Software Development for a Farm Management System for Research

Saikumar , Mahendra Kumar B
PG Scholar Department of MCA, Dayananda Sagar College of Engineering, Bangalore
saikumardesai86@gmail.com
Assistant Professor Department of MCA, Dayananda Sagar College of Engineering, Bangalore
mahendra-mcavtu@dayanandasagar.edu

Abstract: This research project focuses on the development of an integrated application for managing a research farm. The application utilizes a decision tree algorithm to provide agricultural recommendations based on the user's requirements. These recommendations may involve the use of fertilizers, pesticides, and other solutions. The system also includes a module for requesting and allocating farm resources, such as machinery, fertilizers, and chemicals. Users can generate reports and communicate with their respective advisors via email regarding their tasks. Advisors can create task lists for their supervised students and monitor the progress of each job, facilitating effective communication and record-keeping. The system underwent evaluation using the ground truth, as well as values for recall and precision were obtained to assess its performance.

Keywords: Decision tree, Research Farm, Recall, Recommendation system, Precision.

I. INTRODUCTION

a management instrument run by computers Precision. called RFMS, operates within a real environment to support research students in making agriculture-related decisions. Farm management, as defined by Kay and Edward (1994), is an ongoing decision-making process that involves allocating competing users for scarce resources like labor, capital, and land. Punjab Agricultural University A management tool that uses computers., which encompasses a 580-hectare land area with several hectares dedicated to research, faces the challenge of managing multiple crops, farming equipment, and manpower on this large scale. To address this issue, It is suggested to use a web-based system to administer research farms.

he research farm management system attempts to improve resource allocation and scheduling, provide an organised database of farming resources equipment, and provide a tool for managing and monitoring daily operations operations. A major concern in inventory management is determining the optimal timing and quantity of orders. To tackle this,

the system synchronizes inventory allocation with the cultivation stages of crops. Specifically developed for wheat cultivation, the system examines the agronomic practices associated with growing

wheat, categorizing them into principal procedures (including Preparation of the soil by tillage, irrigation, seed treatment, soil analysis, use of fertilisers and chemicals, and plant protection) and sub-processes. The rules and procedures required to accomplish these tasks, along with the necessary materials and inventory, are stored as knowledge in a structured and unstructured database.

To recommend the best possible solutions, algorithms have been developed to identify student requirements from both the table-oriented and text-based databases. The effectiveness of the system was evaluated to assess its overall performance

II. RELATED WORK

In order to investigate decision support systems that help smallholder farmers make strategic and tactical decisions, Churi built a system. The main goal was to increase crop productivity in semi-arid areas and reduce climatic risks. The study studied information communication and knowledge sharing strategies for improving decision making and evaluated the choices taken by farmers at the farm level to reduce climate risks. This DSS was created to improve communication between various agricultural actors accessing the internet and mobile applications agricultural knowledge from other farmers, Through a centralized database, agricultural extension agents and research organizations can communicate. The created database acts as a storehouse for knowledge and information about agriculture, including market trends, climatic data, and the agricultural

(2006) Whelpton and Cooke created a computer system specifically designed for equipment management, aimed at fulfilling the needs of equipment management processes. Initially developed for personal computers, the system has undergone upgrades to offer true multiuser functionality and advanced program capabilities. These enhancements were made possible through improved hardware and the implementation of a relational database.

The system offers a complete collection of information, including worksheets, service records, repair costs and durations, and inventory data. The integrity of the data was ensured with particular care, and it was made simple to enter further data. The goal of the development of the DSSAT4 Shell programme was to give users a convenient working environment that smoothly integrated different apps and standalone tools that use the DSSAT4 crop models. It gives users access to programmers that let them create and alter data files, run crop models, and examine the output of those models. The project was implemented as a XBuild program to enhance the accessibility and effectiveness of the crop models' functionality.

With the DSSAT4 Shell program, users have the flexibility to specify different combinations of management options for simulating various crops. This includes purposes such as validation through Crop rotations, seasonal analysis, comparison with observed data, and geographical analysis are all features of DSSAT. the programme, driven by a user-friendly menu, prompts The Through a centralized database, research institutions and agricultural extension agents can communicate., fertilizer (including dates, amounts, and types of fertilizer applications), residues, and other pertinent factors.

A concept called the Computed Farm Machinery System (ComFARMS) was developed by Lazzari and Mazzetto to address the difficulties Italian agricultural mechanization encountered. farms with a land size of less than 250 hectares. The primary objective of the model was to analyze these challenges from strategic and management perspectives, with a specific focus on the selection of farm machinery for multicopying scenarios.

ComFARMS utilizes a strategic approach to assist users in selecting appropriate farm machinery. Users input the desired A schedule for crop rotation with a list of activities for each crop. Based on this information, the model generates a collection of implements and tractors for use in machinery. Each machine in the set has a type, a number, and a size specified.

Tahir and Chaudhary (2011) suggested a technology-managed intelligent decision support system (DSS) for inventory analysis and control principles. ABC Analysis, Price-based Analysis, and Quantity-based Analysis are three main categories of analytical procedures that are included in the DSS. The inventory management system was created especially for a gas plant.

The Price based Analysis and Quantity based Analysis involve formulating a comparative analysis matrix to identify the most critical inventory items based on their respective quantity and pricing. MATLAB is used to implement the system. The inventory products, their prices, and the amounts used within a specific time frame serve as the system's primary inputs. The DSS produces outputs based on these inputs that categorise goods as crucial based on their price, quantity, annual cost, or a combination of all three.

The authors came to the conclusion that an Inventory Analysis and Control Decision Support System indispensable in effectively managing inventory, especially in the context of the gas plant industry.

III. METHODOLOGY

In order to give users the most recent data, RFMS is built as a dynamic web application that constantly retrieves new data from the database. A scripting language used on the server is used to allow interaction with the database. Here, PHP is used to perform queries against the MySQL databases that house the Agri-knowledge library..

The development of RFMS involves the implementation of several algorithms. In contrast to Algorithm-I, also known as AGRI_DDS, Algorithm-II, also known as AGRI_DDS_2, operates on unstructured data. The use of these algorithms allows for the processing and analysis of data. within the system, allowing for efficient retrieval and presentation of information to the users.

Pseudocode for Algorithm AGRI_DDS:

Step 1: Initialize set 'u' with users/students.

Step 2: Initialize set 's' with solutions they are seeking.

Step 3: Define function 'f(r)' that generates a recommended solution for a user.

Step 4: For each user 'u' in set 'u', perform the **following** steps: Obtain 'n' inputs or hints from the user.

Build the function 'f(r)' dynamically based on the inputs provided.

Evaluate the set of available solutions {s(i)}.

Select the best response is 'r'. from the set of available solutions based on the function 'f(r)'.

Assign the recommended solution 'r' to the user 'u'.

Algorithm: AGRI_DDS

The algorithm AGRI_DDS is designed to address decision- making and control problems in agriculture. It utilizes structured data stored in relational databases, which contain Agriculture-related information, guidelines, best practises, and facts. These databases serve as a repository of knowledge and information. The processed and examined data is saved various perspectives, aiming to solve issues and problems and generate summarized outcomes in the form of useful information, specifically agricultural solutions.

The method makes use of knowledge discovery and data mining techniques to suggest the desired outcome to the user. In the database, established best practises proposed by Punjab Agriculture University (PAU) are matched with key parameters submitted by the students, such as nitrogen concentration and soil type. Based on this matching process, the algorithm provides the finest suggestion for the student.

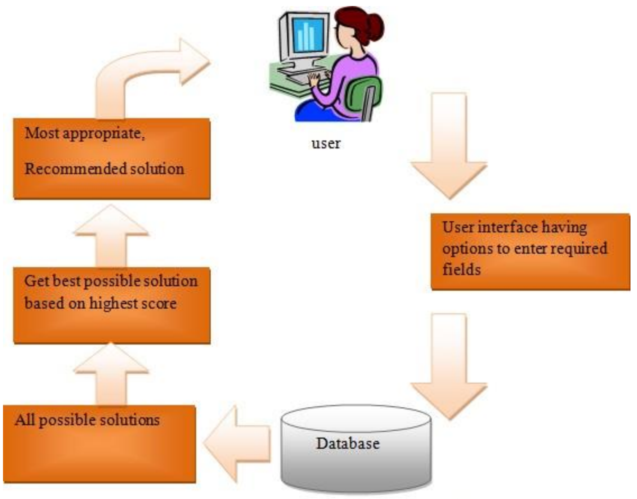

Fig. 1. The Algorithm-I flow diagram for structured data

(Algorithm AGRI_DDS_2) Pseud logic

Step 1: For each query in the set of queries, perform the following steps:

Convert the query into tokens.

Step 2: Remove any stop words from the tokens.

Step 3: Remove any duplicate tokens.

Step 4Calculate each query's primary process score:

Calculate the similarity score if the user query data (tokens) matches the text-based data's keywords. Else, calculate the dissimilarity score.

Step 5: Calculate all sub-process scores for each query.

Step 6Determine the overall score for each query utilizing the product of the main process score and the sub-process scores.

Step 7: Display the result with the largest score.

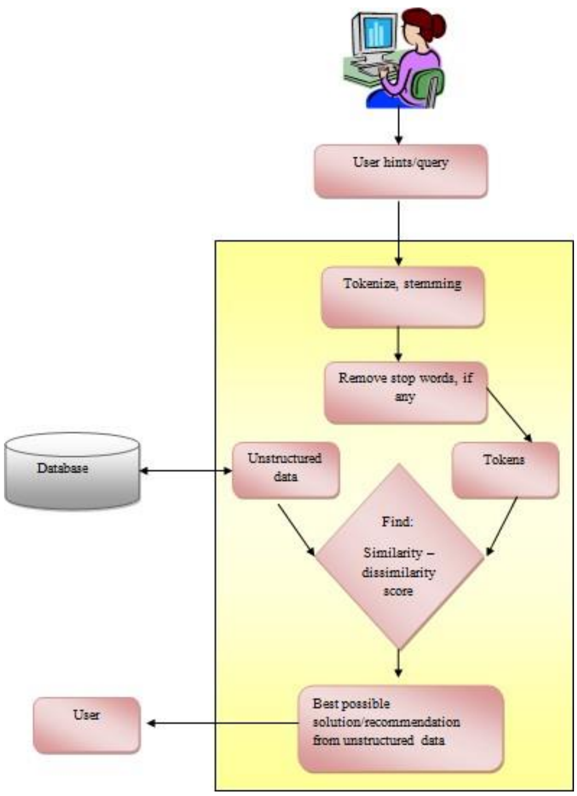

Fig. 2 shows the algorithm-II's flow model for unstructured data.

Algorithm: AGRI_DDS_2

The AGRI_DDS_2 algorithm employs a method that compares the query tokens with the potential recommended solutions to determine the categorical difference. It constructs similarity and dissimilarity matrices to calculate the term frequency based on both common and disjoint sets. This approach allows for the identification of a solution by computing a relevance score, which considers the product of the common and disjoint sets. To ensure accurate results, unnecessary and clichéd language excluded based on the relevance rating calculation. The score is determined by the difference between the categorical Euclidean distance on the issue at hand and the several suggested solutions.)

IV RESULTS AND DISCUSSION

The effectiveness or the effectiveness of a recommendation system assessed by how closely the suggested results align with the user's actual preferences. To evaluate the recommendations provided by the RFMS, matrices for accuracy and recall scores were used. recall and accuracy are fundamental metrics employed in evaluating search strategies. Precision refers to the proportion of relevant information or solutions that match 0the user's requirements out of the total number of documents that the search turned up. Contrarily, recall is the ratio of the number of pertinent documents returned by the search to the total number of pertinent documents that were found (precision).. In the initial testing phase, the system was evaluated using 15 sample queries, and the outcomes were presented as diverse results in tabular form. Table I showcases a selection of the

Query No.	Query	No. of Results	No. of relevant results	No. of irrelevant results	Total results in database	No. of results left in database
1	Nitrogen to wheat	16	10	4	30	2
2	Brown leaves around the edge	13	8	2	25	3
3	DAP in medium soil type	19	12	2	38	5
4	Pest in wheat	26	16	6	53	4
5	manganese deficiency	22	14	5	44	3

queries that were used to assess the system's performance.

The algorithm-II's flow model for unstructured data is depicted Based on the evaluation against the actual data, the system's recall and precision values are as follows, using query number 1 from Table I as an example:

There were 10 relevant results.

30 total outcomes are in the database.

Recall = (Number of relevant results / Total results in the database) * 100

Recall = (10 / 30) * 100 = 33%

Number of relevant results: 10

Number of results: 16

Precision = (Number of relevant results / Number of results)

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* 100

Precision = (10 / 16) * 100 = 62%

These values indicate that the system achieved a recall of 33%, meaning it successfully retrieved 33% of the relevant results from the database. The precision value of 62% indicates that out of the total results retrieved by the system, 62% were relevant to the query.

COLUMN NAMES	DESCRIPTION	EXAMPLE
Query No.	Number of sample queries	Total 15 has been taken
Query	Text queries fired by the user to interact with our database (DB)	For query 1: Nitrogen application
No. of Results	Total results fetched (having score count more than 0 for the matched keywords in DB)	For query 1: 16
No. of relevant results	All results matched in DB for queried keywords	For query 1: 10
No. of irrelevant results	Those rows which are extraneous to the problem	For query 1: 4
Total results in database	Count of the queried phrase available in the DB in totality	For query 1: 30
No. of results left in database	Those relevant solutions which could not be fetched from DB	For query 1: 2

Describes table I in table II

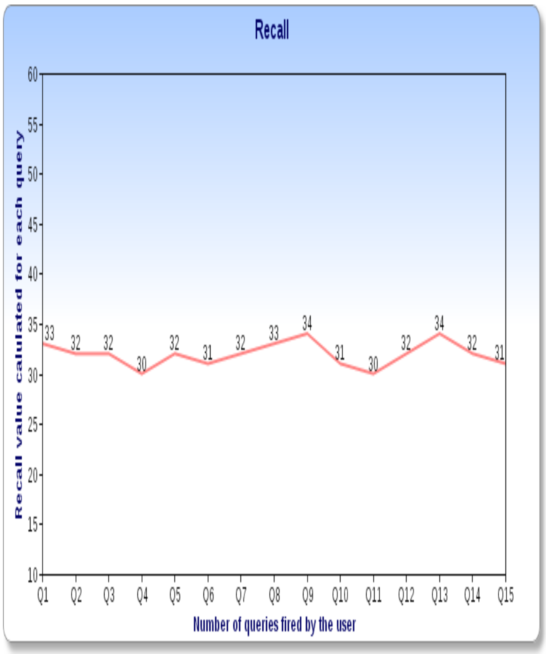
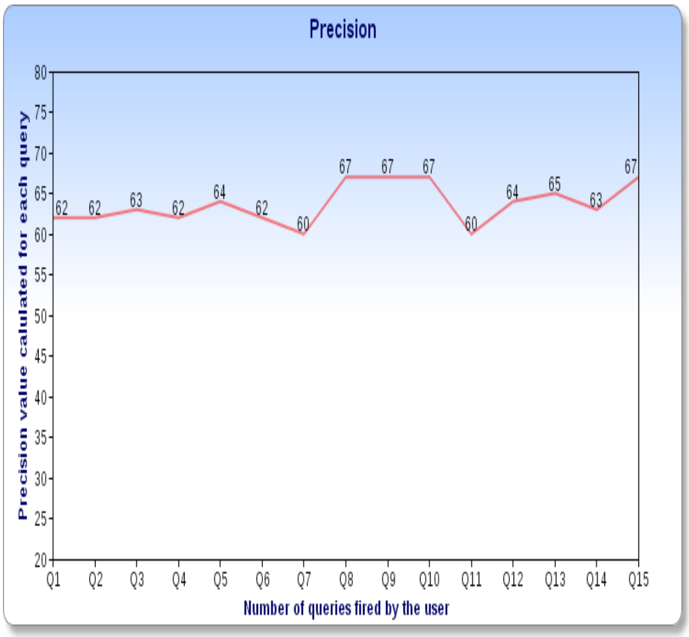


Figure 3: Recall value graph

The recall values obtained for each of the many sample queries evaluated to gauge the system's efficacy are shown in Figure 3 for each query. The X-axis represents the query numbers, ranging from Q1 to Q15, which were used during the testing phase. The recall values, which indicate the proportion of relevant results retrieved by the system out of the total number of existing The Y-axis shows the essential documents. and the Y-axis represents the recall numbers' minimum and greatest % range. The graphs demonstrate that the recall value for each of the fifteen sample inquiries ranges from 30% to 34%.



Those precision values are shown in Figure 4.

obtained for each of the diverse sample queries used to assess the system's effectiveness. The X-axis displays the query numbers (Q1, Q2, Q3, ..., Q15) that were tested, while the Y-axis indicates the percentage range between 0% and 100% for precision values. According to the graph, All fourteen of the example queries' precision values fall between 60% and 67%., providing an insight into the system's performance in terms of precision across different quarter.

CONCLUSION

The fluctuating values of precision and recall depicted in the graph are expected and natural for our system. Each query carries a varying weights for values of accuracy and precision, resulting in varying outcomes. Based on the obtained values, we can conclude that the precision and recall lie within the range of 31% to 67%, which is considered satisfactory for a system of this nature. It is worth noting that our system could benefit from additional data to further enhance the quality of its results. In our academic research, we utilized a dataset comprising approximately 300 rows. By incorporating more data into the system, its efficiency is expected to improve. Overall, the current algorithm and the data's level of quality

within our system are deemed to be adequate based on the observed ratio.

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