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Krishi Jal – App Water Availability Based Crop Recommendation System

Sakshi Shinde[1], Krupashree Sawant[2], Komal Shirsath[3], Akshata Raut[4]

[1, 2, 3]Final Year Student, Computer Enginnering Department, VIVA Institute of Technology, India
[4]Assistant Professor, Computer Enginneering Department, VIVA Institute of Technology, India

A B S T R A C T

Agriculture plays a pivotal role in the Indian economy, contributing approximately 17% to the total GDP and employing over 60% of the population. However, agricultural commodities must undergo several complex operations such as harvesting, threshing, winnowing, bagging, conveyance, storage, processing, and exchange before reaching the market, leading to considerable losses in crop output at various stages. The challenges faced by Indian agriculture include uncertainty in water supply, lack of remunerative income, and fragmentation of land holdings. Previous research has focused on using soil parameters and weather conditions to predict the most appropriate crops to plant on a given farm. To address this challenge, many researchers have used different types of Machine Learning and Deep Learning algorithms to develop their own model of Crop Recommendation Systems. In this paper a Crop Recommendation System is proposed which not only considers the soil parameters but also considers the water that is available with the farmer for farming and then provides the output which takes all input and based on those parameters it provides the crop that have to be planted on the farm. The model works in two phases. In the first phase, the model extracts the information from the input. In the second phase, the extracted information is then given as input to the trained Deep Learning model and then the crop suitable for the farm is recommended.

Keywords: Crop, Deep Learning, Machine Learning, Model, Parameters, Recommendation

1. Introduction

Agriculture is the backbone of the country. It is continuing to be one of the major sources of income for a significant portion of the population in India, sustaining livelihoods and contributing to economic growth. More than 50% of the people depend on agriculture. More than 60% of the land in the country is used for agriculture to suffice the needs of 1.3 billion people [5]. A few decades ago, people used to do farming by using ancient tools. But now, after the Green Revolution, and globalization, advanced technology has come. High yielding varieties of food grains and vegetables have also been invented which has led to greater growth of agriculture in India. Our country, India is the world's largest producer of fresh fruits, vegetables, and food grains. For all these correct nutrients of soils, weather forecast, and enough water is essential for the cultivation of crops. For agriculture we require water which does not contain high amounts of salt. Water is a ubiquitous resource that covers an astonishing 71% of the Earth's surface. But only 0.3% of the earth's surface has fresh water. So, many people follow many ways to conserve the rainwater. We have various kinds of land water resources such as rivers, lakes, ponds, and groundwater resources such as wells, borewells etc.

Based on records from the previous years of 2018 and 2019, it can be estimated that there were approx. 145 million landholdings in India [8]. It results in negative impacts like farmer suicides, diversion of agricultural land for non-agricultural purpose. On the other hand, 48% of farmers don't want their next generation to take care of their agriculture and its land, instead want to settle down in urban areas [1]. The reasons behind doing this dreadful act are wrong decisions about crop selection like selection of a crop that won't give much yield for the soil, planting in the wrong season, and so on. Farmers can be in a great loss if they do not know the previous status of the land. If the family primarily depends on agriculture for the major source of income, then it is very difficult to survive.

So, to address these problems, a Crop Recommendation System has been proposed for farmers which provides predictive insights on crop sustainability and recommendations based on Deep Learning model trained. It is done by considering essential environmental parameters such as rainfall, temperature, and geographical location, soil parameters such as Nitrogen(N), Phosphorus(P) and Potassium(K) and water availability. By considering all the above parameters, a suitable crop will be predicted to the farmer for their land.

2. Related Work

This section describes the various methodologies used in prior studies to identify and classify plant leaf diseases. In this paper, a system is put forth to assist the farmers in selection of crops by considering all the possible factors such as sowing season, soil, and geographical location of the agricultural land. Priyadharshini A, et.al. [1] has presented a crop recommendation by using various data mining techniques which will help the farmer by predicting

the crop which has to be cultivated by considering the season and productivity. Vaishnavi. S et.al. [2] has proposed a system for precise prediction of crops by using Big Data and Data Mining techniques. Here, proper prediction of crops is informed to the agriculturists on the basis of real time by considering the various parameters like production and season. D.Jayanarayana Reddy, et.al [3] has introduced a system in which examine various machine learning techniques has been examined which utilized in the field of crop yield estimation. Dr.V. Geetha, et.al. [4] has put forward a crop prediction system by using Random Forest algorithm for analyzing the growth of the crop in relation to the different climatic conditions like dried period, increasing in temperatures and biophysical changes. Nischitha K, et.al [5] has presented user- friendly crop prediction system by using different machine learning algorithms which is designed to predict the best suitable crop for particular land on the basis of parameters like soil content and weather parameters. Ms Kavita, et.al [6] implemented a crop yield prediction system that predicts crop yield using area, yield, production, and area under irrigation. Sonal Agarwal, et.al. [7] has enhanced existing built model on machine learning algorithm like SVM by applying deep learning techniques like LSTM, RNN and predicts the crop which provides best profit to the farmer by considering soil as well as climatic parameters. N. Manjunathan, et.al. [8] has built a web application by using machine learning model trained by using Support Vector Machine (SVM) algorithm that accurately predict the rice crop yield. Dr. Y. Jeevan Nagendra Kumar, et.al [9] implemented a system which predict the best crop yield as output by using Random Forest algorithm. Shubham Prabhu, et.al. [10] has introduced a prediction engine that gives soil analysis of the farm and a crop prediction model by using the soil analysis and rainfall. Mrs. R. Usha Devi, et.al [11] has designed a recommendation system which will suggest the farmer with an appropriate crop has to be planted by considering soil parameters, rainfall, temperature, and region. Saeed Khaki, et.al [12] has basically trained deep neural networks DNN (G), DNN(S) and DNN (W), one for yield and other models to check yield, and then used that difference of their outputs as the prediction for yield difference. Kusum Lata, et.al. [13] has proposed four classification algorithms (Random Tree, J48, Bayes Net and KStar) that are used to improve crop yield prediction with the help of WEKA tool. Meeradevi, et.al.[14] has designed an application which will help the farmer to predict crop yield Using crop dataset from various regions of India, farm size, rainfall, and temperature dataset for same regions. Zeel Doshi, et.al. [15] has presented an intelligent system named "AgroConsultant" is introduced which gives informed decision related to the growth of the crop on the basis of sowing season, geographical region of the farm, characteristics of farm's soil and environmental factors.

3. Research Objectives

Agriculture, the major source of livelihood for majority of our population, but it is done in an unscientific manner owing to lack of awareness leading to lower productivity and over exploitation of the scarce water resources. There are other existing models for the recommendation of the crop which does not consider the already available water with the farmer. To overcome this problem, a Crop Recommendation System is created in order to provide correct and accurate prediction of crop which is sustainable to grow in the farm of the farmers by considering soil factors, environmental factors and water that is available with the farmer. The models which use both Machine Learning and Deep Learning algorithm predicts an accurate crop for their farm. There are numerous Machine Learning and Deep Learning algorithms used for building the models like Random Forest algorithm, Decision Tree algorithms, K-NN, Neural Network, Linear and Logistic Regression algorithms, SVR, Lasso and Ridge Regression algorithms, LSTM, RNN, Naïve Bayes algorithm, ANN, and DNN.This research aims to implement the Crop Recommendation System which consider the already available water resource with the farmer.

4. Proposed System & Methodology

4.1 Data Collection:

The process of developing deep learning model starts with collection of dataset and then processing the dataset "Crop Recommendation with water data"[16], a dataset from the kaggle is utilized that contains the soil parameters i.e. N(Nitrogen in soil), P(Phosphorus in soil), K(Potassium in soil) as this are the most important parameters that are considered for crops cultivation, weather conditions i.e. temperature(in degree celsius), humidity(in percentage) and rainfall(in mm). In this dataset, only the soil parameters and weather conditions are the features that are present. The total water available in the farm is not the feature of the dataset. Added the new feature in the dataset that contains the total water available in the farm in liters per year by referring to the government websites which contains the information about the total water required by each crop and then the processing of the dataset is carried out by training the deep learning model.i.e., Simple Neural Network model. The dataset contains a total of 22 crops with its soil parameters, weather conditions and the total water required for the crops. Each crop has 100 unique values in the dataset. The different types of crops that are present in the datasets are rice, muskmelon, watermelon, papaya, banana, apple, sapota, maize, chickpea, kidney beans, pigeon peas, moth beans, mung bean, black gram, lentil, pomegranate, mango, grapes, orange, coconut, cotton, and finger millet.

4.2 System Block Diagram:

In Figure 1, the main block diagram is demonstrated. The system is basically divided into two phases. Each phase is explained in detail with its block diagram. In this block diagram, in phase 1 the collection of the dataset and the processing of the dataset is carried out with training and testing the model, the whole process is explained in Figure 2. In phase 2 the extraction of the input data from the user is carried out i.e., the basic information of soil parameters, weather condition and total water available in the farm and then the recommendation of the crop is displayed to the user based on the input data that the user has entered, the whole process is explained in the Figure 3.

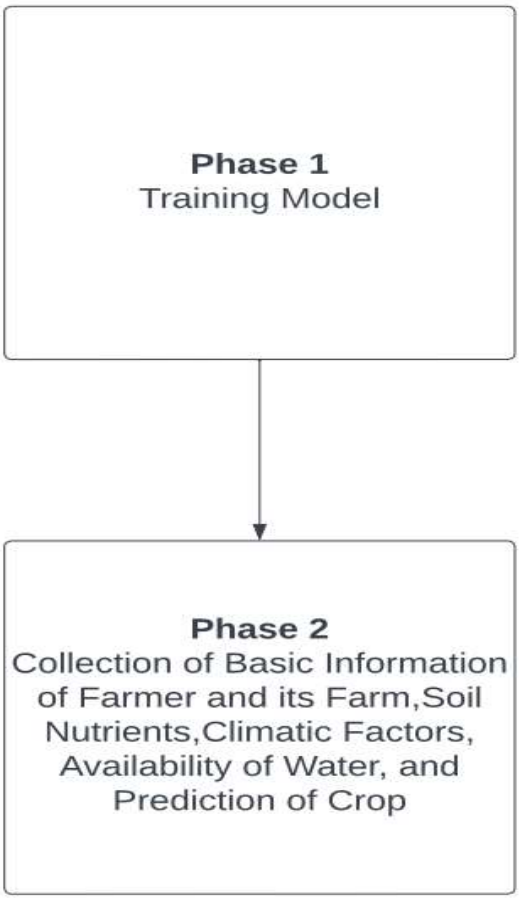

Fig. 1 Block Diagram for Krishi Jal - App

In Figure 2, a block diagram of phase 1 is demonstrated. The system firstly collects the data once the dataset is ready then filtering and extraction of the required features is done. Then the preprocessing of the dataset is carried out i.e. the dataset is scaled so that the numeric data present in the dataset is in the one format as the any Machine Learning model or any Deep Learning model needs the numeric values as an input. The dataset is splitted into training and testing sets, the rule used for splitting is 80% training model and 20% testing model. The training model is given as an input to the Simple Neural Network and the trained model is developed. To test the trained model, testing model is used i.e unseen data is used to check whether the model is recommending the crop correctly. To check the accuracy of the Simple Neural Network model 100 epochs are used.

Fig. 2 Phase 1 Block Diagram for Krishi Jal - App

In Figure 3, a block diagram of phase 2 is demonstrated. The system firstly takes the trained model and then it initializes the model. The basic information is collected from the user and then the information is stored in the database i.e. the firebase database. Then this information i.e. soil parameters, weather condition and total water available is given as an input to the Simple Neural Network model and the the model recommend the crop to the user based on the input parameters.

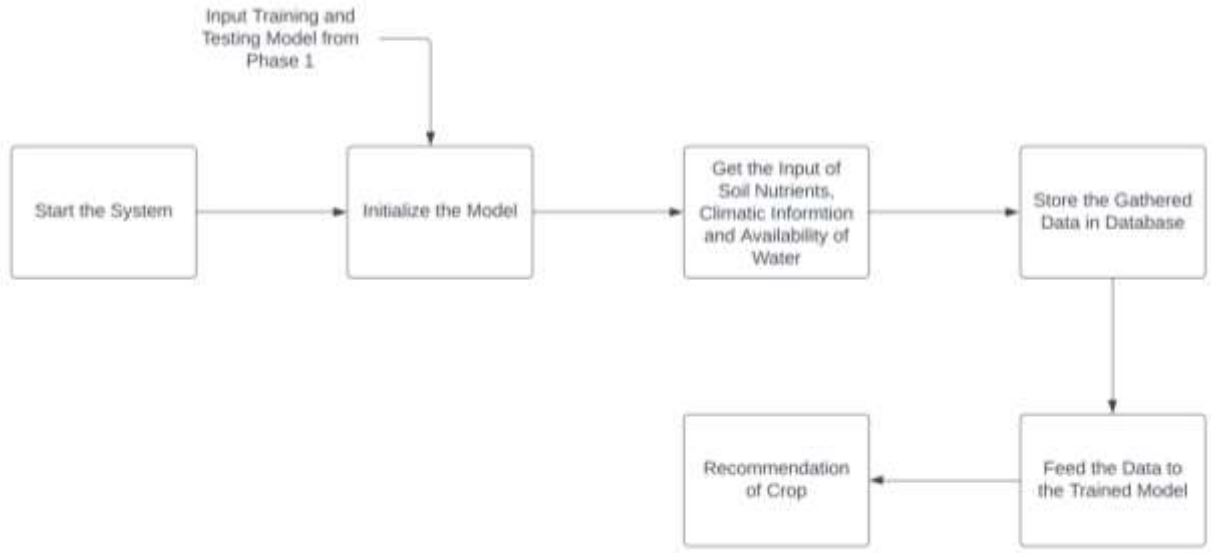

Fig. 3 Phase 2 Block Diagram for Krishi Jal - App

5. Results & Analysis

Figure 4 shows the 'Sign Up' Page which takes Name, Age, Mobile Number and Area of Farm from the user. If the user is new to the application, then they have to sign up on the application by providing details of the user such as Name, Age, Mobile Number, Area of Farm owned by the user.

Fig. 4 Sign Up Page taking Name, Age, Mobile Number and Area of Farm

Figure 5 shows the 'Sign Up' Page which takes Nitrogen, Phosphorous, Potassium and pH of the Soil and Location of the Farm of the user. After providing the basic details of the user, here, they have to provide the soil nutrient's details of the soil in their farm such as Nitrogen, Phosphorous, Potassium, and pH of soil. Then, the location of the farm is asked to the user which is taken in the form of latitude and longitude.

Fig. 5 Sign Up Page taking Nitrogen, Phosphorous, Potassium and pH of the Soil and Location of the Farm

Figure 6 shows the 'Sign Up' Page which takes the Water Resources data from the user, and it sets up the email and password for the sign up of the application. Here, the data of the water resources is taken which is available with the user. Basically, there are two types of available water resources like Ground Water and Surface Water. In Ground Water, the user can have ground water like Well, Borewell, and Hand dug Well. Following the selection of the ground water type, users are asked to provide the quantity of water available in their ground water resource. Afterwards, the user is asked to select the type of Surface Water resource available like River, Lake, and Pond. By the completion of the filling of all the above crucial information, the user has to provide their email id which they want to register with the application and set the password and click on 'Submit' button. On clicking on it, the information of the user gets stored in the database and the message of successful registration is showed and then it directs to the Sign In page of the application.

Fig. 6 Sign Up Page taking Water Resources data and Setting up Email and Password

Figure 7 shows the 'Sign In' Page. Here, the user have to enter their registered email id and password. Then, after clicking on 'Login' button, it will be directed to the Main page of the application. The user those who does not remember the password kept for the application can use 'Forgot Password' option to set new password.

Fig. 7 Sign In Page of Krishi Jal – App

Figure 8 shows the 'Main Page' of the Krishi Jal. Here the Soil Parameters and the crop which is recommended to the user to cultivate on their farm is shown on the page. On the side menu, there are various other options like Home, Change in Soil Parameters, Privacy Policy of the application and Log Out. The page that shows the weather information of the farm, is linked to the main page. To go on that page, the user can click on the arrow button which is provided on the bottom right corner of the page.

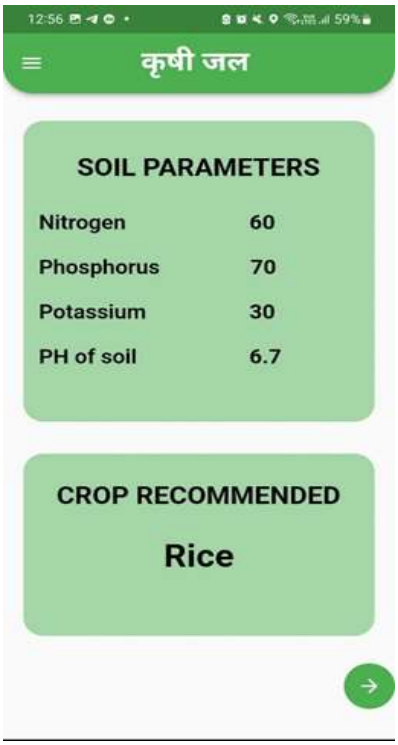

Fig. 8 Main Page of the Krishi Jal – App

3. Conclusion

Agriculture makes a dramatic impact inside the economy of an India [2]. Due to exchange of natural elements, agriculture farming is degrading now-a-days. The proposed application helps the farmers to choose the right crop which will be more profitable. Proposed application tries to overcome drawbacks of existing system. For crop prediction this application will consider certain environmental parameters such as geographical location, temperature, rainfall, water availability and soil parameters like Nitrogen(N), Phosphorus(P), Potassium(K). This application is implemented using machine learning algorithms. The developed application is user friendly.

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