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Soil Fertility Detection For Crop Recommendation

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***Abstract:** Technological advances in agricultural process have changed from traditional methods to automated methods to achieve productive yield. Thus, suitable climatic and soil conditions are tested to maximize performance. Agricultural parameters are monitored to improvise the quality and quantity of agriculture. An important parameter is soil fertility, which is the proportion of nutrients in the soil necessary for cultivation. Determine the average percentage of essential nutrients (e.g. nitrogen, phosphorus, and potassium) and determine the appropriate crops for a given soil type. The proposed system analysis soil nutrient concentrations in real time and prepares a yield forecast. The system predicts humidity, humidity and temperature values based on historical data through sensors. Yield prediction involves many factors, including biological \properties, soil properties, and environmental conditions.*
***Keywords:** SVM, Random Forest, LSTM, K-NN, K-Means, Crop Prediction, Soil Fertility*

I. INTRODUCTION

Agriculture plays a momentous function in the Indian economy. Conventional methods of agriculture have been practiced in India, which involve the utility of manpower to bear not with diverse agricultural activities such as cultivation of crops, irrigation of fields, application of suitable fertilizers etc. Suitable climatic and soil conditions are tried to maximize naturalness. Agricultural parameters are monitored to improve the agricultural production. Soil analysis is a very important part for farmers that determines all the inputs needed for economical and efficient production. A correct soil analysis ensures that plants need enough fertilizers. An important parameter is the fertility of the soil, at a distance which the soil contains the specific amount of nutrients necessary for plant growth. Soil fertility is monitored by measuring soil PH. Important nutrients such as potassium (K), phosphorus (P), nitrogen(N), and soil moisture and moisture are common soil properties that are measured. The proposed system analyses soil nutrient concentrations in real time and makes yield predictions. Automated agricultural practices reduce human errors by monitoring soil quality with soil sensors. The most important thing is to determine and predict the crops suitable for the current soil condition using various parameters. Yield prediction involves factors that include biological characteristics, soil characteristics, and environmental conditions. This system uses variable algorithms to estimate the past growth rate of crops on a given land type. Modern farms and agriculture make a huge difference from many decades ago, mainly due to advances in technology., sensors, devices, machinery, and information technology.

Today's agriculture typically uses advanced technologies such as robots, temperature and humidity sensors, aerial imagery, and GPS technology, along with many sophisticated IoT devices. This advanced agricultural equipment allows businesses and farmers to be more productive, efficient, safer, and eco-friendly. The rise of digital agriculture and its connected technologies has opened a wealth of latest knowledge opportunities. Remote sensors, cameras, and alternative attached devices will contain information twenty-four hours per day over a complete farm or land.

These will monitor plant health, soil condition, temperature, humidity, etc. the quantity of information these sensors will generate is overwhelming. This enables farmers to achieve a best an improved understanding of state of matters on the bottom through advanced technology which will inform them additional regarding their situation more accurately and quickly. Agriculture field is rising crisis to India's economy. In recent years, due to industrialization and the widespread use of pesticides, soil strength has weakened. Many agricultural practices are not sufficient to increase production.

A typical fight faced by Indian farmers is the lack of knowledge about suitable crop which depends on their location. Because of the soil demand, it affects the production. Farmers in India face several hurdles in deciding which agricultural technology to use and which crop to choose. The most public problem faced by farmers in India is the selection of the right plants to maximize their yield. Maximize yield depending on topographical and economic factors. Maximize yield in agriculture. The purpose of production is to control costs.

II. LITRETURE SURVEY

[1] A study custom of the R.F.A looked at crop growth in relation to different climatic conditions such as dry spells, temperature changes and biophysical changes. Data gathering from different sources was used for train and test. The Random Forest algorithm has been found to outperform other methods in accurately predicting crop yields. [2] An advanced system called Argo Consultant has been proposed to help farmers in India make informed choices about farming. production of crops. This system includes two subsystems: suitable crops are recommended based on factors such as planting, geographic location, soil properties, temperature, and rainfall; and another to predict rainfall in specific areas to become better the reliability of crop forecasts. [3] Another research paper supports a real-time crop forecasting system that provides farmers with news on harvest forecasts based on parameters such as yield and time. . . by Using various data cleaning and large data techniques, personalized recommendations are created for farmers that ultimately lead to increased production levels. [4] A system has been introduced in India to forecast yields despicable on data from 1950 to 2018. Five crops - rice, wheat, jowar, bajra, tobacco and maize - were selected for evaluation and the decision trees showed the highest accuracy of 98.62%. This system is useful for smallholder farmers because it helps in the evaluation of the thing accomplished and the subsequent decision making. [5] An innovative application has been proposed to help farmers predict crops in specific areas based on climatic result such as rainfall. and temperature. Using data from different crops and corresponding precipitation and temperature data, the application uses a modified ARIMA pattern to foretell weather conditions and linear regression to prophesy crop production. The system provides comprehensive crop optimization recommendations based on analysis of site, cultivation size, heat of land, quantity of rain and yield data. [6] The model was developed to predict cost-effective crop selections based on soil and temperature parameters, achieving 97% accuracy. This model helps farmers select plants that maximize yield by providing detailed analysis and predictions. [7] A machine learning model using an SVM (Support Vector Machine) algorithm accurately predicts rice yield. The model classifies crops based on area and seasonal variables using a web application that facilitates user interaction. The system, developed for machine learning algorithms Weka and a web platform using HyperTextMarkupLanguage, CSS, and JavaScript, achieved 96% accuracy [8] The manuscript presents a soil analysis and a performance prediction model that aims to absolute the most specific culture. suitable for the type of soil. By estimating soil fertility and rainfall, the model accurately predicts crop yields. The system continuously monitors, presents, and uploads the analysed data to the IoT cloud, which improves decision-making in agriculture.[9] A built model was created using neural networks, which improves the accuracy of yield forecasts and reduces over configuration. By experimenting with different hyperparameters, the researchers found that n-n with 21 hidden layers and 50 neurons in each layer gave the best weighing between prediction correctness and overshoot risk. Despite exploring deeper network structures, this configuration consistently produced the most accurate predictions.

III. AIM AND OBJECTIVES

The aim and Objectives of this paper are:

1) Enhance crop diversity: The primary aim is to broaden the variety of crops available to farmers, thereby promoting agricultural resilience and reducing dependence on a limited range of crops.
2) Analyse soil properties: Conduct comprehensive assessments of soil characteristics, including Nitrogen (N), Phosphorus (P), Potassium (K) values, and pH levels. These analyses will facilitate informed crop selection decisions based on soil suitability.
3) Predictive crop selection: Utilize data on soil properties to predict the particular application crops for farming on specific parcels of land. By leveraging scientific insights, farmers can optimize harvest selection and increase the wellbeing of successful yields.
4) Improve agricultural productivity: By aligning crop choices with soil properties, the main task is to enhance overall agricultural productivity and efficiency. This entails selecting crops that are well-fitted to the soil's composition, leading to healthier plants and higher yields.

IV. DESIGN AND IMPLEMENTATION

A. *Proposed System*

This employs data analysis technology to continuously monitor and update changes in crop production rates. The primary aim of this research is to introduce an effective crop selection method to tackle a myriad of agricultural and farmer-related issues. By optimizing crop yield rates, the system aims to bolster the Indian economy. It assesses various land conditions to identify crop quality through a systematic ranking process, thereby distinguishing between low-quality and high-quality crops. Utilizing required classifiers to intensify the accuracy of predictions. by considering multiple perspectives. Furthermore, a ranking technique is employed to aid decision-making by selecting the most reliable classifier results.

DATA FLOW DIAGRAM:

1) Often referred to as a bubble chart, the Data Flow Diagram (DFD) serves as a straightforward graphical representation for depicting a system's input data, the various processes applied to this data, and the outcomes of data.
2) Among the essential modelling tools, the Data Flow Diagram (DFD) stands out as it effectively models the components of a system. These components typically encompass system processes, associated data, external entities interacting with the system, and the flow of information within the system.
3) By illustrating the combined endeavour of information and the transformations it undergoes within the system, the Data Flow Diagram (DFD) offers insight into how data is modified through successive processes. This graphical technique vividly portrays both the flow of information and the applied transformations from input to output.
4) Recognized interchangeably as a bubble chart, the Data Flow Diagram (DFD) holds versatility in representing systems across various levels of abstraction. Additionally, DFDs can be segmented into levels that correspond to escalating levels of information flow and functional intricacy.

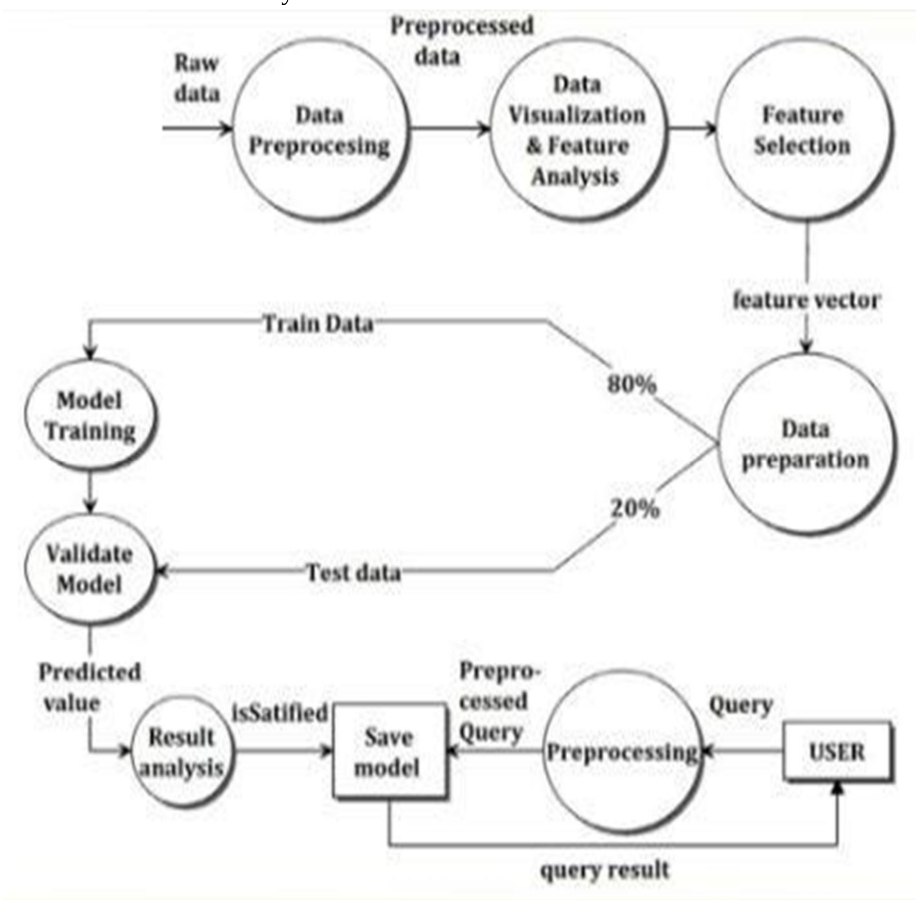

Fig 01: Data Flow Diagram

B. Modules

1) *Module 1: Data Pre-processing:* The raw crop data undergoes a cleaning process, where unnecessary elements are removed and metadata is appended, facilitating easy training of the data. Initially, the metadata is loaded and attached to the data, replacing converted values. Subsequently, unnecessary data is filtered out, and remaining data is split into training and testing sets.
2) *Module 2: Crop Prediction Module:* The product of caculation obtained serve as valuable insights for farmers to determine crop yields, aiding them in selecting high-yielding crops and optimizing agricultural field usage. By providing guidance on efficient crop choices, we assist farmers in achieving better yields.
3) *Module 3: Crop Recommendation Module:* This module introduces a model designed to tackle these challenges. The innovation lies in guiding farmers to maximize crop yields while recommending the most profitable crops tailored to their specific regions.

V. METHODOLOGY

The methodology involves utilizing specific components like Arduino Uno microcontroller board and various sensors to gather information for the project. The Arduino Uno board, built around the ATmega328 microcontroller, features multiple digital input/output pins, analogue inputs, and other essential components, making it a versatile platform for data acquisition. It is powered either by via USB connection or through an AC-to-DC adapter or battery, facilitating easy setup and usage. The capacitive humidity sensor utilized in the project employs silicon technology on a glass wafer, allowing for cost-effective mass production. Comprising three layers, with the middle layer being humidity-sensitive polyimide, this sensor demonstrates high independence to temperature fluctuations. Its grid-like structure on the top layer ensures rapid response to difference in humidity levels, converting them into capacitance. Similarly, a temperature sensor is employed to detect heat energy emitted by objects or their surroundings. Ground dampness sensors play a decisive role in measuring the volumetric water content in the soil. Unlike direct gravimetric methods, which involve sample removal, drying, and weighing, these sensors indirectly measure soil moisture using properties such as electrical resistance or dielectric constant. Calibration of these sensors is necessary to establish a relationship between the measured property and soil moisture, as atmospheric factors such as soil type, temperature, and electrical conductivity can influence this relationship.

VI. CONCLUSION

Agriculture stands as a cornerstone of India's economy, significantly impacting the livelihoods of millions of farmers who rely on it as their primary source of income. However, the sector faces formidable challenges, including the adverse effects of global warming on the environment and a lack of knowledge regarding suitable crops for cultivation. Consequently, farmers often encounter substantial losses in their farming endeavours. To mitigate these challenges, crop recommendation systems have emerged as a valuable tool for farmers.

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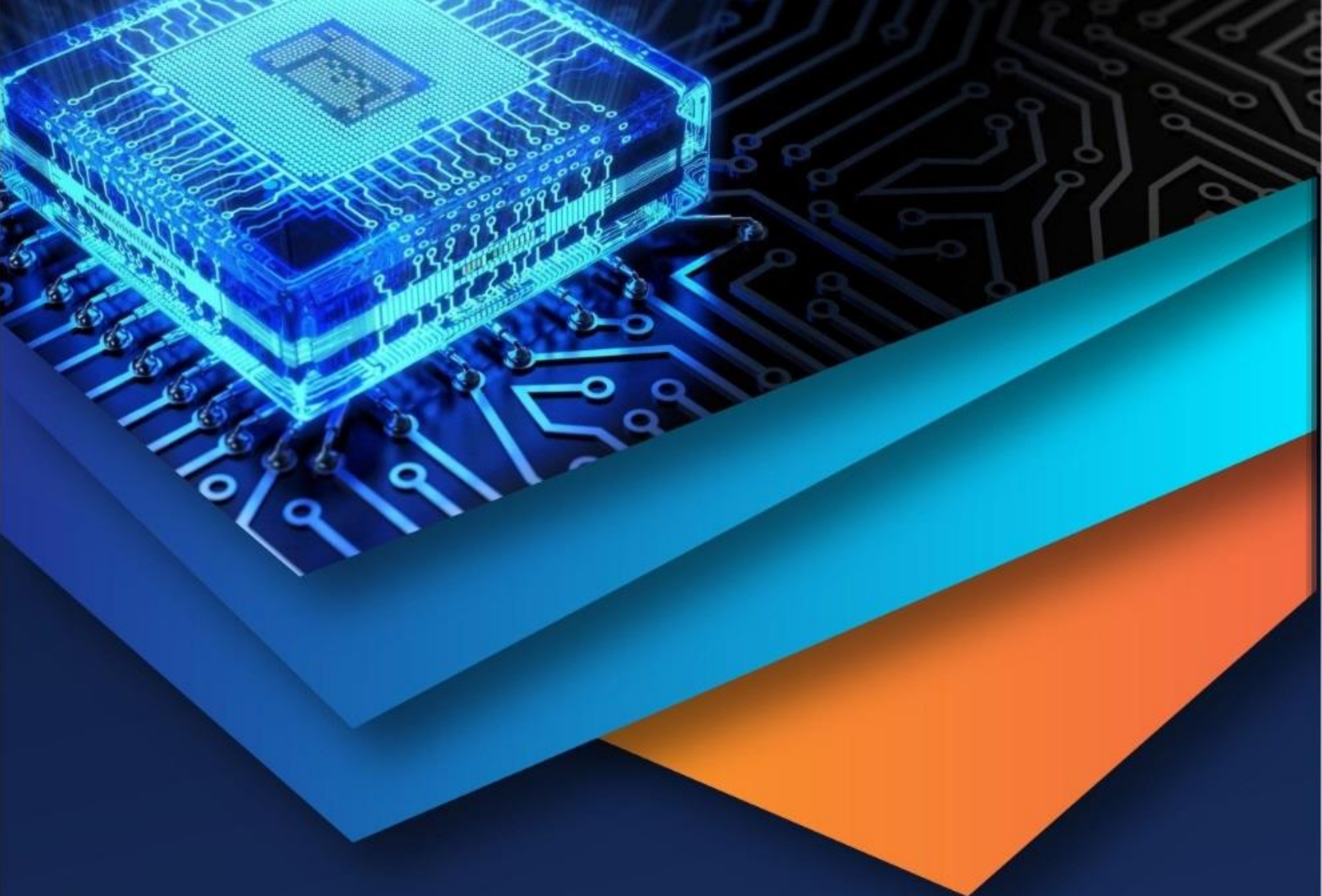

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