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Escuela Técnica Superior de Ingeniería Industrial

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A Report on

IOT BASED SMART SYSTEM FOR WHITE BUTTON MUSHROOM FARMING

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ABSTRACT

Agriculture techniques keep on improving day by day. Adapting modern agricultural technology plays an important role in improving overall efficiency as well as the productivity of their yields. In modern agriculture, Internet of Things (IoT) connects farmers to their farm via the sensors so that they could easily monitor the real-time conditions of their farm and control environmental parameters from anywhere. White Button Mushroom is a widely cultivated crop among farmers. Although being the most consumed and high demand cash crop, it is still overshadowed by the traditional cultivation approach which is resulting in low productivity, high manpower efficiency, more effort and cost.

This work aims to develop a monitoring and controlling system to monitor and control the environmental conditions such as temperature, humidity, moisture and lighting conditions of the white button mushroom farm. It enables a user to monitor crucial factors such as temperature, humidity, moisture, the light intensity on a mushroom farm through the end devices. White Button Mushroom requires optimum temperature ranging from 22°C to 25°C* and humidity from 70% to 90%*. It needs good quality compost with well integrated moisture level of about 60% to 70%* whereas dim bright lighting conditions* inside the mushroom farm. Sensors are placed on fixed location and spots of the farm. Then, the sensors measure the status of parameters which are transmitted to the remote monitoring station via a low power Node MCU and finally they are able to monitor conditions of a mushroom farm through platforms such as Node-RED, ThingSpeak, Blynk.

The codes for the controller are written in the Arduino programming language, debugged, compiled, and burnt into the microcontroller using the Arduino integrated development environment. Along with this a programming tool called Node-RED is used for wiring together the hardware devices. It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in palette that can be deployed to its runtime in a single-click for monitoring and controlling of the environmental parameters of the farm. The result shows successful monitoring and controlling of environmental conditions accessing the internet from anywhere. It minimizes human efforts and automates production, which could be beneficial to farmers.

*- Nepal Agricultural Research Council (NARC)

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INTRODUCTION

Mushrooms are classified as vegetables in the food world, but they are not technically plants. They belong to the fungi kingdom. The rising demand for crop production and quality has significantly increased the utilization of high quality greenhouse. We can cultivate the crops which need some specific environmental conditions in the greenhouse. This project is an implementation of smart farming for mushroom cultivation. Smart farming is about real-time data collection, processing and analysis, as well as automation technologies on the farming procedures to achieve improvement on the farming activities. Internet of Things (IoT) sensing and mobile technologies has now becoming a daily assistant to numerous activities. Smart farming has also improved to a new level. An IoT technology has been widely implemented in measuring smart home system and agricultural monitoring system. Mushroom cultivation is a relatively new concept. Beginning from 1970s, mushroom farming is slowly becoming known to farmers and agriculture scientists. The wild varieties are also becoming slowly known to other countries as well. There are few wild species of medicinal importance and high value. This however is in very small scale. Their commercial cultivation has yet to be done. Among them white button mushroom is produced and consumed more.

(Adapted from: https://www.flickr.com/photos/mushtella/6859748428/in/photostream/

For the large cultivation of the white button mushroom we consider the following points:

- Temperature
- Humidity
- Ventilation and light
- Spawn
- Disease

OBJECTIVES

- To design and develop an IOT based smart monitoring and control system for white button mushroom plant.

METHODOLOGY

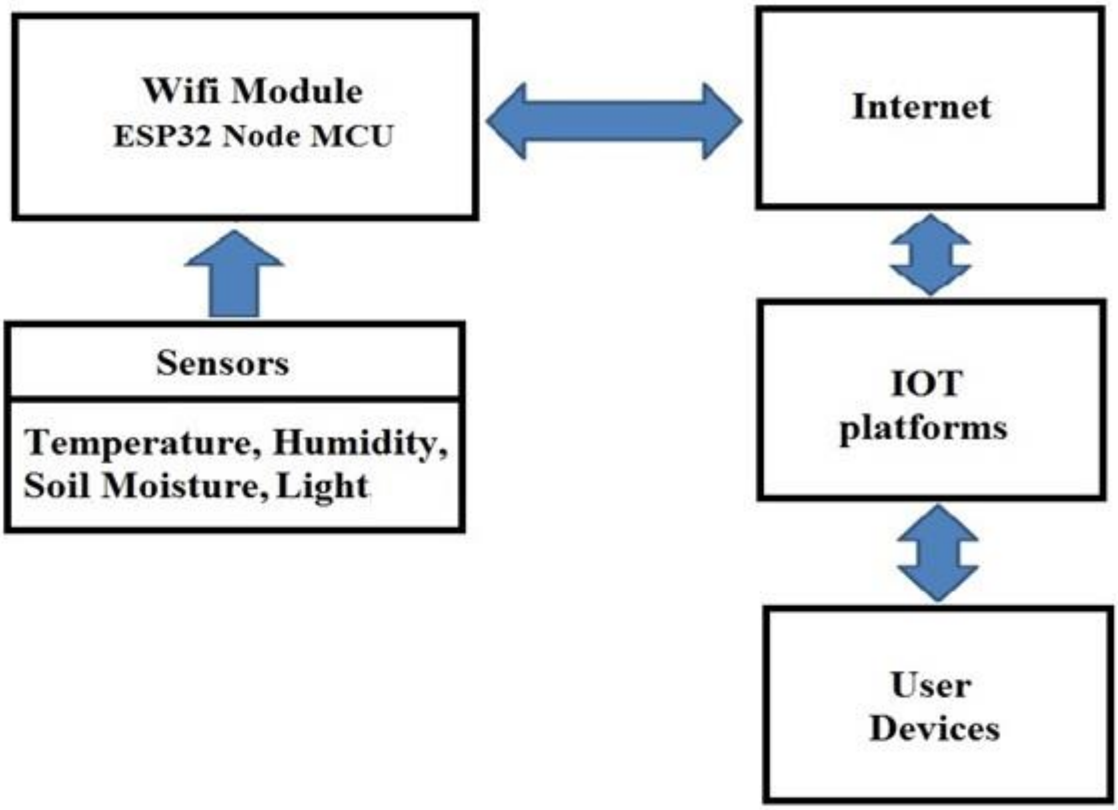

Figure: Working Block Diagram of System

The block diagrams above are the basic idea of how the project proceeds. It provides the conceptual idea of how each block are interrelated to each other. Software portion will detail out mainly the part focused in platform and its interface with number of sensors. Since the system is mainly based in automation, accuracy is focused more. The system has been being well designed. It consists of sensor nodes distributed on various areas of the farm each covering the certain areas as shown in figure. It is simple, light weighted protocol for machine to machine communication. It works on publish subscribe basis which means it publishes sensor data and send it to the devices which are subscribed to it. It transports data from sensor to the gateway from each node. Further from gateway we send data over to internet. The different IoT service providers provides us the platform such as to give data to users and public.

RESULTS AND DISCUSSIONS

DHT-22 (Temperature and Humidity Sensor)

First, we start by measuring the temperature given by DHT-22 followed by its humidity.

Temperature

The value given by the DHT-22 sensor for temperature was recorded. DHT-22 sensor is generally used for temperature range of -40 to 80°C while it has accuracy level of ±0.5°C.

Table: Reading of the temperature from DHT-22

SN	Sensor Value (°C)	
1	23.5	
2	25.6	
3	22.5	
4	25.7	
5	26.5	
6	24.8	
7	24.2	
8	23.0	
9	19.2	
10	23.8	
	Average	**23.9**

Thus, the average for temperature reading given by DHT-22 was found to be **23.9**°C.

Humidity

Similar method was applied in case of humidity. The value given by the DHT-22 sensor for humidity was recorded. DHT-22 sensor has better humidity measuring range from 0 to 100% with 2-5% accuracy level.

Table: Reading of the humidity from DHT-22

SN	Sensor Value (%)	
1	56	
2	62	
3	51	
4	63	
5	67	
6	67	
7	62	
8	56	
9	58	
10	61	
	Average	**63%**

Thus, the average for humidity reading given by DHT-22 was found to be 63%.

Soil Moisture Sensor

The 10HS Decagon moisture sensor was used to measure volumetric moisture content of soils. The 10HS measures volumetric water content via the dielectric constant of the soil using capacitance technology. The output for 10HS is 300 (dry soil) – 1250 (saturated) mV, independent of excitation voltage with (0-50%) volumetric water content. Here, by measuring the moisture level before watering (low soil moisture) and after watering (high soil moisture), the readings are collected as follows as:

Table: Reading of 10HS moisture sensor

SN	Before Watering(%)	After Watering(%)
1	15	34
2	14	34
3	15	33
4	12	34
5	13	33
6	15	32
7	15	35
8	11	31
9	14	30
10	13	34
	Average **14%**	**33%**

By averaging the corresponding value, we obtained the moisture value. Upon conversion, the required soil moisture value for white button mushroom was found to be 44.8% for dry to 69.6% for moist in 100g of mushroom plant cultivation.

LDR

The value of the light intensities was measured using LDR. In order to set the threshold value for LDR, readings were taken at different times of the day. Since, we had to find the maximum readings of LDR where mushroom grows. It was found that readings were bit higher in the noon time where the light intensity was highest. We averaged those readings and set it as threshold.

Table: Reading of the LDR sensor

SN	LDR Reading (lux)	Time of the day
1	2559	Morning
3	2616	Morning
4	2599	Morning
5	1616	Noon
6	1698	Noon
7	1642	Noon
8	1672	Noon
9	2848	Evening
10	2845	Evening

11	2890		Evening
12	2868		Evening
13	4096		Night
14	4096		Night
15	4096		Night
	Average of Noon	**1653**	

Thus, for LDR **1653 lux** was set as the threshold value. If the reading from the LDR exceeds this, then it will indicate room as dim else bright. Under low lighting conditions, the reading is around **4090 lux** and for extreme dark is **4096 lux.**

Circuit Diagram of System

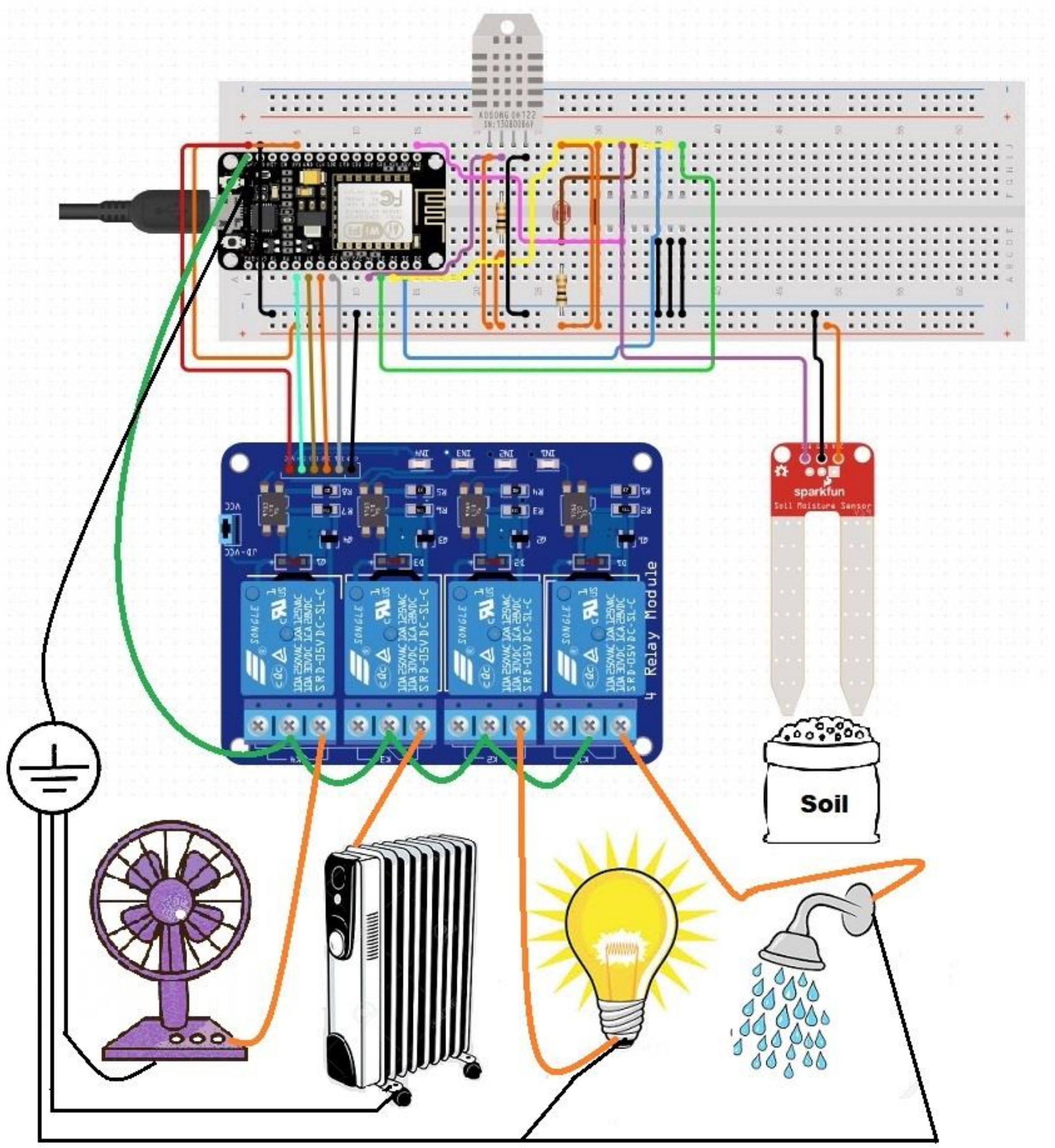

Figure: Circuit Diagram of the System

Circuit Diagram of System was designed using circuito.io with necessary modifications.

Flow Diagram of System

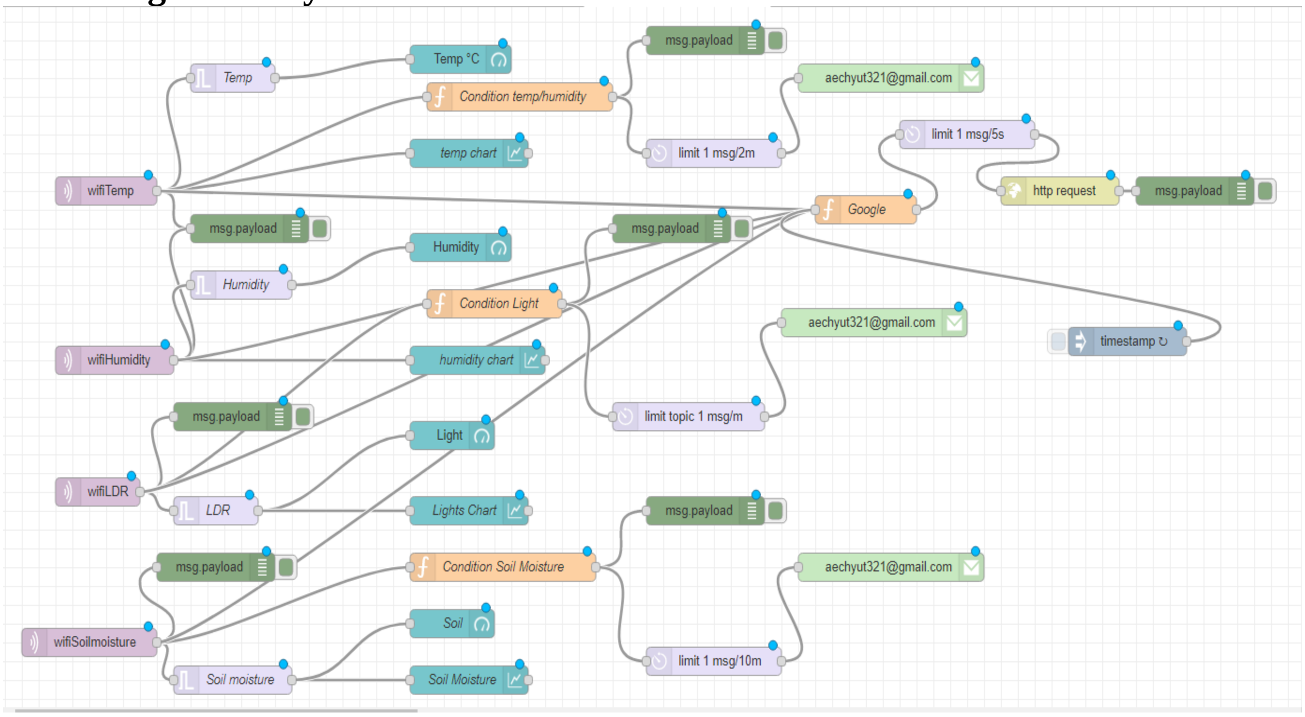

Figure: Flow of sensor nodes in Node-Red

The flow diagram of the system was designed using Node-RED. Here, the four major sensor nodes; Temperature, Humidity, Soil moisture and LDR are connected to various sub-nodes via MQTT platform. The measurements taken by these sensor nodes are displayed separately in a Node-RED dashboard.

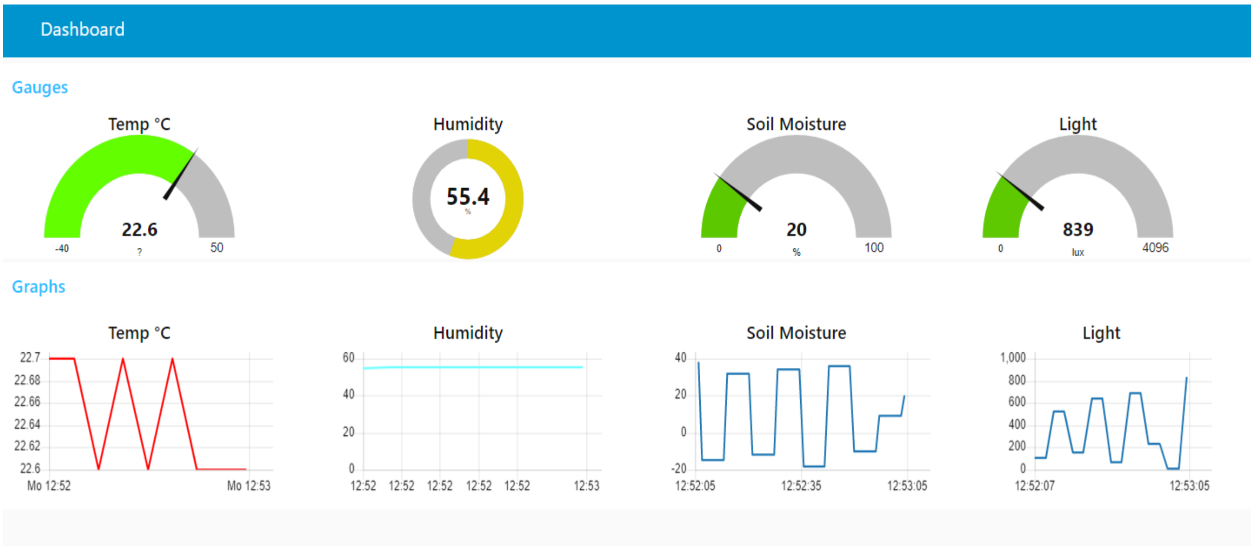

Figure: Sensors data measurements in Node-Red dashboard

CONCLUSION

The project redefines the concept among farms, agronomists. Major sensors such as DHT-22 sensor, soil moisture sensor and LDR have been tested and their data are sent to IoT platforms for further accessing and monitoring. In addition, a new platform of programming tool called Node-RED was adapted to provide a browser-based editing to make easy wire flow using wide range of nodes in palettes. Similarly, hardware implementation and testing was done successfully. As mushroom farming requires continuous monitoring in environmental parameters, the system can play an important role in stepping towards automation of mushroom plants. Furthermore, this project will help to reduce manpower and reduce the overall costing of white button mushroom production.

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Appendices

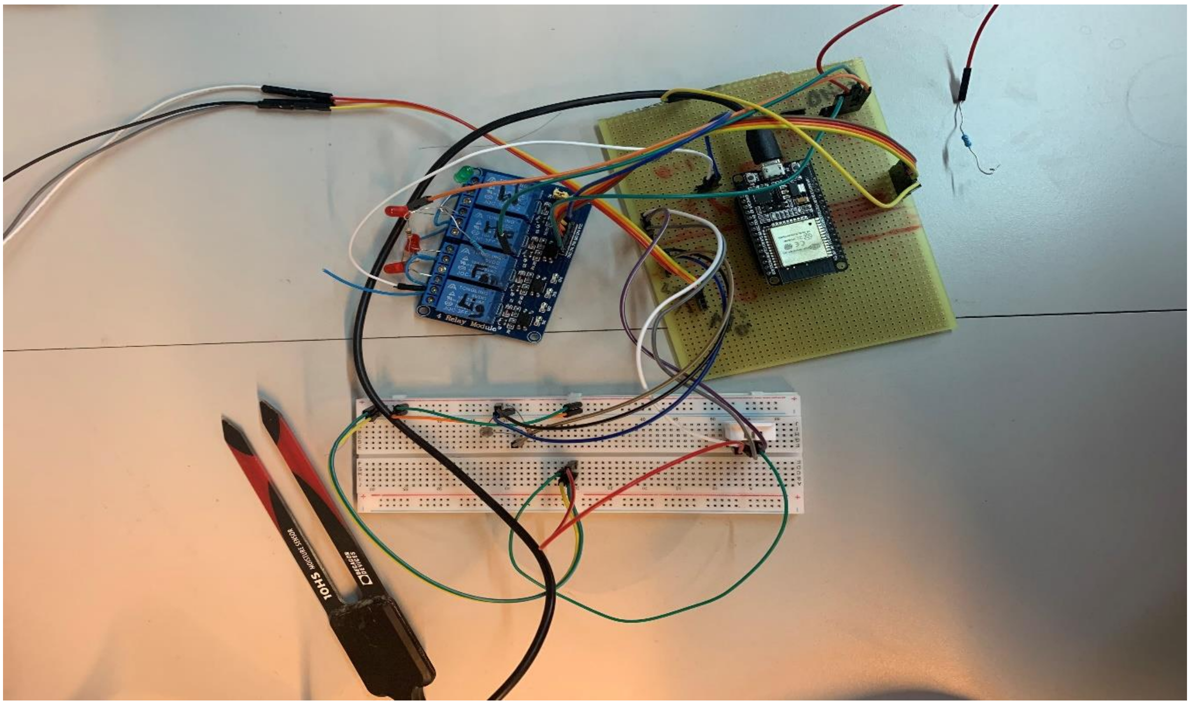

Figure: Overall Circuit

```
12:00:37.736 -> It's Dark Outside; Lights status: OFF
12:00:37.736 -> Humidity: 51.30 %      Temperature: 22.80 *C 22.47 *C Sample OK: 22 *C, 51 %
12:00:37.736 ->
12:00:37.736 -> Temperature= 22.80
12:00:37.736 -> Humidity= 51.30
12:00:37.736 -> 3.FAn is off
12:00:37.736 -> 3.heater is off
12:00:41.815 -> Soil Moisture: 31Light Value: 4095=================================
12:00:41.861 -> Sample DHT22...
12:00:43.893 ->
12:00:43.893 ->  The analog reading of moisture level is 779
12:00:43.893 ->  Moisture : 28%
12:00:44.877 -> 1.pump is off
12:00:44.877 ->
12:00:44.877 -> 2.result of ldr is 4095
12:00:44.877 -> 2.light is off
12:00:44.877 -> It's Dark Outside; Lights status: OFF
12:00:44.877 -> Humidity: 51.30 %      Temperature: 22.80 *C 22.47 *C Sample OK: 22 *C, 51 %
12:00:44.877 ->
12:00:44.877 -> Temperature= 22.80
12:00:44.877 -> Humidity= 51.30
12:00:44.877 -> 3.FAn is off
12:00:44.877 -> 3.heater is off
12:00:48.955 -> Soil Moisture: 28Light Value: 4095=================================
12:00:49.049 -> Sample DHT22...
```

Figure: Serial Monitor in Arduino IDE