iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** III **Month of publication:** March 2024

DOI: https://doi.org/10.22214/ijraset.2024.59014

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue III Mar 2024- Available at www.ijraset.com

Soil Moisture Detector

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Abstract: Soil Moisture is directly related to the amount of irrigation in agriculture and influences the yield of crops. Accordingly, a soil moisture sensor is an important tool for measuring soil moisture content. In this study, the previous research conducted in recent 2-3 decades on soil moisture sensors was reviewed and the principles of commonly used soil moisture sensors and their various applications were summarized. Furthermore, the advantages, disadvantages, and influencing factors of various measurement methods employed were compared and analyzed. The improvements presented by several scholars have established the major applications and performance levels of soil moisture sensors, thereby setting the course for future development. These studies indicated that soil moisture sensors in the future should be developed to achieve high-precision, low-cost, non-destructive, automated, and highly integrated systems. Also, it was indicated that future studies should involve the development of specialized sensors for different applications and scenarios. This review research aimed to provide a certain reference for application departments and scientific researchers in the process of selecting soil moisture sensor products and measuring soil moisture.

I. INTRODUCTION

Now a days sensor technology is one of the fastest growing technologies. A sensor is a device capable of detecting a change in the physical or chemical environment which then converts it into electrical signals both
electric current and voltage [1]. Sensor technology is also related to wireless technology, this technology is known as wireless sensor network (WSN). Wireless sensors are standard measurement devices that measure one or more physical quantities and use transmitters equipped with the conversion of measured physical quantities into radio signals and transmit radio signals through a communication model. The radio signal is interpreted by the receiver or electronic instrument which then converts the wireless radio signal into the desired output [2]. The role of wireless sensor technology can be applied in human life to help people obtain information quickly and more accurately. One application that can be done by this technology is in the application of soil moisture sensors. This sensor will provide information about the moisture content in the soil. Wireless sensor network (WSN) is one of the emerging technologies which finds application in variety of fields such as environmental and health monitoring, battle field surveillance, and industry process control [1]. Sensor networks consist of a large number of sensor nodes, which are normally deployed in an ad-hoc manner and they coordinate among themselves to perform a sensing task. The design of a WSN focuses mainly on extending the lifetime of the system since nodes work on battery while energy constraints are secondary criteria to the traditional wireless networks like cellular network.

II. LITERATURE SURVEY

Sandip Khot, Dr. M. S. Gaikwad proposed the Green House Parameters Monitoring System. They have used raspberry pi, Wi-Fi, web server in their system .Light intensity based most of the devices can be controlled. Most of the time to differentiate between day and night time, measuring light from sunlight is essential. Where,
light measurement and analysis is an important step in ensuring efficiency and safety. Plant growth in farming is
purely dependent on the light intensity falling on the top of the canopy. This paper introduces real time remote Light intensity monitoring system using Raspberry Pi which enables the user to track the lighting system in greenhouse remotely for improving plant growth .By gathering all data it uploads to cloud based server from which the data is accessible to the user via wireless internet connection to cloud from smartphone or tablet. Kiran Ganesan,Uzma Walele suggested Raspberry-Pi Based Automated Greenhouse A greenhouse provides an environment to grow plants all year round, even on cold and cloudy days. However, extreme environmental factors inside the greenhouse such as high temperatures and a high humidity can negatively impact the plants. Consequently, controlling this environment is essential in order for the plants to grow strong and healthy. The aim of this project is to design and build a greenhouse controller that can maintain the environment, by acting upon live sensor readings and be able to display the status of the system to the owner.

III. PROBLEM STATEMENT

In agricultural and environmental monitoring applications, accurately assessing soil moisture levels is crucial for optimizing irrigation practices, crop yield, and water resource management. Traditional methods of soil moisture measurement, such as gravimetric techniques and time-domain reflectometry (TDR), are often labor-intensive, time-consuming, and limited in spatial coverage. Additionally, existing soil moisture sensors based on capacitive or resistive principles may suffer from drift, calibration issues, and susceptibility to environmental factors like temperature and soil salinity. Therefore, there is a need for an innovative soil moisture detection system that overcomes these limitations by providing reliable, real-time measurements with high accuracy, minimal maintenance, and cost-effectiveness. This problem statement aims to address the design and development of a novel soil moisture detector that integrates advanced sensor technologies, data acquisition methods, and data processing algorithms to deliver accurate and actionable soil moisture information for precision agriculture, environmental monitoring, and water resource management applications.

IV. PROPOSED METHODOLOGY

The proposed model proficiently screens climatic parameters and intelligently regulates the climate parametric values (using sensors, attached output devices, Arduino, Soil mature sensor) to capitalize crop yield and enhance the production. The real-time instantaneous status of soil can be seen on LCD. This study consists of several steps that begin with data collection which was done automatically through the sensor. For more details about the input and output processes of the application system will be illustrated through the general architecture that can be seen in Figure.

A. The Sensing Module

The sensing unit as shown in fig. 1 is responsible for harvesting the moisture content of the soil at a particular time. The system consists of three sensor unit boxes for three crop species and each sensor box consists of a network of five Soil Moisture Sensors, an Arduino UNO Microcontroller (Slave Arduino) and a Nrf24L01+ transceiver. The soil moisture is measured using the Probe- type Soil Moisture Sensor. The sensor gives out a value usually between the range of 420 and 1023 based on its architecture and moisture content. The Sensing Units establishes a wireless serial communication with the Master Arduino (actuating unit) via the Nrf24L01+ communication transceivers. Power is supplied to this unit by a 9 Volts D.C. battery.

B. Soil-Moisture Sensors

This device is used to approximately determine the moisture content of the soil based on the dielectric constant (soil bulk permittivity) of the soil. Precise water content measurements of the soil are essential for grasping the concepts of chemical as well as organic course in the roots of plants as well as in the vadose zone.

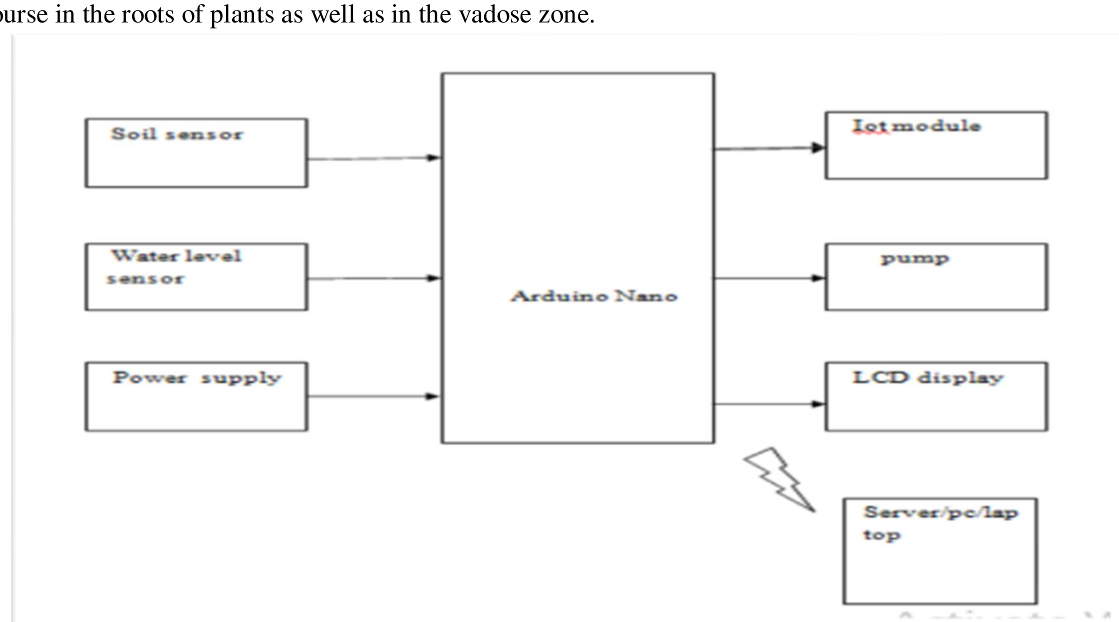

Fig. Block Diagram

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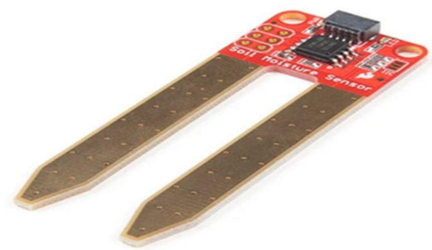
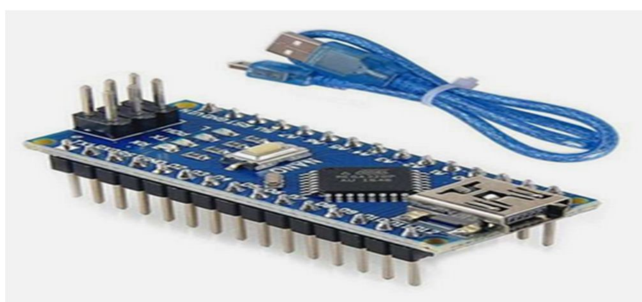
V. COMPONENTS USED

A. Soil Sensor



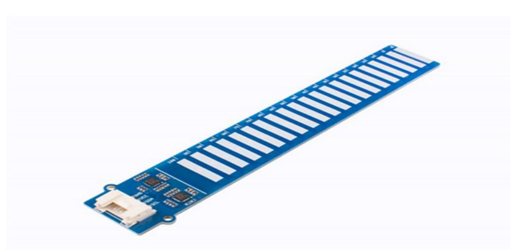
A soil sensor, also known as a soil moisture sensor or soil moisture meter, is a device used to measure the moisture content of soil. These sensors typically consist of probes or electrodes that are inserted into the soil, where they detect the electrical conductivity or dielectric properties of the soil, which vary with moisture content. Soil sensors provide valuable information about soil moisture levels, allowing farmers, gardeners, and environmental researchers to make informed decisions about irrigation, plant health, and water management. They are widely used in agriculture, horticulture, and landscaping.

B. Arduino Nano



The Arduino Nano is an open-source breadboard-friendly microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery. The Arduino Nano is a microcontroller-based device with 16 pins that can be used for various purposes. It can be used for almost every task, from minor to massive industrial-scale projects. It can also be used for prototyping and developing new applications.

C. Water Level Sensor

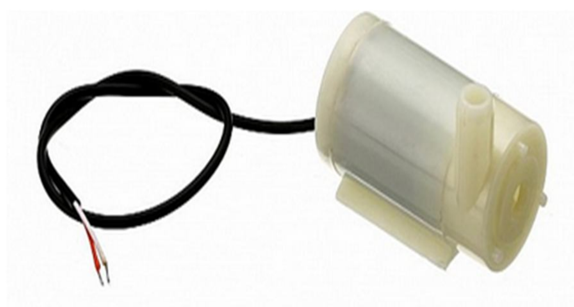


A water level sensor is a device used to detect and measure the level of water in a container, reservoir, or other water-containing structure. It typically consists of probes or electrodes that are placed at different heights within the container. When water comes into contact with these probes, it completes an electrical circuit, allowing the sensor to detect the presence and height of the water level. Water level sensors are commonly used in various applications, including water tanks, sump pumps, industrial processes, and environmental monitoring systems, to ensure proper water management, prevent overflow or leakage, and control water-related processes.

D. IOT Module

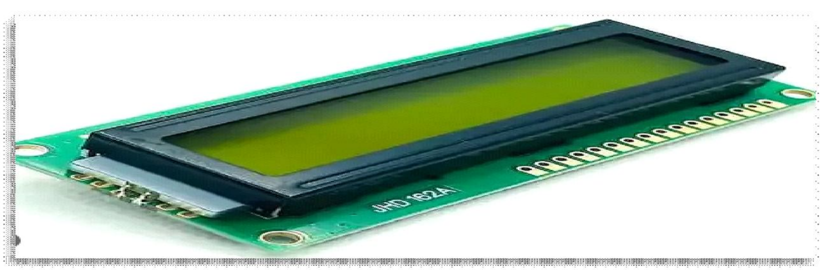
The IoT module is a compact electronic device designed to connect physical objects to the internet. It includes sensors, communication interfaces, and processing capabilities like microcontrollers and wireless modules (e.g., Wi-Fi, Bluetooth). These modules collect data from their surroundings, transmit it over the internet to a central server or cloud platform, and can receive remote commands or updates. With applications in smart homes, industrial automation, healthcare, and environmental sensing, IoT modules facilitate connectivity, data exchange, and remote control of devices and systems, making them integral to the Internet of Things ecosystem.

E. Pump



The pump in a soil moisture detector serves to regulate soil moisture levels by either adding water when dry or removing excess water when wet. Controlled by a microcontroller, it responds to soil moisture levels detected by embedded sensors. When moisture falls below a set threshold, indicating dryness, the pump activates to supply water. Conversely, if moisture surpasses a defined limit, indicating overhydration, the pump may extract excess water. This regulation ensures soil moisture remains within optimal levels for plant growth or other applications.

F. LCD Display



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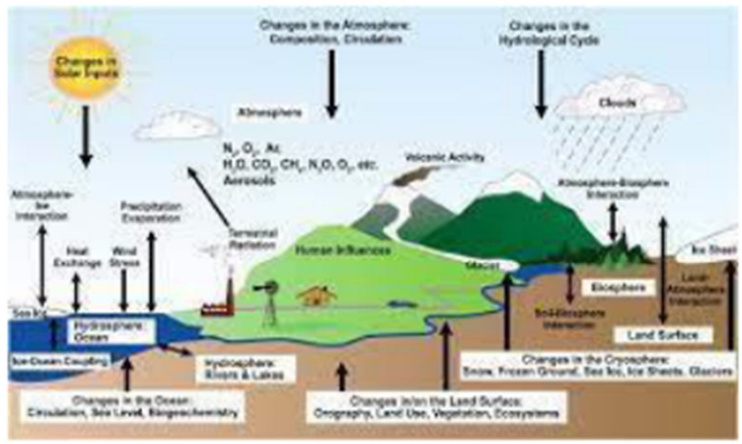
LCD stands for Liquid Crystal Display. It is a flat-panel display technology that uses liquid crystals to produce images. In an LCD, liquid crystal molecules are sandwiched between two transparent electrodes and two polarizing filters. When an electric current is applied to the electrodes, the orientation of the liquid crystal molecules changes, altering the passage of light through them. This controlled light modulation creates images or text visible to the viewer. LCDs are commonly used in devices such as televisions, computer monitors, smart phones, and digital clocks due to their lightweight, compact size, and energy efficiency.

VI. APPLICATIONS

Some of the applications are:

- Numerous research applications
- Agricultural science
- Climate researches
- Used in Environmental science



VII. CONCLUSION

The proposed model explores the use of IoT (Internet of things) in the agriculture sector. This model aims at increasing the crop yield by helping in predicting better crop sequence for a particular soil. Thing speak helps in real time sampling of the soil and hence the data acquired can be further used for analyzing the crop. We have also taken many readings of the soil moisture, temperature and humidity of the environment for various days at different times of the day.

Data on the cloud also helps the agriculturists in improving the yield, evaluating the manures, and illness in the fields. This system is cost effective and feasible. It also focuses on Soil Moisture Detection And Monitoring Through Iot optimizing the use of water resources which combats issues like water scarcity and ensures sustainability. This model focuses on the utilization of IoT in agriculture and the solutions proposed in this paper will improve farming methods, increase productivity and lead to effective use of limited resources.

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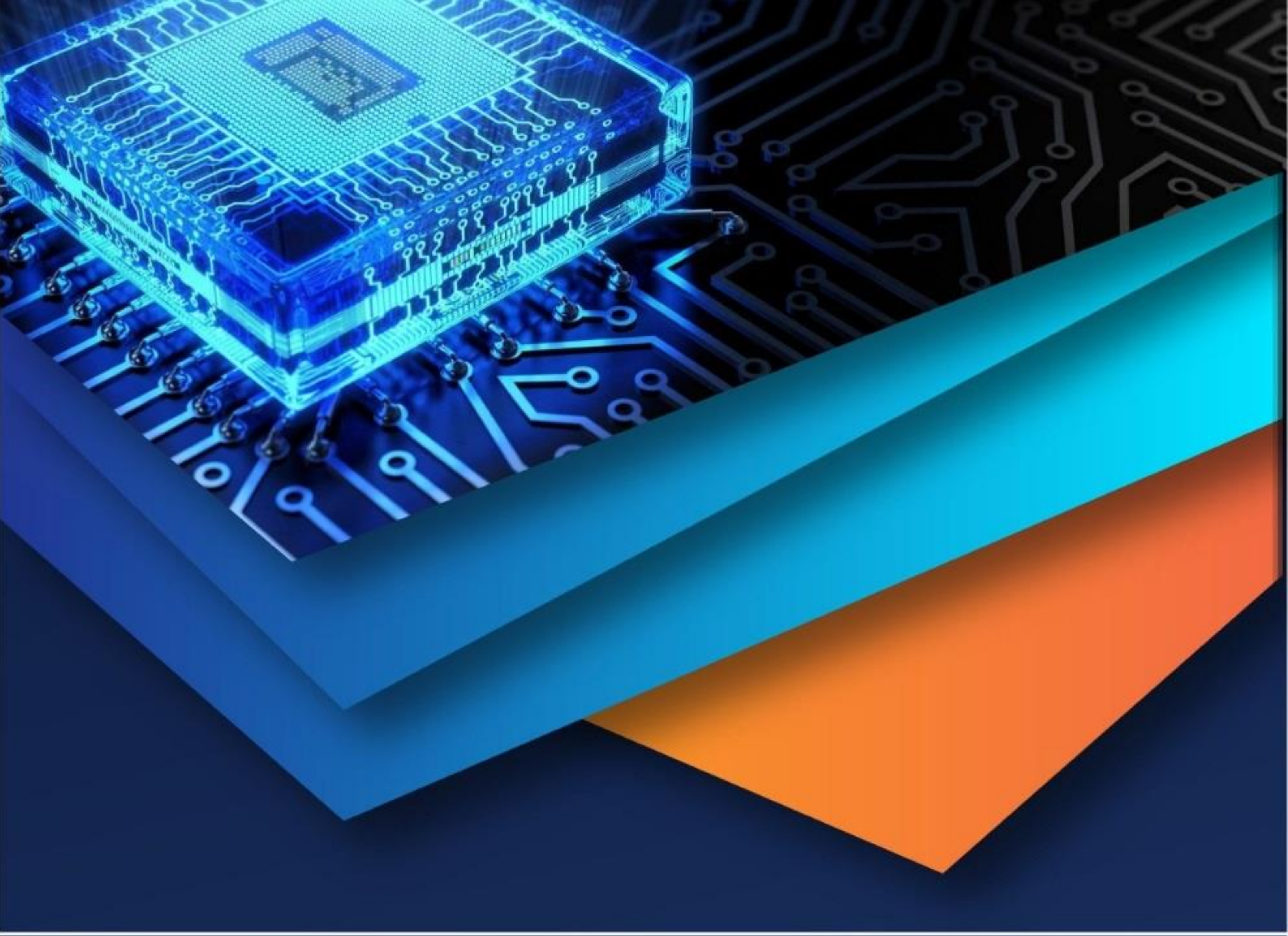

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