International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 10 | Oct 2023 www.irjet.net p-ISSN: 2395-0072

Smart Gardening System Using the Internet of Things

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Abstract - *This paper has been prepared for easy gardening using a lot of advanced technology, The main purpose behind this process is to reduce the manual & and mental pursuer. As we well know soil productivity is the base thing for the growth of plants. The requirements which are basically required are air temperature, humidity, sunlight, soil moisture, and PH factor, etc in this regard this paper has set to improve the condition of the soil and to give proper guidance to the requirements of the farmer. The process that will be included is it will give a better understanding of how each parameter affects the growth of plants. In the absence of the farmer the smart gardening system will provide convenience and comfort to the user, they will get all the information in their phone or email. The smart gardening system will give a big hemisphere to the farmers to check the soil condition accordingly they will enhance to get the proper output from the soil. Not only that they can have the ability to take the necessary steps for a better output. For better output, a sensor system will be input into it. so that they could have a better outlook in this regard. Analise the information received on the mobile and arrange for automatic as required. Here by using microcontroller ESP 32, the information received from the garden sensors will be sent to the gardener through email at specified intervals, so that the gardener can maintain the garden even without being physically present.*

Keywords: **Internet of Things (IoT), Microcontroller-ESP32, Sensors, Smart Garden.**

1. INTRODUCTION:

India is a riverine and agricultural country from ancient times the people of India have been living with agriculture and science. Our India has been taking special care of wildlife including trees, agriculture, and gardens since ancient times. Yet more than half of India's Population is dependent on agriculture, Trees, and Cultivated lands play an important role in agriculture. We need the help of modern science to increase the fertility of agricultural land, using modern equipment to irrigate the land at the right time or to be alert when an unexpected person arrives or protect from other dangers. by using modern programs and modern equipment and storing that information we can take agricultural land to a more advanced level through automatic monitoring and control. So, Agriculture needs modernization to survive global warming This can be done through a smart gardening system.

Using the ESP-32 platform, we can take smart Gardening Systems to the next level of modernity. Microcontroller-ESP-32 is an easy-to-use electronic platform based on software and hardware and it is an open-source platform. empowering users to eventually adapt them to their particular needs ESP-32 boards are able to read inputs of a soil moisture sensor, an air humidity, temperature sensor, etc. The use of microcontroller-ESP 32 platform and Cloud, IoT. It is open source and global demand growth. It can be monitored remotely even if it is not present in the field, this makes the work of the farmer easier. That's why need to properly install microcontroller ESP-32 in the garden first. And I have taken the help of online simulator platform to show smart garden system experimentally in my research paper.

2. INTERNET OF THINGS (IoT):

The Internet of Things or IoT is a network of various sensors or computer devices, it is also a technology that collects some information through communication between mechanical devices and cloud storage and other devices. IoT helps common people to connect with various things anytime from anywhere using internet technology through computer devices or mobile devices. When the data obtained through various sensors is sent to the user from cloud storage or directly through the Internet or Wi-Fi or Bluetooth, the method is called the Internet of Things. In this method, the user can collect information from the home security system, webcam, or various sensors from a remote location, or can operate it or take necessary measures immediately. Another thing that can be said is that IoT basically helps to connect the objects of the virtual world with the real world. It can be said that IoT is an advanced automation analytics technology, that provides a complete system of services with artificial intelligence, various sensors, cloud messaging, network, etc example, it can be said that a

farmer can often get the necessary information about his land through a mobile device without going to his arable land. Again, the current situation of the house is known through the webcam from a distant place. The use of this IoT has also been observed in fire extinguishing systems, that is, if the temperature rises at a significant rate or a fire occurs, then we can take measures to control the temperature or control the fire based on the information received from the sensors from a remote location. Also, the use of IoT has been observed in various fields such as- In factory security, home security, gardening, In terms of fire safety, Transport Location Systems, To controlling smart devices at home. etc.

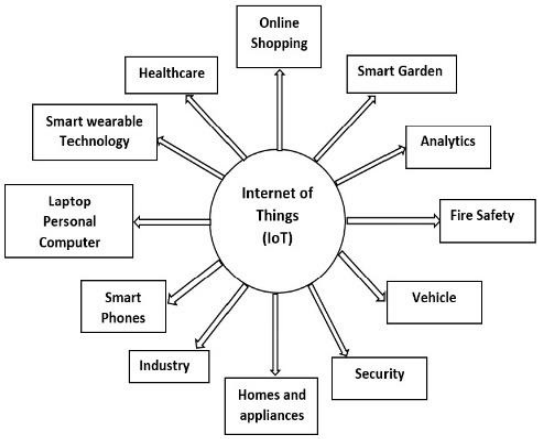


Fig-1: Applications of the Internet of Things.

3. RELATED WORK:

Here we will discuss various methods used in Smart Garden Monitoring Systems.

I. "Tomen: A Plant monitoring and smart gardening system using IoT", by Ramkumar. E, Nagarani. S, Roger Rozario A. P, Arjuman Banu.S in this paper they show the Use of IoT in Smart Automated PiBerry and Pi Platforms, in case of Garden or Garden Plant Monitoring.

To provide information to users or farmers about the health and growth and other conditions of the garden, they first observed the garden and then recorded it, and then sent it to the users through the IoT platform. Here the parameters of the garden are controlled with the help of various temperature, humidity, and light intensity sensors. and these sensors are interfaced with the Raspberry Pi board. In addition, to send data, and store data in the cloud database, the Raspberry Pi system, and sensors are connected to the Internet through a wireless router. But how often the user will get this information is not mentioned here. Some automatic measures are mentioned here, such as the use of sprinklers, and Automation tasks that need to be increased.

II. "Automated Agricultural Monitoring and Controlling System Using HC05 BT Module" Samarth Mehta, Namrata Saraff, Sahil Sawant Sanjay, Shaily Pandey Here they have shown about automation at the beginning for garden maintenance. Then they used a microcontroller board, Arduino, various sensors, an Android application, Bluetooth, and greenhouse parameters. The circuit diagram of the whole project shows the sensors connected to the Arduino board. Here are the sensors that are connected to the Arduino board: Soil moisture Sensor KG003, Temperature Sensor DHT11: Light-dependent resistor LDR: HC-05 Bluetooth module. Not only that, but they have also used the Android app to send garden monitoring information to the user. Not only this, but there is also a system to control an Agricultural Submersible Pump (180-240 Volts) with this app, which can be turned on or off as needed by the farmer by analyzing the data. Bluetooth SPP (Serial Port Protocol) module is mentioned for connection of Arduino board with all sensors and data transfer but in my opinion, using Wi-Fi internet technology along with Bluetooth here will make the work much smoother.

III. "Smart Garden Monitoring System Using IOT" T.Thamaraimanalan, S.P. Vivekk, G.Satheeshkumar and P.Saravanan. A somewhat similar work is shown in this paper. Here also several sensors are connected to the microcontroller unit. These sensors are moisture sensor, humidity sensor, temperature sensor, and ultrasonic sensor. The ultrasonic sensor is connected to a tank of water. These sensors send their data from their fixed location to the node MCU. Here too, an application is used to communicate information to the user. Here, this data is updated through the internet at regular intervals. This application is developed using Android Studio software. Here all garden information is stored in Firebase. A connection is created between the application and Firebase. So that the user can monitor the condition of the garden from anywhere using this application and water the garden using this application.

IV. Design and Implementation of Smart Garden System with Monitoring Based on Android as a Part of Application of Industrial Revolution 4.0 on Agriculture" Imanuel Christian Mauko*, Nikson Fallo,

James Josias Mauta. In this paper, the whole proposed system is divided into three partsInput processing and Output, Sensors are placed at the input, which are connected to the Arduino microcontroller board which is part of the processing unit (hardware part) and finally, output unit to controls the result or to use the water in the garden or operate the pump as required. Bluetooth module is used here for wireless transmission of data. This paper shows system monitoring through an Android application. In other words, by using this application, the user can make a decision by looking at the saved data of the garden. user can give water as needed or stop it.

V. "Automatic Plant Watering System using Arduino UNO for University Park" Yin Yin Nu, San San Lwin, Win Win Maw I found this paper similar work. Here works are done for greenhouse operations in harmony with the environment. Basically, to provide automatic watering from home without workers going to the field frequently. The sprinkler is used for watering as needed Also, almost the same sensors used in the previous paper roll are used here, which are connected to the Arduino microcontroller ATmega328 board. This project is done for watering and monitoring plants in a university park with an automation system for their maintenance. In this method, water is given twice a day. Through programming, the entire project is connected to the Arduino in such a way that it completes the tasks in an automated manner to maintain the garden properly.

4. PROBLEM STATEMENTS:

The old method of irrigating the garden is being used which is costing both energy and time. Unplanned watering of the garden increases water wastage, which results in the depletion of groundwater which is a major problem worldwide. in addition to using the manual method, additional non-essential plants will give rise to parasitic plants which will cause nutrient competition. But here the garden can be maintained from a long distance with the help of a Smart Gardening System. The project of a Smart Gardening System using IoT is basically divided into two parts, one is monitoring and the other is control. Microcontroller-ESP 32 is used as a controller for monitoring and Microcontroller-ESP 32 collects data on the temperature humidity and other conditions of the soil of the garden through various sensors, I have shown the temperature sensor humidity sensor, and Soil Moisture sensor in this paper. In my paper, I have used a garden sample and given three parameters.

5. PROPOSED BLOCK DIAGRAM:

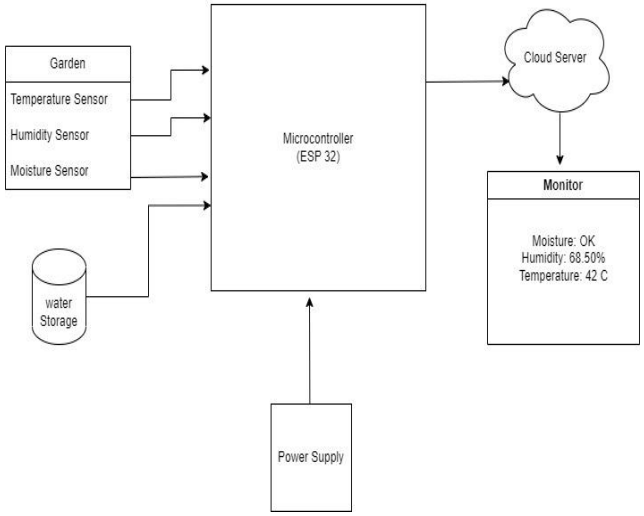


Fig-2: Block Diagram.

6. SYSTEM REQUIREMENTS:

The Hardware and software involved in implementing the above design are as follows-

A. Software Descriptions:

(i) Python: Python is a high-level, general-purpose programming language. It is also called interpreted, interactive, object-oriented programming language. It is used for web development (server-side), software development, and system scripting.

(ii) AWS Lambda: Aws lambda is a Function as a Service (FaaS) product by AWS. This is also called a microservice platform. Lambda can run almost any type of application, as long as the application is not very CPU-heavy. This project uses lambda as a backend server because It requires a rest api which is built using the Node JS framework. AWS claims lambda is very much responsive and highly scalable, which means lambda can handle many more incoming requests. In AWS lambda documentation, it is stated that Lambda can achieve concurrency up to 1000 instances at a time. This project will require hardly 1-2 seconds of computation time for a single request. So it can easily handle more than 500 simultaneous incoming HTTP requests. It is a serverless computing platform provided by Amazon and part of Amazon's web service. In other words, AWS Lambda is an infrastructure that performs multiple functions

including coding, maintenance, automated scaling, and monitoring. AWS Lambda, here it is possible to run code without server management. If you run the code here, you have to pay a charge, otherwise, there is no need to pay any charge. AWS Lambda is a medium suitable for running any type of virtual application.

(iii) AWS API Gateway: AWS api gateway is used to create and expose Rest API URLs, which internally invokes the specified lambda function. API gateway has two options to expose URLs, rest api and web socket. We need rest api because this HTTP call is a one-way connection and does not rely on the server response. Amazon API Gateway is a service designed for computer program developers. Here we can create robust, secure, and scalable APIs easily, publish, maintain and monitor APIs (Application Programming Interface) at any scale, as well as data stored in the AWS Cloud. Here I can create APIs to use my own client applications or make APIs accessible to others.

(iv) Amazon SES: AWS SES is called Simple Email Service. It is an email client service offered by AWS. This service can help to send emails to notify users about the current situation. To send emails to users, a sender's identity need to be verified first, like an email address or a valid activated domain. An email address has been used in this project to send emails. Emails are sent when the sensing values are below or above the specified limit.

(v) AWS SNS: AWS SNS is a notification service; the full form is a Simple Notification Service. Unlike AWS SES, SNS is used to send SMS notifications to the user. This SMS or Email will only be sent to the user when sensing values will reach or exceed a specified limit. AWS provides a Software Development Kit (SDK) to integrate with SES and SNS. Here AWS lambda will send this notification.

(vi) Cloud Server: A Cloud server is an internet technology where users can store and access data from anytime anywhere if an Internet Connection and Computer Device is required. Here users can Store and manage data on remote servers. A Cloud Server is a virtual infrastructure that performs applications data processing and storage.

B. Hardware Descriptions:

(i) Microcontroller-ESP32:- It is an open-source platform. ESP32 is one kind of physical programmable circuit board it is also used in electronic projects. No separate hardware is required to load code on this platform. This is why this platform is so popular among programmers. It also consumes less electricity than other microcontrollers and has integrated Wi-Fi and dual-mode Bluetooth.

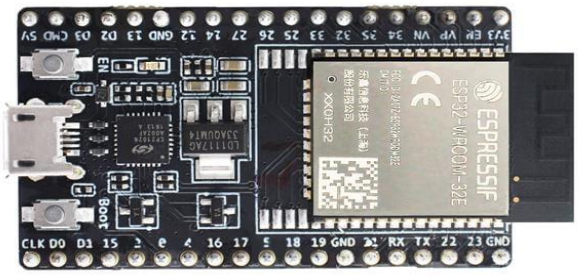


Fig-3: ESP-32 Microcontroller.

(ii) Sensors: In the Smart Garden monitoring system, the two sensors used here are a temperature sensor and a humidity sensor. In my program two more sensors have been added in the name of param 1 and param 2 (Fig-1) the temperature sensor can monitor the amount of temperature rise in the garden and help to control if necessary, using other cooling devices.

- **Temperature Sensor:** A temperature sensor is a device used to measure temperature, be it air temperature or ground temperature, or the temperature of any subject. The sensor consists of a combination of two metals that measure voltage and generate electrical voltage when temperature changes, As the voltage rises or falls, the temperature rises and falls. And it reaches the cloud storage through a microcontroller and then to the user's mobile.

Fig-4: Temperature Sensor.

- **Humidity Sensors:** Humidity sensor senses and measure and reports moisture and air temperature. Humidity sensors work by detecting changes in temperature in the air.

- **Soil Moisture Sensor:** Soil moisture sensors measure soil moisture deep in the soil, The moisture sensor indicator measures the amount of water in the soil and sends it to the user through a microcontroller device.

- **Wi-Fi Censor:** The Wi-Fi Censor is the most convenient and widely used wireless network, it is used to incorporate sectors. A household with four or

more smart Devices opts to have Wi-Fi connectivity. It is an accurate short-range radar technology that picks up object movement from room to room. This sensing system communicates in either infrastructure mode or ad hoc network in forms case, each mode in the sensing system communicates with a central access point. Later, each of the modes communicates with another directly.

(iii) LCD Screen / Monitor: LCD screen or monitor is a device commonly used as an output of computer devices. The current situation can be visualized through this device. Here is also the complete information regarding the garden Report.

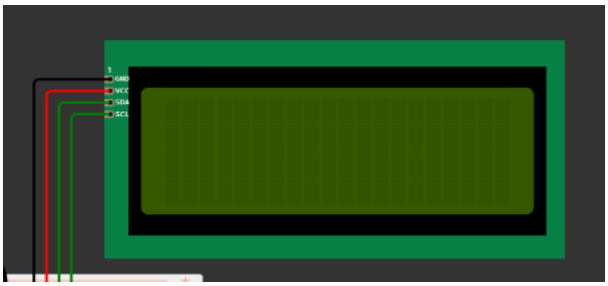


Fig-5: LCD Screen / Output Monitor

(iv) Breadboard: A breadboard is a device used when testing a circuit or an electronic experiment before finalizing it. A breadboard is a device used when testing a circuit or an electronic experiment before finalizing it. This board consists of two parts, the upper part is side by side and the lower part is connected up and down. In various electronics labs or computer architecture labs or make a circuit, users use this board as per their needs.

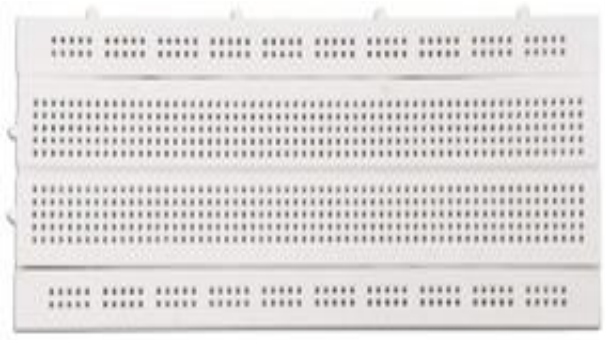


Fig-6: Bread Board.

7. FLOWCHART DIAGRAM FOR SMART GARDENING SYSTEM:

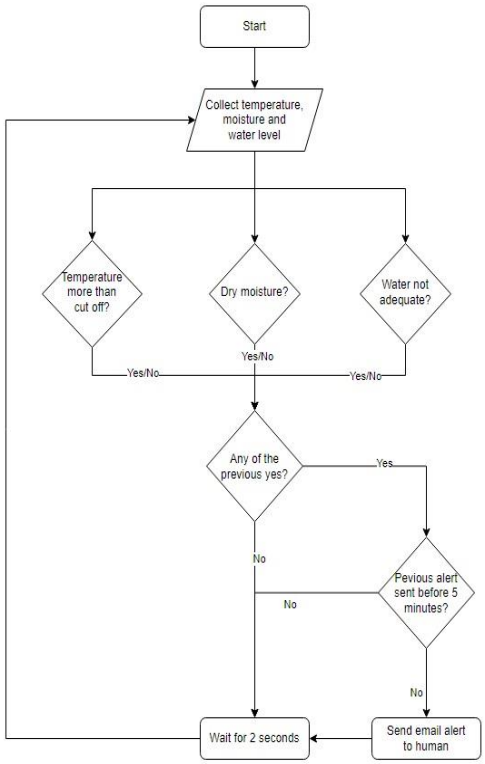


Fig-7: Flowchart Diagram.

8. GRAPHICAL REPRESENTATION OF SMART GARDENING SYSTEM:

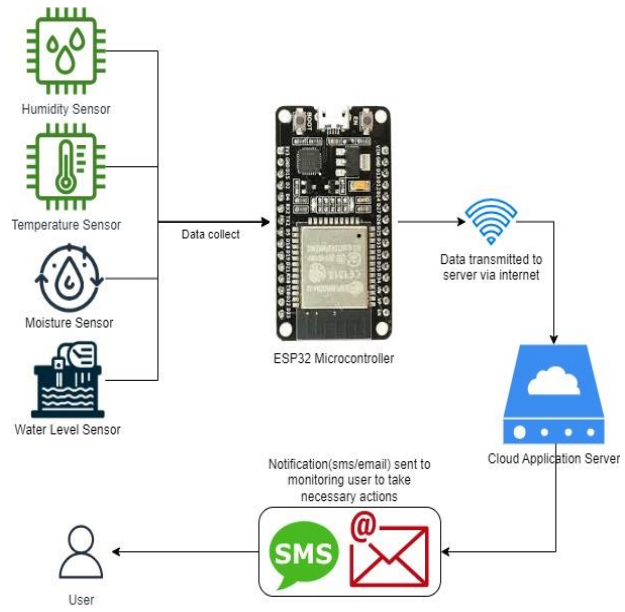
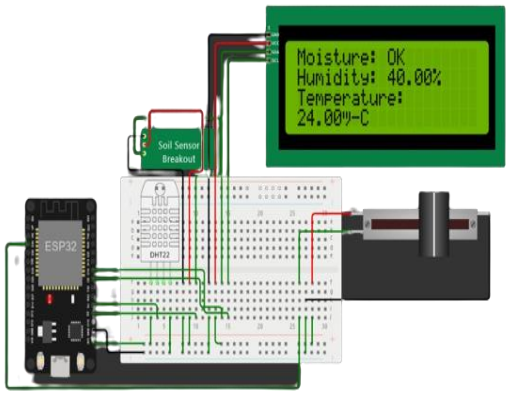


Fig-8: Graphical representation.

9. CIRCUIT DIAGRAM:



a) Sensors- Temperature, Humidity, Moisture, Water Level.
b) ESP32 Microcontroller Board with Power Supply.
c) Internet Connection.
d) Cloud Server
e) Monitor

Fig-9: Circuit Diagram with types of equipment.

10. RESULTS:

```
WiFi connected
IP address: 10.10.0.2
Water level: 0%
Moisture: WET
Humidity: 40.00%
Temperature: 24.00°C
============================================
Sending data...
200
"Recorded!"
Water level: 65%
Moisture: WET
Humidity: 80.50%
Temperature: 40.00°C
============================================
Sending data...
200
"Recorded!"
Water level: 65%
Moisture: WET
Humidity: 80.50%
Temperature: 40.00°C
============================================
Sending data...
200
"Recorded!"
Water level: 65%
Moisture: WET
Humidity: 80.50%
Temperature: 40.00°C
============================================
Sending data...
200
"Recorded!"
```

```
Water level: 65%
Moisture: WET
Humidity: 80.50%
Temperature: 40.00°C
============================================
Sending data...
200
"Recorded!"
Water level: 65%
Moisture: WET
Humidity: 60.50%
Temperature: 30.00°C
```

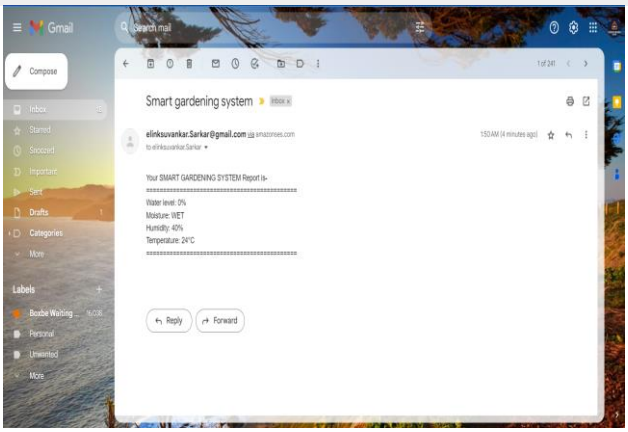


Fig-10: Email Alerts.

11. CONCLUSION:

The proposed approach of smart garden monitoring is based on Node MCU microcontroller, mobile computing, and the Internet of Things. It provides real-time statistics of garden environmental factors, so the local users and gardeners are able to treat their plants in a good manner. Gardeners can easily take care of more plants or fields with the help of a smart garden system. Soil temperature, moisture, and relative humidity are considered environmental factors. Humidity and temperature are the aspects that have been looked at so far in the smart gardening system. This work can take the Smart gardening system to a more technologically advanced level. As shown in this work, the farmer can know the condition of the garden from the comfort of his home via email or mobile message. Much more remains to be done on the project This kind of smart gardening system project will give a lot of opportunities to agricultural countries like India in the future. I have tried in this research paper to show the whole project using online simulator platform. The report shows some parameters and I am thinking of adding more parameters to this project in the future.

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IV. Automated Agricultural Monitoring and Controlling System Using HC05 BT Module Samarth Mehta1, Namrata Saraff 2, Sahil Sawant Sanjay 3, Shaily Pandey4 1,2,3,4 Student (B. Tech EEE), Vellore Institute Of Technology, Vellore, T.N. International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056. Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072.

V. Automatic Plant Watering System using Arduino UNO for University Park. Yin Yin Nu1, San San Lwin2, Win Win Maw3 1Lecturer, Department of Information Technology, Technological University, Monywa, Myanmar. 2Lecturer, Department of Information Technology Engineering, Technological University, Kyaukse, Myanmar. 3Lecturer, Faculty of Computer System and Technologies, University of Computer Studies, Mandalay, Myanmar. International Journal of Trend in Scientific Research and Development (IJTSRD) Volume: 3 | Issue: 4 | May-Jun 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470.

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X. Moisture Sensor: https://eos.com/blog/soil-moisture-sensor/

XI. Moisture Sensor: https://eos.com/blog/soil-moisture-sensor/

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