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Recommendation System: A Collaborative Model for Agriculture

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***Abstract*—** Agriculture is the main sector of employment in India. Yet, it contributes only 13.7% to the total GDP of India. One of the major causes for the continuing downfall in agricultural trends is cultivation of crops that are not suitable with the environmental factors like soil and weather conditions. One way to solve this problem is to use the Recommendation System. It is the information filtering system forecasting the items that may be additional interest for user within a big set of items on the basis of user's interests. This system uses the Collaborative filtering, which offer some recommendations to users on the basis of matches in behavioral and functional patterns of users and also shows similar fondness and behavioral patterns with those users. It also seeks to predict the suitability of an item for a given set of conditions. Such a recommendation system can provide suggestions for a crop that can be cultivated based on soil and weather conditions. The research focus on to build a recommendation system that can collect raw data for environmental factors like soil, weather parameters from experienced farmers, agricultural researchers and other stakeholders. The collected data then will be maintained whether this data is processed. Statistic data analysis and predictive modeling are applied in order to predict a suitable crop accordingly.

Keywords — Recommendation System, Agriculture, Collaborative Filtering, Predictive Modeling.

I. INTRODUCTION

Agriculture is one of the important sector in India. Most of the Indian population is engaged in agriculture occupation. Most of the Indian farmers do farming in traditional way they are unaware of new technologies and trends in market. Farmers work hard for growing good quality of crop. Information and communication technology (ICT) plays important role in agriculture sector to increase income and economical standard of farmer. Agriculture is very information intensive industry but information related to this sector is not properly maintained. The advantages of ICT will be very helpful for providing accurate and timely relevant information about weather and market prices to farmers. This will be helpful for facilitating an environment for remunerative agriculture.

Collaborative Filtering

The biggest challenge in Collaborative Filtering recommended system is scalability. The system should provide accurate recommendations for the super user as the more number of users is increasing in the site. A filtering technology that is widely used in recommended systems is Collaborative Filtering. In comparison with the content-based filtering system, collaborative filtering system could naturally filter the data that the system could not consider and represent, and recommend up-to-date information. Collaborative filtering approach is based on collecting and evaluate a large amount of information on users' behavior, activity or preferences and conclude what users will like based on their relationship to other users. One of the most common types of Collaborative filtering is item-to-item collaborative filtering (people who buy x also buy y), an algorithm promote by Amazon.com recommended system.

User-based collaborative filtering search is to model the collective improvement of asking a friend for guidance. An appropriate type of collaborative filtering algorithms uses matrix factorization, a low-rank matrix similarity technique. A key advantage of the collaborative filtering approach is that it does not rely on machine analyzable content and therefore it is capable of accurately recommending complex items such as movies without requiring an "understanding" of the item itself. Many collaborative filtering techniques have been developed. They can be categorized into two types.

Memory Based Collaborative Filtering: Memory-based CF uses user-to-user or item-to- item correlations based on users' rating behavior to recommend or predict ratings for users on future items. Correlations can be measured by various distance metrics such as Pearson correlation coefficient, Cosine distance, and Euclidean distance. Memory-based

collaborative filtering uses the whole training set each time it computes a prediction, which makes it easy to incorporate new data but suffers slow performance on large data sets.

Speedup can be achieved by pre-calculating correlations and other needed information and incrementally updating them. For some applications, however, the size requirement makes the approach infeasible. It can perform with high recommendation accuracy, and new data can also be easily applied into recommendation. However, it is costly in computing and with bad scalability [1] [2].

Model Based Collaborative Filtering:
Unlike Memory-Based CF, Model-Based approach does not use the whole data set to gauge a prediction. Instead, it frame a model of the data based on a guidance set and uses that model to conclude future ratings. For example, model based CF method builds a model of the data set as clusters of users, and then uses the assessment of users within the cluster to predict. A very fortunate model-based method is the Singular Value Decomposition (SVD)[3], which represents the data by a set of vectors, one for each item and user, such that the dot product of the user vector and the movie vector is the best approximation for the training set. Typical the model building process is computationally expensive and memory intensive. After models are constructed, predictions can be done very fast with small memory requirement. Model-based CF methods frequently achieve less authentic prediction than memory-based methods on dense data sets where a large fraction of user-item values are applicable in the training set, but perform better on sparse data sets.

Section I explain the importance and role of ICT in the Agriculture field and also present different Collaborative Filtering Techniques. Section II provides the details of different research papers relating to the decision making methods for the suitable crop that is to be cultivated based on various factors. Section III explains the proposed system through the architecture that provide suggestions for a crop that can be cultivated based on various factors. Section IV concludes the paper on building a recommendation system that can collect raw data for environmental factors like soil, weather parameters from experienced farmers, agricultural researchers and other stakeholders.

II. RELATED WORK

In existing approaches, given a region and a crop, the suitability level for a crop is shown for different sub-regions within the region. Many geo environmental factors like soil, climate, slope, flood and erosion hazards are considered. But it is limited to very few crops. Results on other environmental factors were not good.

Earlier, the multi-criteria land suitability was assessed more non-spatially, assuming the spatial homogeneity over the area under consideration. This, however, is unrealistic in cases like land suitability studies, where decisions are made using criteria which vary across in space (Malczewski, 2003) [4]. Non-spatial conventional Multi-criteria Decision making (MCDM) techniques average or total the impacts that are judged appropriate for the whole area under consideration. To address the spatial decision making, Multi-criteria Evaluation (MCE) and Geographic Information Systems (GIS) can be integrated [4][5].

The inability of the normal decision making methods to address the imprecision and the uncertainty paved the path for the fuzzy decision making techniques. There are some approaches which takes uncertainty of data into account [6] (like weather and nutrient data).

The system by Prakash T.N uses Analytic Hierarchy Process (AHP), Ideal Vector Approach and Fuzzy AHP [7]. A multicriteria decision making technique is developed using fuzzy logic and land suitability (current suitability) is analyzed for agricultural crops. Much more factors like soil, climate, irrigation, infrastructure and socio-economic factors are considered. But limited to a very small area (594 sq. km) and restricted to a single crop (rice).

III. METHODOLOGY

Recommendation System: Content-Based System and Collaborative System

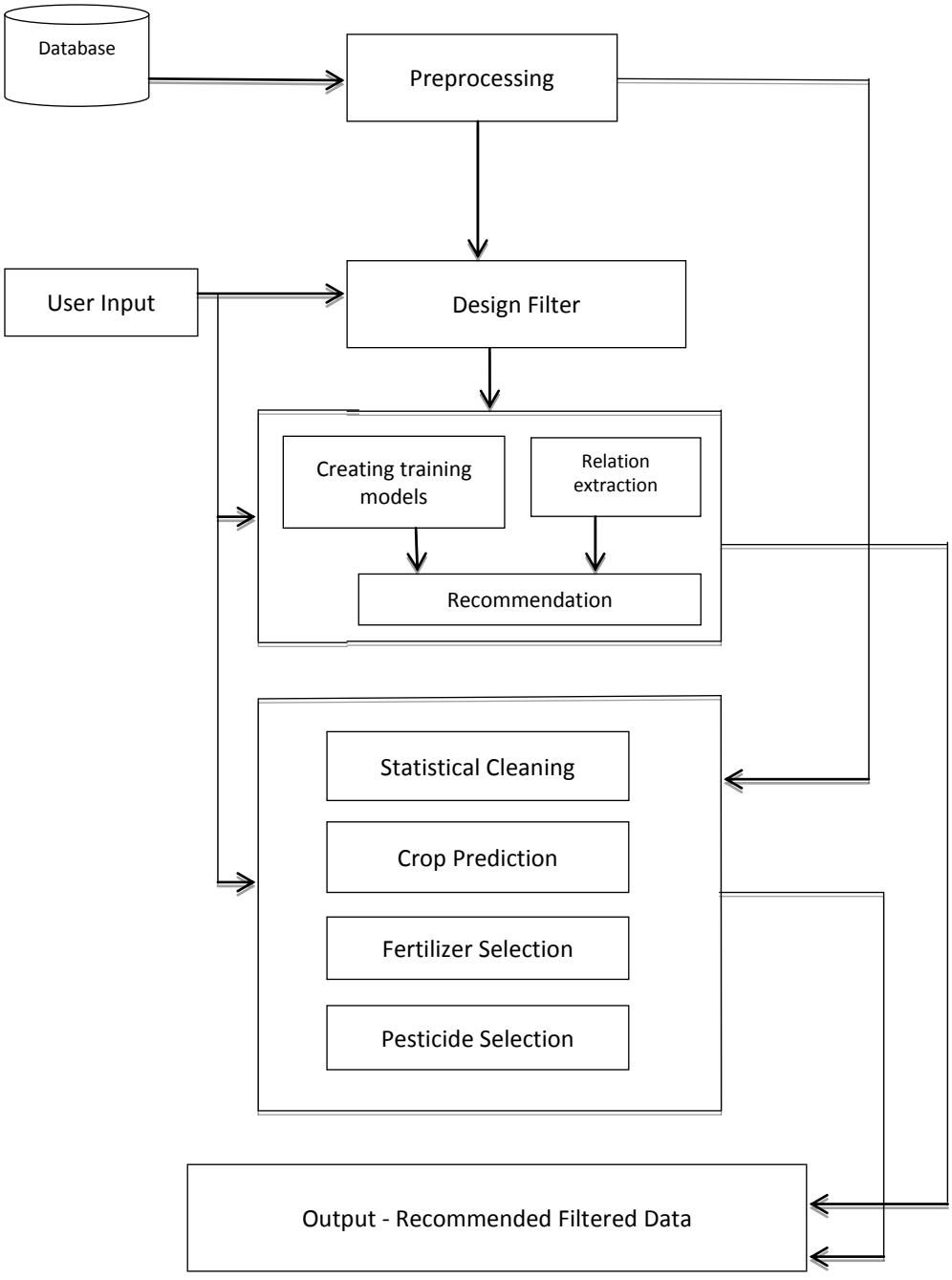

Figure 1: Architecture of the Proposed System

Content-based systems examine properties of the items for recommendation while collaborative filtering systems recommend items based on similarity measures between users and/or items. Information extraction [8] is the task of

automatically extracting structured information from unstructured and/or semi-structured machine-readable documents. In most of the cases, this enterprise concerns processing human language texts by means of common language processing.

In this paper as shown in Figure 1, proposed a hybrid recommendation system by including the advantages of content and collaborative systems to suggest a crop and farming strategy based on regional historic parameters [9]. The focus is on looking at the suitability of parameters, similarity of parameters with the historic weather and soil data collected. Thus the proposed crop recommended falls under the collaborative system of recommendation.

On the other hand, the cost and weather predictions and agricultural modules are content based systems. So, integrating content based and collaborative based system to form a new hybrid recommendation system, wherein the content based system comes from the consideration of weather and soil prediction systems while incorporation of cost contributes to the collaborative system of recommendation. Given a region as input, the system should recommend the most suitable crops based on weather prediction for the region, soil parameters of the region, cost predicted for the crops to maximize yield [10]. The system should also suggest fertilizer, pesticide, other farming strategies for the crops recommended. The crops should match the historic data and the weather, soil of the region. With increasing lack of information about agriculture among farmers' major disasters for farmers has been on the increase. This paper will yield as a complete support for farmers and also small scale garden farmers for choosing crops for harvesting.

IV. CONCLUSION AND FUTURE SCOPE

Recommender systems are one of information filtering systems forecasting the items that may be additional interest for user within a big set of items on the basis of user's interests. Recommender systems are considered as a filtering and retrieval technique developed to alleviate the problem of information and products overload. Collaborative filtering is the most popular and successful method that recommends the item to the target user. This paper proposes a new collaborative filtering approach for recommender system, which have been studied in dynamic environment. By developing an improved collaborative filtering recommender system based on proposed algorithms, will be useful in the agricultural field.

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