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Machine Learning-Based Agricultural Solutions – Agrosahayak

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ABSTRACT: In many developing nations, agriculture stands as the primary source of income. The evolution and contemporary methodologies in agriculture are collectively known as modern agriculture. Farmers, grappling with the evolving demands of the planet, encounter various challenges from customers, companies, and more. Some of the issues faced by farmers include nutrient management, climate change induced by soil erosion and industrial emissions, soil deficiencies in essential minerals like potassium and nitrogen, and inhibiting phosphorus affecting plant growth. Cultivation mistakes, such as persistently growing the same plants and using fertilizers without awareness of quality and quantity, are common. To aid farmers in effective farm management and increased crop yields, Agro Sahayak was developed. It provides features such as connecting with agricultural experts, accessing weather and market data, receiving crop management guidance, and utilizing a Crop Prediction Model based on the farmer's crop selection. The overarching goal of AgroSahayak is to equip farmers with information and resources for data-driven decisions to enhance crop yields and profitability. Our website offers a convenient service for growers and gardeners to identify the best fertilizer for their specific soil. Instead of a soil testing service, users manually input their soil nutrient levels and pH information into our website, allowing our algorithm to generate personalized fertilizer recommendations based on their soil conditions. This user-friendly service enables users to rectify soil deficiencies easily, promoting healthier and more productive plants. Keywords: Climate Change, Modern Agriculture Techniques, Soil Nutrient-Based Crop Fertilizers, Personalized Fertilizer Recommendations, Weather Data, user-friendly Services

I. INTRODUCTION

AgroSahayak stands as a comprehensive solution catering to the diverse needs of farmers. It encompasses all necessary information, guiding farmers from the planning phase of a harvest, through crop cultivation, and up to the sale to customers. In the planning stage, AgroSahayak aids farmers by offering insights into suitable crops based on local weather conditions and assists in structuring the crop cycle. The escalating global population and depleting resources pose challenges in meeting the rising demand for food production. Therefore, enhancing agricultural productivity becomes imperative. By facilitating more efficient crop growth, AgroSahayak contributes to ensuring an ample food supply for everyone. This tool proves invaluable for farmers, providing an extensive array of information and resources to aid in effective crop planning and cultivation. This empowers farmers to make informed decisions on crop selection aligned with weather conditions, subsequently enhancing agricultural productivity and bolstering food security. Additionally, AgroSahayak offers guidance on marketing crops to customers, thereby positively impacting the livelihoods of farmers. In essence, AgroSahayak emerges as a valuable resource, fostering improved farming practices and increased yields for farmers.

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II. METHODOLOGY

Data Collection:
We gathered soil information from diverse farms through an online platform. This website enables farmers to enter data regarding nitrogen, potassium, and phosphorus levels in their soil, along with details about the crops cultivated and the fertilizers applied. Additionally, the website captures other pertinent information, including climate conditions and the geographical region of the farm.

Data Preprocessing:
The data underwent preprocessing, involving the elimination of any missing or inconsistent values. Additionally, normalization was applied to ensure uniform scaling across all features.

Machine Learning Models:
Three machine learning models, namely KNN classifier, SVM, and decision tree, were employed for the analysis of soil data and the generation of crop recommendations. A grid search was conducted for each model to identify the optimal hyper parameters.

Fertilizer Recommendation:
Applying regression analysis to the soil data, we suggested the suitable fertilizer for use. A regression model was developed by training it with both the soil data and the fertilizers employed in individual farms. Subsequently, the trained model was applied to anticipate the required amount of fertilizer for each crop, leveraging the provided soil data.

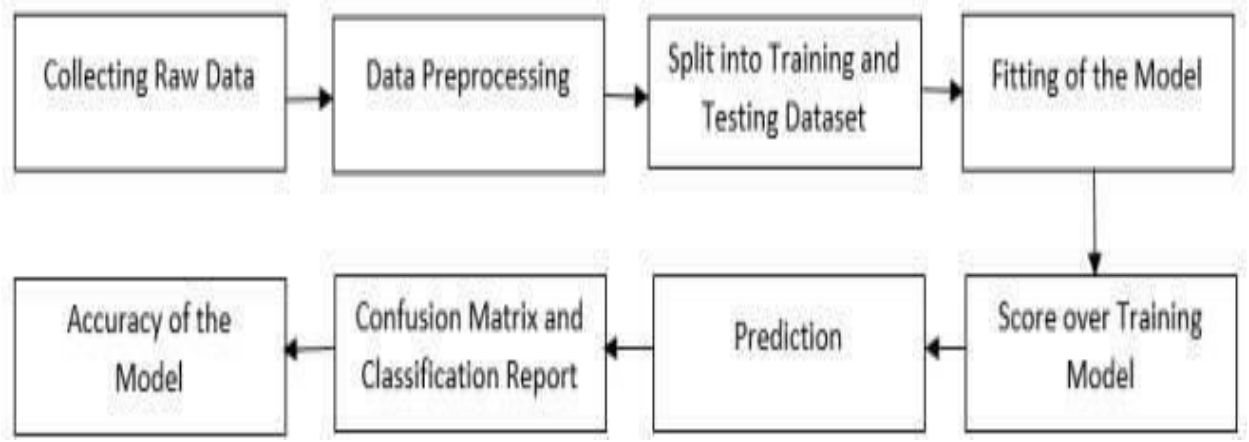

Figure 1: Steps for Methodology

III. MODELING AND ANALYSIS

Machine learning models necessitate distinct algorithms to glean insights from provided data and enhance performance through experience, independent of human intervention. These algorithms predominantly fall into two categories: Supervised Learning Algorithms and Unsupervised Learning Algorithms. Our project primarily centers on forecasting crop yields or determining suitable fertilizers. Leveraging labeled data, we opted for a Supervised Learning Algorithm. Various classification models were assessed to identify the most precise one capable of accurately predicting crops or fertilizers. The models subjected to testing included:

1. KNN Classifier: KNN Classifier, short for k-nearest neighbors (KNN or k-NN), represents a non-parametric supervised learning classifier. It relies on proximity to make classifications or predictions about the clustering of a given data point. While it can address both regression and classification tasks, its predominant application lies in classification. The KNN algorithm functions on the premise that similar data points typically reside in close proximity to each other.

2. Support Vector Machine (SVM): The Support Vector Machine (SVM) stands as a widely embraced algorithm catering to both Classification and Regression challenges within Supervised Learning. However, its predominant usage resides in Classification tasks within the realm of Machine Learning. SVM aims to delineate the most efficient line or decision boundary for partitioning an n-dimensional space into distinct categories. This facilitates straightforward classification of

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forthcoming data points. Termed as a hyperplane, this optimal decision boundary is meticulously constructed by SVM, selecting the most extreme points or vectors, known as support vectors. Thus, the algorithm earns its moniker, Support Vector Machine.

3. Decision Tree: The Decision Tree, a form of supervised learning methodology, possesses the capability to handle both classification and regression challenges, though it predominantly excels in classification tasks. Functioning as a tree-like classifier, it features internal nodes representing dataset features, branches depicting decision rules, and each leaf node denoting an outcome. Within the Decision Tree structure, two node types exist: Decision Nodes and Leaf Nodes. Decision nodes undertake decision-making responsibilities, branching out into multiple options, while leaf nodes furnish the resultant output without further branching. Decisions or tests within the model are contingent upon the features present within the dataset.

A Decision Tree offers a visual depiction of various potential solutions to a problem or decision, contingent upon provided conditions. Termed as such due to its resemblance to a tree, it initiates with a root node and subsequently branches out, forming a tree-like configuration. Employing the Classification and Regression Tree (CART) algorithm facilitates the construction of this tree. Essentially, a Decision Tree poses a question and, predicated on the response (Yes/No), proceeds to partition the tree into sub trees.

4. Random Forest: Random Forest represents a widely recognized supervised learning algorithm applied in both Classification and Regression tasks within the realm of Machine Learning. It rests upon the principle of ensemble learning, wherein multiple classifiers are amalgamated to tackle intricate problems and refine model performance. Serving as a classifier, Random Forest comprises numerous decision trees derived from distinct subsets of a dataset, employing averaging to enhance predictive accuracy. Diverging from sole reliance on a single decision tree, the algorithm aggregates predictions from each tree, culminating in the final output based on majority voting. Augmenting the number of trees within the forest correlates with amplified accuracy and serves to mitigate over fitting concerns. Gradient Boosting: Gradient Boosting is a renowned boosting algorithm that has each predictor rectify its predecessor's error. In contrast to Adaboost, Gradient Boosting doesn't alter the weights of the training instances. Instead, each predictor is trained using the residuals of its predecessor as labels. One of the techniques used in Gradient Boosting is called Gradient Boosted Trees, which has CART (Classification and Regression Trees) as its base learner.

IV. RESULTS AND DISCUSSION

The discoveries and discussions can either be combined into a unified section or presented separately. Alternatively, they can be divided into subsets with brief and informative captions. An easy way to adhere to paper formatting standards is to utilize this document as a reference, ensuring that this section is formatted with Times New Roman font, size 10.

SN.	Model Type	Accuracy
1	KNN-Classifier	0.9781818181818182
2	Support Vector Machine	Linear Kernel Accuracy: 0.9745454545454545 Rbf Kernel Accuracy: 0.9872727272727273 Poly Kernel Accuracy: 0.9890909090909091
3	Decision Tree	0.9872727272727273
4	Random Forest	0.97
5	Gradient Boosting	0.9945454545454545

Table 1. Model Selection

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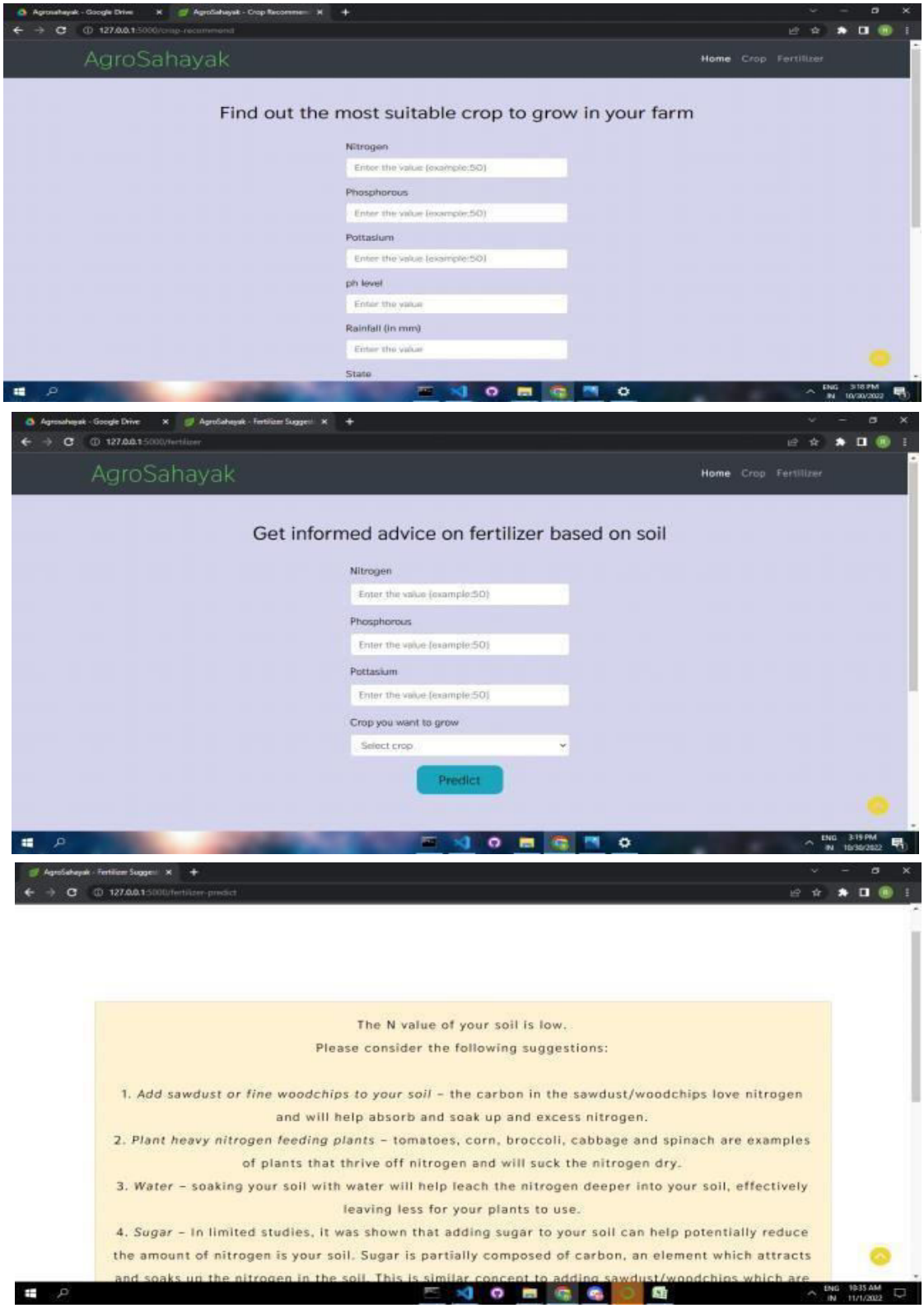

Figure 2: Screenshots of Project

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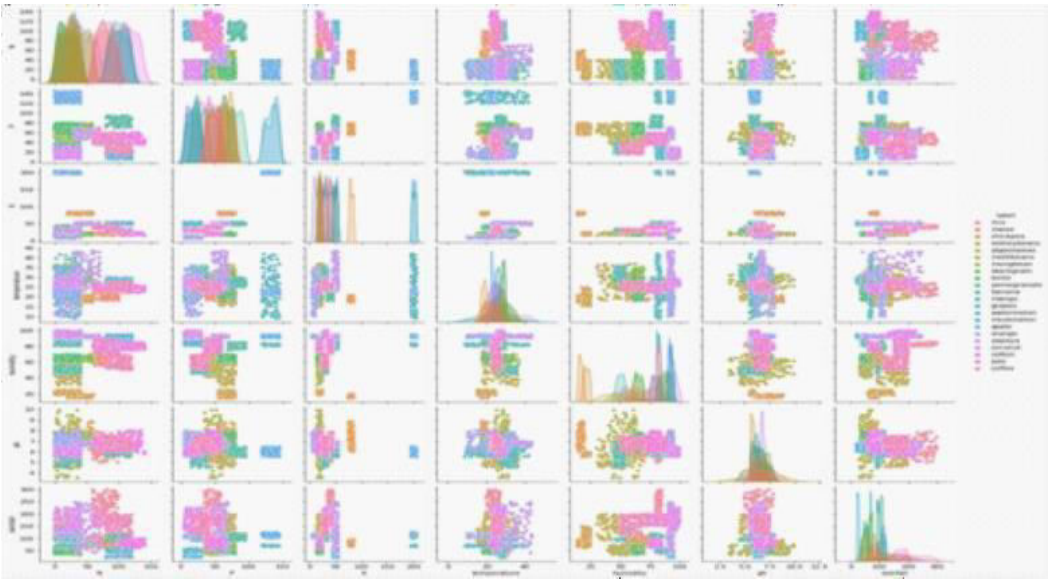

Figure 3: Visual Representation of Data

V. CONCLUSION

In summary, our website provides a valuable service tailored to growers and gardeners, delivering personalized crop and fertilizer suggestions derived from user-inputted soil content and rainfall data. Employing sophisticated machine learning methods, our algorithm can assess weather patterns, enabling data-driven decisions for recommending optimal crops in specific regions. Furthermore, the site offers guidance on selecting the most effective fertilizers to enhance crop growth and productivity. This user-friendly service empowers farmers to make informed choices, optimize yields, and boost profitability, facilitating more effective farm management with the assistance of AgroSahayak.

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