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Recommendation System for Crop Prediction

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***Abstract*—** The focus of the paper is to recommend crops to farmers based on their geographical location, soil and weather conditions. India is a country where agriculture employs a significant amount of the country's population. Regardless of that agriculture contributes only about 15-17% of the country's total Gross Domestic Product. Also the suicide rates of farmers are increasing in India due to lack of information or less produce or no produce. Some reasons for this are growing crops that are incompatible with the type of soil, the weather conditions or the water content. Another reason is the inexperience of novice farmers in the field of agriculture. One solution to solve this dwindling produce is to use a crop recommendation system that recommends crops to farmers using filtering techniques like collaborative filtering and content-based filtering and machine learning algorithms. By doing this the farmers would be recommended crops that would maximize their crop yield and grow healthier crops.

***Keywords*—** Farming, Agriculture, Machine Learning, Recommendation System, Filtering Techniques.

I. INTRODUCTION

In the age of computers, internet is one of the most innovative improvements in our society. However, with all its advantages it also has its weaknesses. There is a lot of raw data available on the Internet without any citations or proof which can be dangerous. Getting relevant information from the internet is one of the biggest challenges in the usage of internet. People enter keywords relevant to their query and get information on search engines. This information may satisfy some users and leave others dissatisfied. So this makes the search quite unreliable. People need cited data from relevant sources [1].

In the domain of agriculture, we need a sophisticated mechanism to recommend crops to the user based on their surroundings. For this we propose a framework for recommending crops based on several characteristics including soil type, weather, etc. which would help for better crop produce. Agriculture is a very important sector in India and while the experienced farmers have a good grip on their methods, people new to agriculture need some help. So we design a framework which will use the knowledge of experienced farmers to drive the system and recommend crops. By using machine learning we can train the system to recommend crops based on farmers' data. As time goes on the system will learn from enough data examples and peer reviews to recommend precise crops to novice as well as experienced farmers.

By definition, Machine learning has evolved from studying pattern recognition and computational learning theory in artificial intelligence and is a branch of computer science. It is about learning and building algorithms that can learn from and make predictions on data sets.
Machine Learning can be used:

1. When there is no human interaction e.g. navigating space.
2. When humans are not able to explain their expertise. e. g. speech recognition.
3. When solution changes with time e.g. temperature control [2].

Machine learning is also heavily used in recommendation systems. Recommendation Systems are software tools and techniques that provide suggestions for items to be of use to a user [3].

Recommended systems can be broadly classified into three types- collaborative filtering, content-based filtering and hybrid filtering [4].

Hybrid filtering:
Hybrid filtering combines the advantages of both collaborative and content based filtering and can avoid their individual limitations. There are different possible ways of combining collaborative and content based filtering methods into a hybrid system. We can implement Collaborative and Content-based filtering separately and then combine their

results or we can use some properties of content-based filtering in collaborative filtering or vice versa or combine both [4].

Collaborative Filtering:
Collaborative Filtering depends on the human psychology of an individual approaching their loved ones for recommendations about something they need, so it helps them to settle on a choice. Collaborative systems can be further classified as: Model-based and memory-based. The memory-based methodology utilizes user rating information to process the likeness between users or items. Memory-based approach makes use of the user database completely for predictions. Statistical methods are used by the system to find the like-minded set of users or neighbours who share similar interests with the active user. The implementation can either be user-user or item-item based. In user-user interaction we are interested in the similarity between two items. Conversely, in user-user approach the focus is on the similarity between two users' behaviour. In this model-based methodology, different machine learning algorithms are used to predict users' rating of unrated items. This approach uses the user database to learn a model which is in turn used for making predictions. When designing a model that is capable of making predictions to a user the strength of both data mining and machine learning algorithms are collectively used [4].

Content-based filtering:
In case of content-based filtering, the system learns to recommend items that are similar to the ones that the user had liked in the past. The likeness of the items is calculated based on the features associated with the compared items. For example, in case of an agriculture recommendation system if a farmer (user) rates a crop good for that particular soil type other farmers would be recommended that crop for similar soil types [5].

In this paper, Section I explains why recommendation system could help the farmers to increase their productivity and also explains the different types of filtering techniques that can be employed in the recommendation system. Section II gives information about the related and the pivotal work that has been done in agriculture for improving the crop yield.
Section III describes the methodology about how the recommendation system can be built to recommend a crop to a farmer suitable for their land based on land and weather conditions. Section IV gives the conclusion that the system is capable of recommending crop based on information provided by farmers as well as learning based on peer reviews.

II. RELATED WORK

Some research has gone down in agricultural area to improve the crop yield. Many factors like soil, climate, etc are taken into account.

J. Lacasta proposed an ontology based system for identifying pests and recommending treatments based on these pests. This model describes the interaction between the crops, pests and treatments [6].

Ontology and Geographic Information Systems (GIS) can be combined to get fruitful recommendations for farmers. The paper proposes using spatial data as well as agricultural databases to get recommendations [7].

Also, a semantic and rule based event-driven Services-Oriented Architecture is used to integrate and distributed and heterogeneous web hosted AIS services to deliver personalized recommendation driven by real-time events and user preferences [8].

Many studies focus on a small area of land and also they assume that the land characteristics wouldn't change over the entire land area. This limits the precision of recommending crops or pesticides or fertilizers as homogeneity is assumed over the entire land. P. Jankowski proposed non-spatial conventional Multi-criteria Decision making (MCDM) techniques that averages or totals the impacts and then is considered for the whole land mass [9].

But these methods are still not completely precise.
S. Pudumalar proposes a precision agriculture recommendation system that uses data mining and also takes into account the soil types and characteristics [10].

Big data is also used for recommendation system. Some studies have also been done in this area where algorithms like SVD are used that is implemented on Apache Hadoop and Spark [11].

Another method goes into machine learning and using Naïve Bayes for recommendation [12].

III. METHODOLOGY

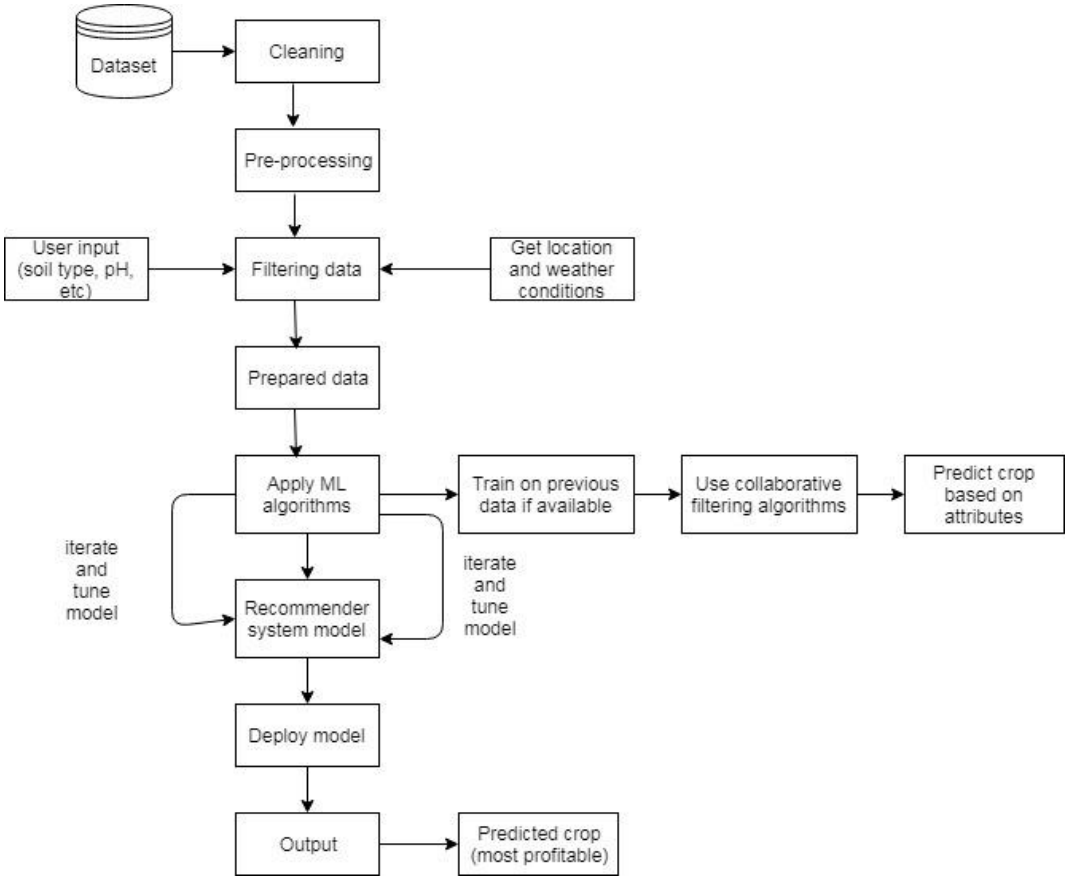

Figure 1. Architecture of Recommendation System

Algorithm for crop recommendation:

1. Start

2. Get user location.

3. Ask user to enter details like soil type, pH, irrigation technology, land size, previous experience and water level.

4. Train the model on available dataset and new user acquired data.

5. Use collaborative and content-based filtering techniques (hybrid) for user-user and user-item recommendations.

6. Recommend the crop based on-

i. The type of soil.

ii. The irrigation technology.

iii. The soil pH level.

iv. Land size.

v. Previous experience

7. Display the recommendation results.

8. Update the model.

9. Stop

Content-based filtering also referred to as cognitive filtering, recommends items based on a comparison between the content of the items and a user profile. Content-based filtering also referred to as cognitive filtering, recommends items based on a comparison between the content of the items and a user profile. Collaborative recommendation systems recommend items that are useful to the users based on other peoples' rating. So basically they use recommendations of other users. These systems work on the principle that if they liked the items in the past, then they would like similar items in the future [13].

In our proposed system we combine the advantages of collaborative and content-based systems to recommend crops based on historic regional data as well as improving the system based on farmers' rating of the suggestions. Here we will look at the similarity between the parameters with the historic data and the soil data. So this will be our collaborative module. On the other hand, the content-based module will be used for weather predictions.

So by combining these two modules we get our hybrid model which will recommend crops based on the soil characteristics, historic data and user interaction data. Given a region, the system should be able to recommend crops that would maximize the yield. And based on the ratings by the users the model would be refined to recommend precise crops thus leading to a precise agriculture recommender system.

The preprocessing module will also include information extraction and will convert the unstructured data into structured data.

The most profitable crop will be recommended to the farmers' based on their soil type, weather and other conditions.

Using Random Forest algorithm we can recommend the crops for farmers' based on their region and their soil types. And we can use the Apriori and K-nearest algorithm for recommending crops or even fertilizers to users based on what other users have purchased.

IV. RESULTS AND DISCUSSION

The proposed model induces rules –
If soil type is loam
And weather is sunny
And water level is 15 inches
And pH is alkaline
Then Wheat

These rules are learned by the system to recommend crops. And if the user rates this recommendation by the system high then that crop is recommended to people with that soil type around the area. This way the system learns from peer ratings and also the fed data.

V. CONCLUSION AND FUTURE SCOPE

Agriculture is the most important sector in India and is the source of livelihood for many people. By using a recommender system for agriculture, the famers' would be able to maximize their crop yield. This can reduce the gap between the novice and experienced farmers as well as the agricultural experts. In coming years, agriculture will be revolutionized with the help of data mining and machine learning as agriculture is still mostly untouched in this area. This will help to increase the productivity of land by wasting less resources and growing crops suitable to an area.

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