KIT-KALAIGNARKARUNANIDHI INSTITUTE OF TECHNOLOGY COIMBATORE - 641 402
AN AUTONOMOUS INSTITUTION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IOT BASED SOIL NUTRIENT ANALYSIS

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ABSTRACT :

The agricultural yield primarily depends on soil fertility, the moisture level of soil and use of appropriate fertilizers. In the current scenario, the manual method of measuring the soil nutrients is less accurate because of the time difference of soil sample collected at the field and when it is measured in a laboratory. It be comes necessary to create a smarter agriculture practice through Internet of Things(IoT) to address this challenge. Soil nutrient analysis using wireless sensor networks (WSN) enables various application like remote monitoring of soil fertility,analysis, provide a selection of crop and build irrigation decision support system. This project focuses on developing an Internet of Things (IoT) system for real-time soil nutrient analysis, aiming to empower farmers with actionable insights for optimized crop management

OBJECTIVE :

- Continuously track soil conditions such as moisture, pH, and nutrient levels to provide up-to-date information on soil health.
- Optimize the use of fertilizers and other soil amendments by providing precise recommendations based on real-time data, thus improving crop yield and reducing wastage.
- Enhance the efficiency of resource use, such as water and fertilizers, by tailoring applications to actual soil needs rather than broad-based methods.
- Promote sustainable agricultural practices by reducing the overuse of chemicals and minimizing environmental impact.

LITERATURE SURVEY

Title	Author	Year	Publication	Methodology	Summary
IoT Based Soil Content analysis	Vidhya.P Ninshiya Mary.J	2023	IJSETR	the study "Monitoring of Soil Nutrients using IoT" involves the integration of various sensors to monitor key soil parameters such as nitrogen, phosphorus, potassium, pH levels, and moisture content.	The paper develops an IoT- system using sensors to monitor soil nutrients in real-time, enhancing precision agriculture and sustainable farming.
Soil nutrient identification using arduino	R.Sindhuja	2021	AJAST	The methodology involves using Arduino to interface with sensor that detect soil nutrients, including pH, moisture, and NPK levels. Data is collected, processed, and analyzed to assess and monitor soil health.	The paper presents an Arduino-based system for detecting soil nutrients, enabling real-time monitoring and improving soil management practices.
Automated irrigation system using IoT	M. Sandhiya, R. Abirami	2020	IRJET	The methodology involves using IoT sensors to measure soil moisture and weather condition, with data analyzed to automate irrigation, optimize water usage	The paper describes an IoT-based system that automates irrigation by using soil moisture and weather

EXISTING SYSTEM:

- **Soil Sampling**: Soil samples are collected from field and sent to a laboratory for analysis.

- **Chemical Analysis**: Laboratories use various chemical methods to determine nutrient levels in the soil, including:Spectrophotometry: For detecting specific nutrients like nitrogen, phosphorus, and potassium.Atomic Absorption Spectroscopy (AAS): For micronutrient analysis like zinc, copper, and iron.Ion Chromatography: For analyzing anions and cations in the soil.

- **Soil Testing Kits:** Some labs provide portable soil testing kits that allow for on-site analysis but with less accuracy than full lab tests.

- **Portable Soil Test Kits**

1) Colorimetric Kits: These kits use color change reactions to indicate the presence of specific nutrients. The intensity of the color is compared against a chart to estimate nutrient levels.

2) Digital Testers: Portable devices that provide digital readouts for pH, moisture

PROPOSED SYSTEM:

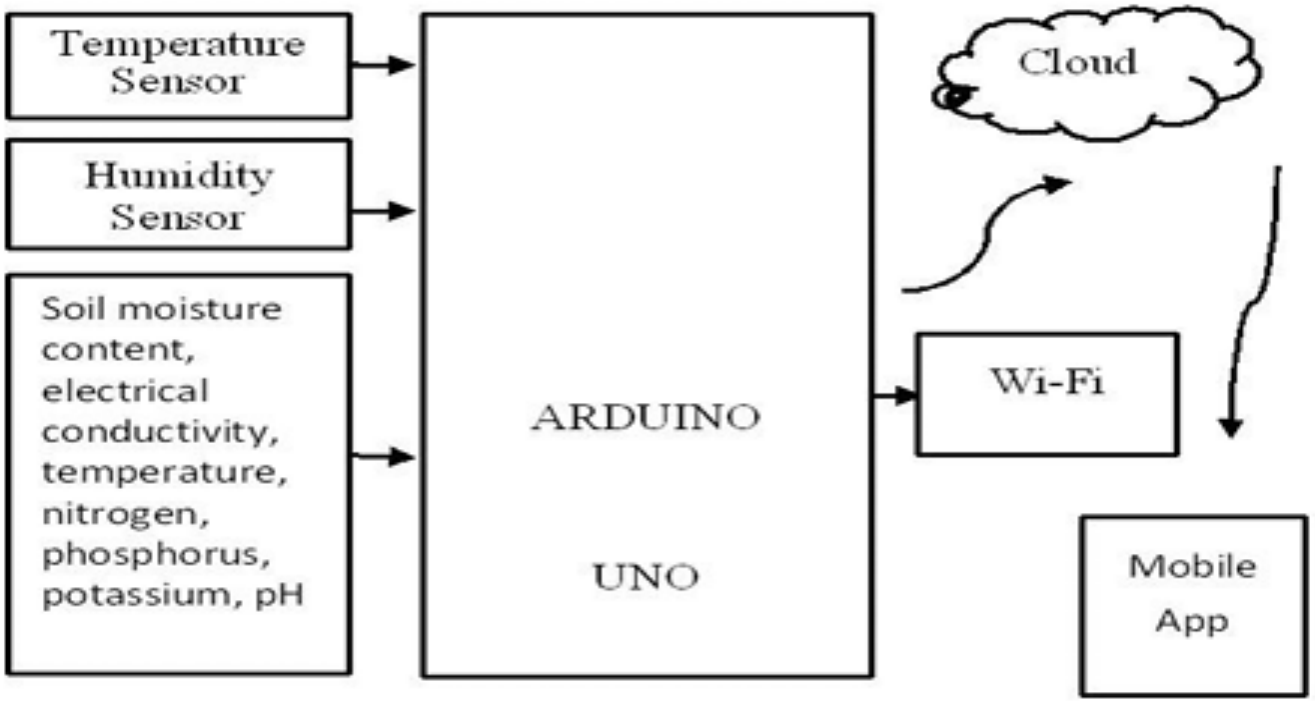
- The proposed system aims to determine the nutrient content of soil to assess its suitability for crop growth by identifying soil type and analyzing nutrient levels.

- Sensors are used to measure key soil nutrients like **Nitrogen, Phosphorus, Potassium (NPK), Moisture, Temperature.** The collected data helps determine the soil's fertility and suitability for different crops.

- The data is transmitted using a **ESP-32 Module** to compare nutrient levels against standard thresholds, and analytical algorithms determine nutrient deficiencies or excesses.

- A detailed report is generated indicating **soil type, nutrient content**. The results are displayed through a **mobile application (IOT Remote)** for farmers or agricultural experts to make informed decisions.

BLOCK DIAGRAM :



COMPONENTS	WORKING
Arduino nano Board	The Arduino Nano serves as the main processing unit. It takes readings from the sensors via its analog or digital input pins and processes this data.Here we use it to collects the data from sensors and transmits the data to esp-32
ESP-32 Module	The ESP32 can serve as a powerful and flexible microcontroller with built-in Wi-Fi and Bluetooth capabilities. The ESP32 can be used to read data from soil sensors, process it, and then transmit the data to a cloud platform or a remote server for analysis.:
NPK Sensor	an NPK sensor assessing the soil's nutrient content of Nitrogen (N), Phosphorus (P), and Potassium (K), which are the primary nutrients essential for plant growth. These three nutrients are fundamental to the health of plants and need to be monitored and managed effectively, especially in precision agriculture or smart farming systems.

COMPONENTS	WORKING
Soil moisture sensor	the moisture sensor plays a crucial role in assessing the soil's water content, which is an important factor that affects the availability of nutrients to plants. Proper soil moisture levels are essential for optimal plant growth, nutrient uptake, and overall soil health.
Temperature sensor	the temperature sensor plays a significant role in assessing the soil temperature, which is an important environmental factor that impacts plant growth, nutrient availability, and soil microbial activity. Soil temperature influences various physiological processes in plants, including seed germination, root growth, and the uptake of nutrients.
RS485 Module	It allows multi-drop connections, meaning multiple sensors or devices can be connected on the same RS485 bus. RS485 is a half-duplex or full-duplex serial communication protocol.

IOT CLOUD REMOTE

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Access your dashboards from anywhere at any time.

Real-time device monitoring and control

Control your devices and get a clear picture of their real time status and history with our insightful widgets and your custom optimized view for your phone.

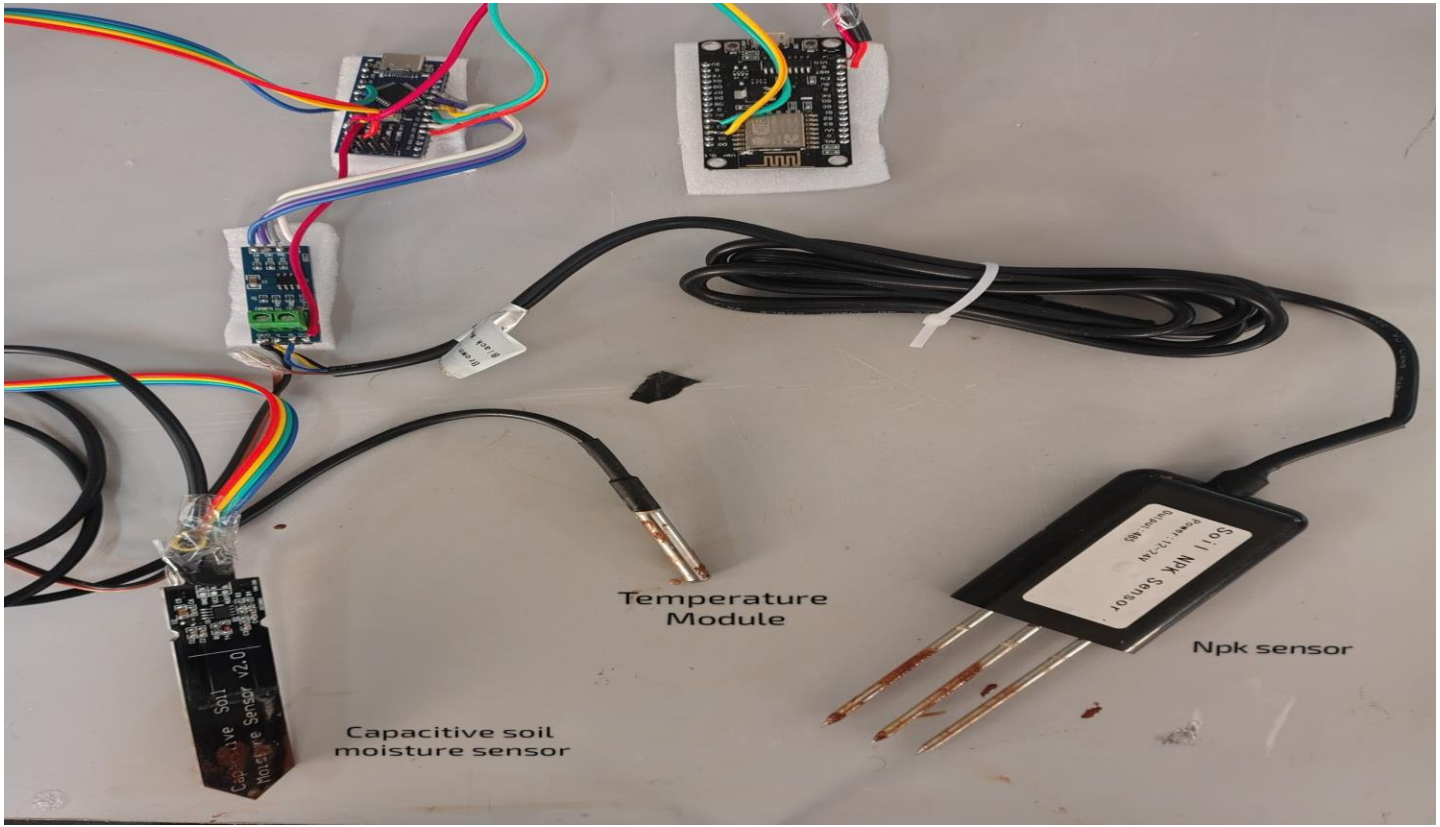
Enjoy the simplicity

User-friendly interface that simplifies the management and control of your devices. With everything organised, you can easily navigate and monitor the status of your devices and sensors in real-time.

Unlock a whole new side to your smartphone

Enable the “Phone Device” to populate your phone’s sensors data to the Arduino Cloud and use it in your projects.

RESULTS:


Temperature
Module
Npk sensor
Capacitive soil
moisture sensor


PHOSPHOROUS
15D
7D
1D
1H
LIVE
99
25 Nov 10:52:26
110
105
100
95
90
85
10:50
10:51
10:52
10:53


MOISTURE
10:52
47%
15D
7D
1D
1H
LIVE
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79.75
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POTASSIUM
15D
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LIVE
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10:52


NITROGEN
15D
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1D
1H
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164
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162
161.5
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10:52


PHOSPHOROUS
15D
7D
1D
1H
LIVE

RESEARCH GAP :

- There is a need for research on improving the accuracy and reducing the calibration frequency of IoT-based soil nutrient sensors. Current sensors often require regular maintenance to ensure precise measurements, which can be a barrier to widespread adoption

- Most IoT systems for soil nutrient analysis have been tested in small-scale or controlled environments. Research is needed to evaluate how these systems perform in large-scale and diverse agricultural settings, such as different soil types, climates, and crop systems.

- IoT devices in agriculture often face energy constraints, especially in remote areas. Research into energy-efficient communication protocols and low-power sensors, as well as renewable energy sources like solar power, is crucial to ensure the sustainability of these systems.

- As IoT devices collect and transmit sensitive data, there is a significant need for research on secure data transmission and storage protocols to protect farmers' information from unauthorized access or misuse. This aspect is often underexplored in agricultural IoT research.

CONCLUSION :

An IoT-based soil nutrient analysis system revolutionizes agriculture by enabling precise and real-time monitoring of soil health. Through sensors for NPK, pH, and moisture, combined with wireless communication and cloud computing, this system provides actionable data to optimize farming practices. It helps in efficient fertilizer application, reducing waste, and enhancing crop yields. The integration of a user-friendly interface allows remote monitoring and decision-making, making it accessible to farmers and agricultural professionals. By promoting sustainable resource usage and improving productivity, this technology addresses the challenges of modern agriculture, ensuring better environmental stewardship and economic benefits for the farming community.


Thank
you!