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SOIL ANALYSIS AND SEED RECOMMENDED SYSTEM

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***Abstract**:* A smarter farm innovative gadget powered by Arduino microcontroller and mobile app technology is a key part of contemporary agriculture in the modern world the system innovation comes in handy during times of crisis when individuals engage in home gardening as a means to supplement food availability or as a method of promoting mental and physical wellness application of these technologies is to facilitate best farming practice by monitoring soil ph and moisture levels and offering accurate and reliable information to farmers qualitative and experimental approach was employed with an iterative waterfall strategy in the accomplishment of both system and user requirements arduino microcontroller was employed as the central point for hardware and software integration pivotal features such as ph probes humidity sensors and the esp8266 wifi module supported real-time data collection the development environment consisted of embedded studio c nodejs embedded and db browser for sql to build a secure and interactive mobile application the system named pantone demonstrated scalability and sagacity in offering insightful agricultural information agricultural sustainability is typically compromised by intensive cropping which depletes soil nutrients as a consequence of this an electrochemical sensor was utilized to track the ph and significant nutrients in the form of particularly nitrogen phosphorus and potassium by acquiring ions from solution soils Arduino-based integrated circuits successfully identify deficiency in nutrients compared to conventional methods the proposed algorithm found to be precise with improved recall precision and f-score with minimal training farmers can simply access and handle soil data through cloud services with the assistance of the iotsna-cr device which increases productivity and reduces the cost of nutrient management.

***Index Terms* -**IOT Devices using Arduino Board, pH sensor, LCD, Cloud Computing.

I. Introduction

Information and Communication Technologies (ICTs) are transforming agriculture by enabling faster, more efficient, and data-driven farming systems. With growing industrialization and technological progress, modern farmers now have access to tools that help them monitor activities and enhance crop yields effectively. The COVID-19 pandemic saw many individuals adopting backyard farming for both sustenance and mental well-being, highlighting the role of technology in supporting sustainable agriculture. Today's agricultural systems incorporate mobile-based platforms and sensors to monitor environmental and soil conditions, aiding in the selection of suitable crops for specific land, optimizing resource use, and exploring alternative farming methods. Since soil quality—affected by pH, moisture, and nutrient levels is vital for crop growth, sensors now track key indicators such as pH (acidic: 1–6.0, neutral: 6.1–7.9, alkaline: 8.0–14), nitrogen (N), phosphorus (P), potassium (K), temperature, and water content. This data supports precision farming and improves crop forecasting by aligning crop requirements with environmental conditions. However, deploying such technology involves significant investment, technical know-how, and consistent maintenance.

II.IMPLEMENTATION

1. Arduino (Arduino Uno R3)

Arduino Uno is an ATmega328P-based microcontroller board that serves as the system brain, accepting input from sensors and providing control outputs (such as LCDs or motors). It can be programmed over USB and is suitable for embedded systems prototyping

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2. pH Sensor

A pH sensor detects the alkalinity or acidity of liquids or soil. In soil test or agriculture projects, it assists in detecting the pH level of the soil, which is important in deciding on the appropriate crop and fertilizer.

3. LCD Display

An LCD (Liquid Crystal Display) is employed to display information visually, e.g., sensor readings or system messages. A 16x2 LCD is often employed to display values like pH level, moisture content, or system status directly to the user.

4. Soil Moisture Sensor

This sensor measures the water level in the soil. It assists in the measurement of soil dryness or wetness, giving information that can be used to automate irrigation or notify farmers when watering is required.

III.EXISTING SYSTEM

The envisioned IoT-based precision agri-food systems are focused towards increasing the crop yield by observing the most crucial environmental factors including temperature, humidity, soil water content, pressure, air conditions, pH, and conditions of the fields. The systems deploy sensors like DHT11, BMP180, soil moisture probes, pH probes, and cameras with microcontrollers like Raspberry Pi B+ and Raspberry Pi 2, which are selected as they are faster compared to Arduino. Other models use Arduino UNO as it is affordable and get programmed with Python, MATLAB, or Arduino IDE. Apps built for the Think Speak platforms enable monitoring in real time, with farmers being able to view remotely. Machine learning, pest identification through image processing, and automating irrigation systems according to the moisture levels in the soil lessen labor and enhance the utilization of resources. Future improvements include the incorporation of alarms or LEDs for immediate notification and other sensors such as PIR and wetness sensors for leaf monitoring to provide better monitoring. These systems not only assist in pest and insect control but also enhance irrigation efficiency, conserve water, and enhance overall productivity. With remote monitoring using Android and iOS applications, farmers are able to monitor and guard crops anywhere they may be, reducing time and money while increasing yield through timely and informed decision-making.

Disadvantages

- High initial investment in sensors, devices, and apps can be unaffordable for small farmers.
- Technical training might be required for farmers to learn about and utilize IoT data.
- Devices require power (electricity or batteries), which can be a problem in remote locations.
- Lack of or poor internet connectivity in rural locations can impact data transmission and system performance.

IV. PROPOSED SYSTEM

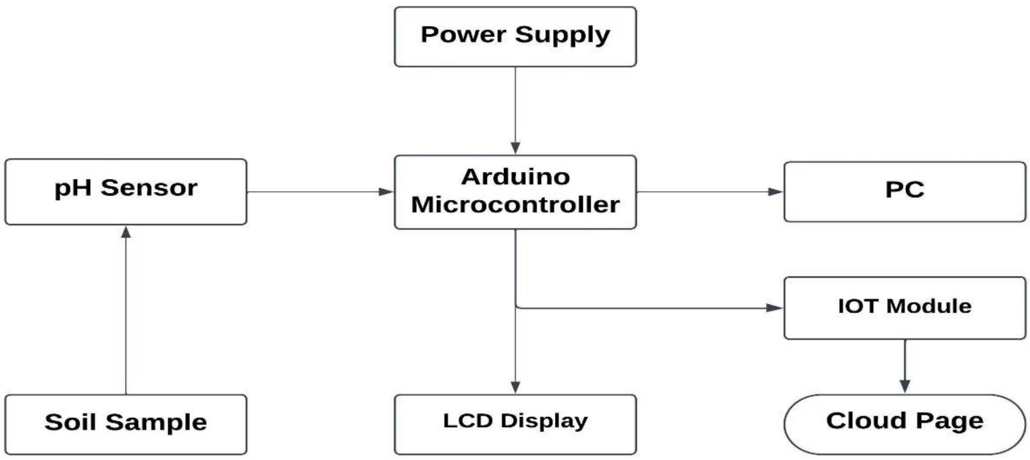
The IoT SNA-CR model employs sensors to obtain pH, NPK, temperature, and soil moisture information that assists it in providing precise crop recommendations. Linear SVM, kernel SVM hybrid method, and decision trees categorize the soil based on these information. The model employs a Multi-class SVM (MSVM) model, and Fruit Fly Optimization (FFO) is utilized to select the optimal kernel function for increased accuracy. This model was tested with benchmark datasets and demonstrated good performance. The crop recommendation system not only gathers data from sensors but also aids in its correct analysis, thus enabling easy selection of appropriate crops in relation to soil nutrients**.**

Advantages

- Real-time IoT sensor-based pH,temperature, and moisture feedback for perfect testing of the soil.
- FFO on MSVM provides soil classification and crop recommendation based on nutritional requirement.
- Farm decision-making and soil analysis are aided by machine learning (linear SVM, kernel SVM, decision trees).
- Farmers access and use soil data from remote cloud storage through mobile applications

V. SYSTEM ARCHITECTURE

A directed acyclic graph and fruit-fly optimization-based parameter optimization are employed in a given manner for MSVM-based classification. The aim of the overall process in this case is to achieve the shortest distance to the hyperplane in such a manner that data point distance is maximized. In our case, we split the multiclass SVM into numerous binary classifications: one vs. rest. A direct acyclic graph is employed in implementing the binary SVM models. In this paper, MSVM model was optimized by the FFO algorithm. We compared the new technique with the traditional techniques such as decision trees, SVM kernel models, and linear support vector machines (SVM). We saw that the FFO method could potentially be used in a broad variety of classification problems in order to select the best kernel function. Compared to other methods, the MSVM with FFO permitted us to identify the soil minerals and suggest the suitable crops with more precision.



VI.TECHNOLOGY

1.Internet of Things (IoT)

IoT is a network of physical objects with sensors, software, and connectivity that gather and share data. It provides remote sensing and control, enhances efficiency, and facilitates smart applications such as smart grids and smart cities. Examples are wearable health devices, smart appliances, and environmental sensors.

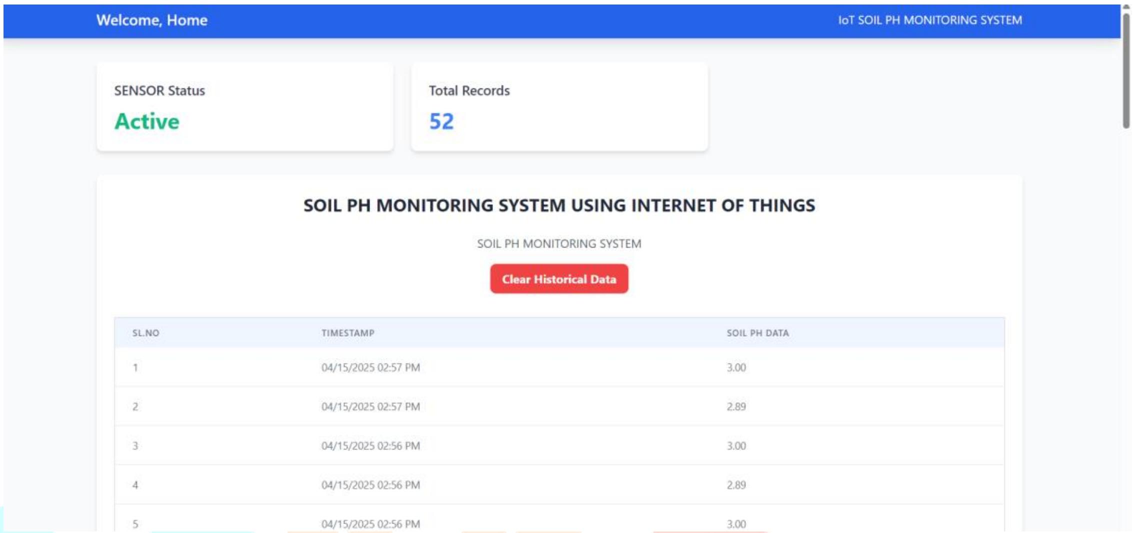
2.Wireless Sensor Network (WSN)

WSNs are made up of scattered nodes that sense conditions such as temperature, movement, or contaminants. Initially designed for military applications, they are currently applied in fields such as healthcare, home automation, and environmental monitoring. Each node generally consists of sensors, a microcontroller, wireless communication, and a power source.

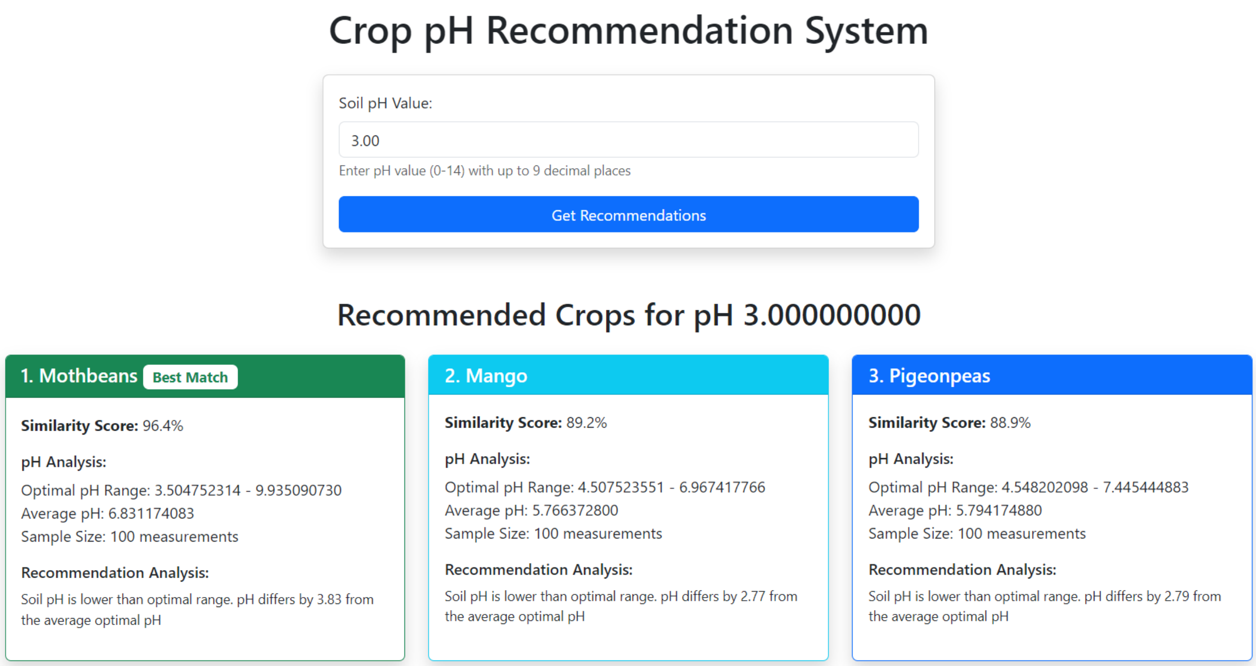
3.Cloud Computing

Cloud computing offers on-demand access to pooled computing resources via the Internet. It offers storage, processing, and data management using other people's servers in the Internet, lowering expenses and increasing scalability. Cloud services offer rapid provisioning with little administrative effort.

VII. DEMONSTRATION OF PROJECT



Ph Level Monitoring System



Crop Recommended System

VIII.CONCLUSION

IoTSNA-CR model detects soil nutrients, moisture, temperature, and pH level in real-time, which are verified and stored soil data at low-cost cloud center. This keeps them updated in terms of soil status and suggests crops. MSVM-DAG-FFO process indicates conversion and assessment of pre-processing data to suggest best crops. An in-situ program offers access to the cloud data to certain kernel functions with enhanced crop forecasts via the FFO algorithm. Experimental outcomes on real data for four crops across five time steps showed higher accuracy and the model attained an accuracy of 0.969. It provides an ideal method of soil health observation and crop selection in addition to assisting the farmer during crop selection based on nutrition, as well as application.

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