Towards an Efficient Deep Learning Approach for Crop Recommendation

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Keywords: KNN, Random Forest, Deep Learning, Decision Tree, Crop Recommendation.

Abstract: The agriculture industry depends heavily on crop output, which is influenced by a variety of meteorological and chemical elements. Just because of these two factors, farmers lose a lot of money. Although the climatic factors are beyond human control, automated technologies may be used to control the chemical factors. Many solutions to these worries have been offered through research. This study, however, focuses on crop suggestions based on chemical and meteorological conditions. In order to recommend better crops depending on chemical and meteorological circumstances, this study proposes an optimization-based deep learning approach based on the grey wolf. According on a number of chemical and meteorological factors, such as pH, nitrogen, phosphorus, and potassium as well as rainfall, temperature, and humidity, this paper makes crop recommendations to farmers. The entire plan is presented in layers: A high-performance Convolution neural network is utilized to extract and categories important characteristics, after which the feature is optimized using the grey wolf method to suggest a better crop based on a variety of criteria.

1 INTRODUCTION

Agriculture has historically been and still is one of the main pillars of the Indian economy because it directly supports two thirds of the country's population. Furthermore, significant is the fact that it accounts for 20% of India's GDP (GDP). The farmer, who serves as our nation's Annadatta (Food Supplier), is at the centre of the agricultural industry and is currently dealing with a number of challenges: 1) Due to the wide variety of soil types in the nation, farmers frequently struggle to select the crop that is most lucrative for their soil, environmental conditions, and geographic region and consequently suffer significant losses. 2) Farmers currently find it incredibly challenging to predict the yield for a particular sowing season and the profit they can achieve because to the fluctuating weather conditions. The depressingly low returns that farmers obtain for their production are a result of the "farm to market" system, which is made up of hundreds of intermediaries that squander the majority of the revenues by transporting and selling items (Devdatta et al 2019, Anguraj.Ka et al. 2019). Artificial intelligence, deep learning, and machine learning are widely used in modern agriculture (Manish Kumar et al 2022). The general quality of the harvest, yield forecast, plant pest detection, and undernutrition of farms can all be improved with the help of methods like precision agriculture and crop recommender systems. AI system deployment could provide the struggling agricultural industry a boost.

2 LITERATURE REVIEW

Prediction of Crop Yield and Fertilizer Recommendation Using Machine Learning Algorithms

Crop yield analysis is a developing study area that includes machine learning. A major problem in agriculture is yield prediction. Any farmer is curious to know how much of a crop he can anticipate. In the past, farmer experience with a certain field and crop was taken into account when predicting production. Based on the information at hand, the yield forecast is a significant problem that needs to be resolved. The more effective option for this is machine learning. In order to predict the crop yield for the next year, many machine learning algorithms are utilised and tested in agriculture (Devdatta et al 2019). In this study, a technique to forecast agricultural yield using historical data is proposed and put into practice. This is performed by applying machine learning

Kumar, D. and Sheeja, S.
Towards an Efficient Deep Learning Approach for Crop Recommendation.
DOI: 10.5220/0012614100003739

In *Proceedings of the 1st International Conference on Artificial Intelligence for Internet of Things: Accelerating Innovation in Industry and Consumer Electronics (AI4IoT 2023)*, pages 281-285
ISBN: 978-989-758-661-3

algorithms to agricultural data, such as Support Vector Machine and Random Forest, and making fertilizer recommendations that are suitable for each unique crop. The research focuses on developing a prediction model that could be applied to crop yield forecasting in the future. It gives a succinct description of how agricultural yield can be predicted using machine learning methods.

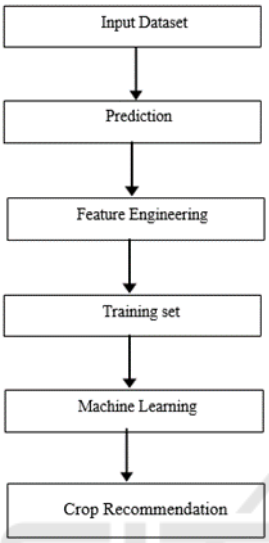

Figure 1: Flow chart of Proposed Model.

Crop Recommendation on Analyzing Soil Using Machine Learning

Influence on crop productivity. By implementing emerging Agriculture into the effect, our government's crops are stretched, which further greatly boosts the economy of our nation. Crop productivity has been strongly influenced by fluctuations in the weather. Modern paradigm has the potential to replace conventional farming with precision farming, that will further improve agricultural yields. Two examples of contemporary technology in use are preliminary study and indeed the internet of things (IOT). The fundamental issue that remains to be investigated is growing precisely crops at precise times (Anguraj.Ka et al. 2019). This can be done using machine learning techniques, which have been found to be an effective strategy for predicting the perfect crop. Agriculture IOT sensors are used to gather the soil data, such as soil moisture, temperature, humidity, and pH, and provide them to a graphical user interface (GUI). The GUI gathers the inputs and recommends the appropriate crops. The system created with IOT and ML significantly aids farmers in making wise decisions.

Crop Recommendation Predictor Using Machine Learning for Big Data

The needs of a constantly expanding human population. In rural areas of India, agriculture is the primary industry. We all know that the majority of Indians work mostly in agriculture. Most Indians, either explicitly or implicitly, depend on agriculture for their livelihood. Most farmers in India rely on their instincts to choose which crop to grow during a certain season. Farmers are used to planting the same crop, applying additional fertiliser, and adhering to popular opinion. They are unaware of the fact that crop productivity is heavily reliant on the current weather, soil, and other factors and instead find comfort in just adhering to previous agricultural traditions and norms. The most frequent issue Indian farmers have is that they don't choose the right crop depending on the needs of their soil and other elements like fertilisers and irrigation schedules (Manish Kumar et al 2022. Nikam et al 2022). Productivity suffers as a result. A single farmer, however, cannot be expected to take into account all of the various factors that affect crop development when determining which crop to plant. Machine learning is an effective solution to this issue. Throughout the past few years, significant improvements have been made in the ways that machine learning can be used in numerous studies and enterprises. As a result, we want to create a model or system that will let farmers use machine learning in agriculture.

3 PROBLEM DEFINITION

Few platforms exist that aid farmers in developing their farming strategies. Decisions based on intuition might not turn out to be advantageous in the long run. Farmers frequently overestimate or underestimate the soil fertility on their fields. They frequently have trouble identifying plant illnesses that have an immediate impact on the rate of output. It is feasible to provide precise crop forecast results by using the right criteria, such as rain patterns, temperature patterns, soil structures, and other things like crop diseases. Furthermore, it is also feasible to determine in advance what disease a crop has. Several of the current systems are exceedingly difficult to use or have numerous problems that make them unintuitive.

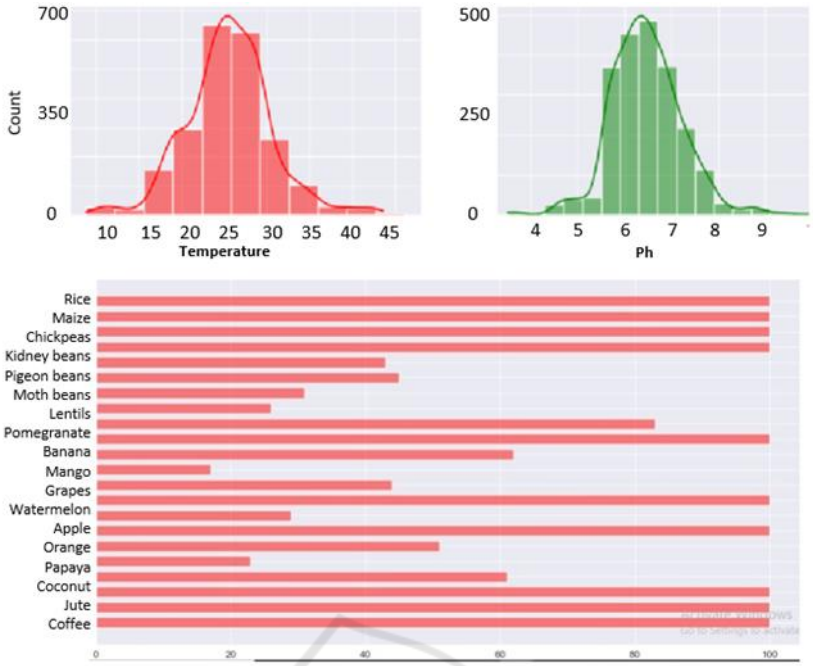

Figure 2: (a) Temperature; (b) Ph; (c) Crops.

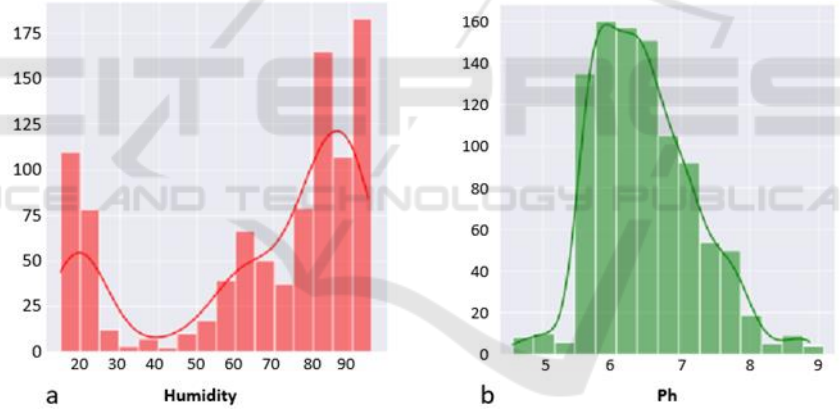

Figure 3: (a) Humidity; (b) Ph.

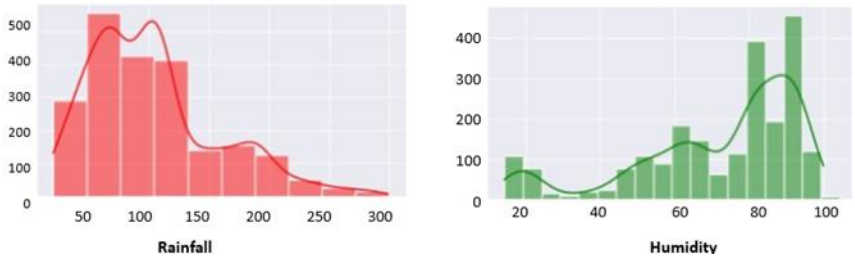

Figure 4: (a) Rainfall; (b) Humidity.

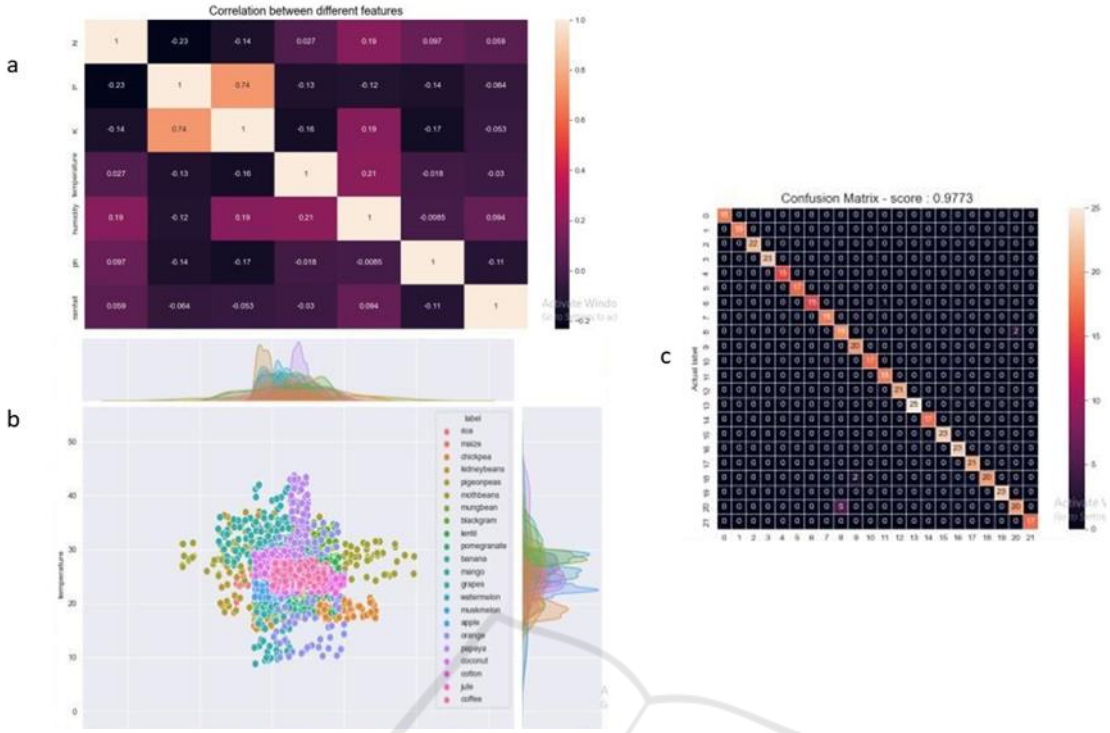

Figure 5: (a) Correlation Between different features; (b) Temperature and crops; (c) Confusion Matrix.

4 PROPOSED MODEL

India's agriculture sector is significant. It is necessary for the Indian economy's survival and expansion. India is a significant producer of many different agricultural goods. In the process of cultivating crops, soil is crucial. A non-renewable, dynamic natural resource required for life is soil. Crop cultivation used to be done by farmers with practical experience. Based on the qualities and properties of the soil, farmers are no longer able to select the ideal crop. Hence, a recommendation system that uses machine learning algorithms to suggest the crop that can be harvested in that specific soil has been developed. To advise the crop, this system employs a variety of machine learning techniques, including KNN, Decision Tree, Random Forest, Naive Bays, and Gradient Boosting.

5 RESULTS AND DISCUSSIONS

The proposed model, designed with the objective of enhancing crop recommendation in agriculture using machine learning, was implemented using the Python programming language. The methodology encompassed a multi-stage approach involving data extraction, feature engineering, model training, and evaluation. The dataset incorporated numerous chemical and meteorological factors, such as pH levels, nitrogen, phosphorus, potassium, rainfall, temperature, and humidity. These variables were carefully selected due to their significant impact on crop growth and yield. The final iteration of the KNN architecture exhibited an impressive accuracy rate of 91.21%. This high accuracy underscores the efficacy of this algorithm in suggesting suitable crops based on the given parameters. The Random Forest Algorithm, while slightly lower in accuracy compared to KNN, achieved a respectable accuracy rate of 75%. Further fine-tuning and optimization might be required to enhance its performance.

6 CONCLUSIONS

The agriculture sector's health is essential for India's long-term economic success. By boosting profitability and enhancing agricultural productivity, our goal was to give small-scale farmers more control. In our trials, a variety of machine learning techniques are used to recommend the crop, including

KNN, Decision Tree, Random Forest, Naive Bays, and Gradient Boosting. The astounding accuracy of the KNN architecture's final version was 91.21%. The accuracy of the Random Forest Algorithm was 75%. To further enhance the system and provide more precise yield prediction findings, the crop production dataset can be expanded.

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