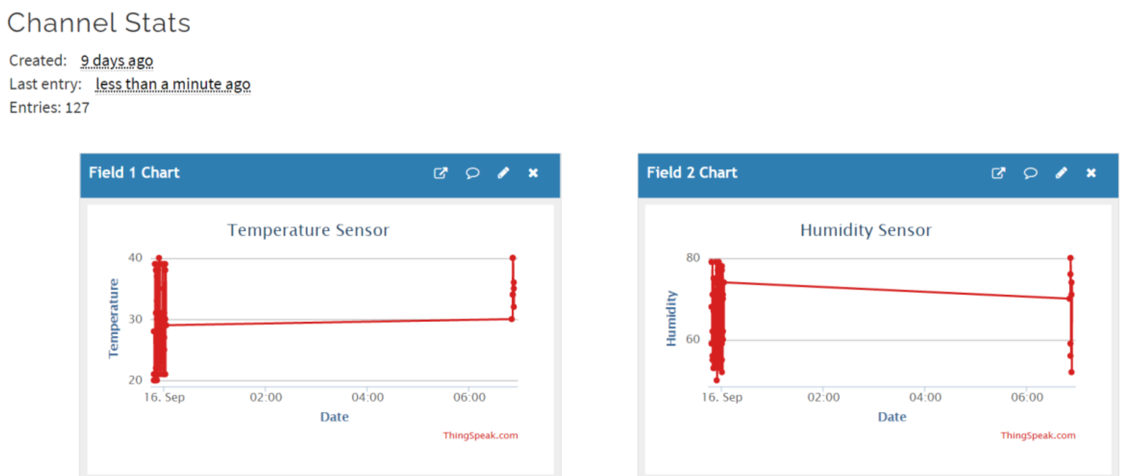


- The **ultrasonic sensor** successfully measures the depth of water in the tank and if required then starts the motor pump to fill the tank based on given conditions.
- The **gas sensor** activates the buzzer as expected on high concentration of toxic gases



- We send our collected data to cloud platform ThingSpeak for better analysis and visualization of data. We can store the data collected for future use easily and efficiently.

  Visualizations obtained using dummy data:



6. SCHEDULE OF WORK

Milestones

Milestones of our project is given below:

ID	Task Name	10-14 August	24-28 August	1-4 September	7-11 September	21 September
1	Literature Survey					
2	Comparative Study					
3	Problem Statement					
4	Requirement Analysis					
5	Design					
6	Implementation					
7	Development					
8	Testing					
9	Demonstration					

7. CONCLUSION & FUTURE WORK

This paper describes the design of a greenhouse monitoring system based on IOT. Agriculture projects even in urban areas are on a rise in recent times, in unique forms. Technological progress makes the agricultural sector grow high, which here is made by the IOT. The IOT will dramatically change way we live our daily lives and what information is stored about us. This monitoring system precepts different parameters inside the greenhouse using sensors and GSM to provide the updates. The developed system can be proved profitable as it will optimize the resources in the greenhouse. The complete module is of low cost, low power hence, easily available to everyone. This paper is a basic idea of the research regarding greenhouse but still there is a lot more to be explored technologically.

8. References

- Poorna Prakash dondapati, K. Govindaraju,- “An automated multi-sensored greenhouse management”, international journal of technological exploration and learning, august2012, pp. 2319-2135.
- G. J. Timmerman and P. G. H Kamp, “Computerised Environmental Control in Greenhouses,” PTC, The Netherlands, Page(s): 15–124, 2003.
- Teemu Ahonen, Virran Kask, Mohammed, “Greenhouse Monitoring with Wireless Sensor Network”, ‘Proceeding of IEEE International conference on Mechatronics and Embedded System Application’,2008 (MESA 2008),Page 403-408.
- Environment effect on plants, Colorado State University,2013.
- L. M. Mortensen “Effect of relative humidity on growth and flowering of some greenhouse plants,” Sci. Horticulture, Vol. 29, no. 4, pp. 3017, Aug. 1986. [6.] Muhammad All Mazidi, The 8051 Microcontroller & Embedded Systems.
- http://www.onlinejournal.in/IJIRV3I3/199.pdf
- https://www.researchgate.net/publication/322020853_GREENHOUSE_AUTOMATION_AND_MONITORING_SYSTEM_DESIGN_AND_IMPLEMENTATION