SDLC for Decision Support System for Agriculture Domain

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Abstract - Decision support system helps to improve decision making process. In this paper, we address how to trace standard SDLC (Software Development Life Cycle) for designing a DSS. The designed DSS will help farmer to take appropriate decisions regarding various aspects of Agriculture so as to minimize the losses of having less yield. This research study finds a good scope in India as Agriculture is the predominant occupation of two-third of working India population for their livelihood.

Keywords - Software Engineering, SDLC, Decision Support System, Crop Selection, Artificial Intelligence

I. INTRODUCTION

Indian agriculture is mainly monsoon dependent with limited land resources. Keeping growing human population, the only way to increase crop productivity with varied farming situations, farmers' practices, thorough planning with active participation of farmers. An online agriculture decision support system is developed to assist the farmer for making a good decision in particular situation.

Generally taking a good decision at proper time is directly affecting the total production of the crop. Taking a decision is very complex process as there are several factors affecting entire farming process. For a good decision, one has to consider rainfall parameters, atmospheric condition, humidity, type of soil and many others factors. End user of the system is farmer and from this particular region the farmers are not more convenient with English. Rather than providing the solution in English, the local language i.e. Marathi is used for the displaying the information in web pages, so that the end user can thoroughly understand it. Entire system contains two different software platforms - more advanced software technology i.e. Dot Net as front end tool and SQL server as back end. The software developed by using MVC pattern which has mainly three layers. This three tier architecture allows programmer to add further modules in the software without disturbing previous one. In this way we can add more number of parameters to make system more complex.

In addition to the normal information we have developed the fuzzy based inference system that gives the framer the idea about the productivity of the crop i.e. the possible yield of the crop. If we provide necessary parameters to this rule based fuzzy inference system then the system provides possible yield of the chosen crop. For the development of fuzzy inference system we have used MATLAB as a software platform. Rest of the program is developed in the .Net and SQL Server2005 as advanced tool for software development. SQL Server gives more security and flexible approach to storing large amount of the data.

II. LITERATURE REVIEW

We have made rigorous analysis of the literature. There are several factors which affect on yield of crops [1]. Further, Farmer has to analyze these several factors while taking decision of cropping and such decisions are changed area wise because geographical conditions differ region to region. In India, weather is the single major limiting factor in crop production. Hence successful farming calls for appropriate decisions in the light of weather conditions have great significance. Similarly, the monsoon depressions can be said to be a single factor that controls the distribution of the rainfall over the India [2]. A sound knowledge of the climate and an understanding of the complex processes of interaction between climate and biological processes of the plants are also essential aspects to be considered. Above discussion highlights complexity of crop selection process. We also witness scope for fuzzy analysis as there is always uncertainty in the factors responsible for crop selection. The benefits reported from the increasing use of fuzzy include more accurate decisions, flexibility, improved quality and minimization of human inconsistencies. Finally, further work should be undertaken to evaluate the effectiveness of the use of fuzzy logic in other areas such as banking, financial investments, military and project management. Today's DSS system includes database and knowledge base. In addition, modules used for formation of models, optimization, simulation, decision analysis and inference are also seen. The simulation was employed to test sensitivity of the plan weather and market variations. We have also witnessed reasons for failure and explore the possibility that the adoption of a user centered design approach to solve the problem. The simple method for incorporating user requirement into this type of software is given. Many scientific institutes have turned to decision support system

including agriculture industry as well. We fill that there are following reasons of lack of uptake of DSS

1. The complexity of the software's interaction with the user.
2. The accessibility and required accuracy of inputs
3. The cost benefit of using the system
4. The need to answer the right questions
5. The fit with the user working patterns and existing organizational structures.

III. ORIENTATION OF PRESENT WORK

Since climatic conditions vary region to region, we are hopeful for providing an online solution for making decision to farmer. The system is basically a web based GUI system designed by using Microsoft Visual Studio Dot Net platform as front end tool and SQL Server as back end tool. An attempt is made to provide all the information in local language i.e. Marathi, so that user will feel more comfortable with it.

For accessing the information from the internet the coding is done in ASP Dot Net platform. Data bases for different aspects like fertilizers, type of soil, rainfall, etc are stored in SQL Server 2005. This version of database package gives more flexibility and security to the data. The system developed contains information related to fertilizers, pesticides, pest control, for specific type of soil.

In addition fuzzification is carried out which mainly focus on the possible percentage of yield of particular crop. The most important parameters have been identified which is suitable for development of fuzzy based system? The parameters will be selected where the vagueness is often encountered for example rainfall, type of soil etc. Data is collected from various agriculture experts and farmers and tested on various farms. The rule based system is devised out of it after consulting Agriculture Expert. We have concentrated on percentage of yield, so the parameters that greatly affects on it will be identified and rule based system can be designed based on it. The output of the system wills nothing but the percentage of yield of the selected crop. The present system is implemented using fuzzy logic tool box which is available in MATLAB software. For implementation, the specification of input, output and rules are required. Design of membership function is another aspect in this system. The careful design of membership function helps to give the correct output. As per the range of values of inputs are provided for the particular crop then the output will be provided by the system.

IV. SOFTWARE ENGINEERING ISSUES

Many researchers have developed decision support system for various aspects related to agriculture such as use of fertilizers [5]. Some of them focus on implemented fuzzy based approach in decision support system [6] to make it more powerful. Some researchers suggest knowledge based DSS [7] and MIS based DSS [8] systems. Decision-making is

a process which decision maker uses to arrive at a decision. The core of this process is described by the Herbert Simon in a model. He describes the model in three phases as a) Intelligence; b) Design and c) Choice. Management Information System follow this model in its development stage [9].

There are several websites available which provide agriculture information. Almost all of them provide the information about the specific crop. Very few from them provide all the information necessary for the users. Due to increasing awareness and use of computer in almost all the fields, use of internet is reached in rural area also. Still there is problem of language, all web sites provides information generally in English which is not understandable by most of the framers. Our attempt has solved this language barrier.

Designing a web application on agriculture information system called "On-line Agriculture DSS" for providing agriculture information to the farmers is the main issue. It offers more flexibility in operation, provides all the necessary information to the farmers for making a appropriate decision in farming. It provides information related to the crops, fertilizers, pest controls, different types of diseases found in various crops and desired action to recover from it. In addition to this program also contains additional fuzzy based module providing information about possible yield of the crop if you provide the necessary parameters.

The feasibility study was conducted by developing the online application within a very short period of time. Few meetings were proposed to be organized with the technical experts for System Design. Minimum hardware requirement of the project is P4 or higher processor , 512MB RAM and Windows-XP or higher operating system. Prototyping was carried out which helped system designers to build an information system that intuitive and easy to manipulate for the end user. System Development Life Cycle (SDLC) was also drafted and traced. It is a structure imposed on the development of software. There are several models for such processes, each describing approaches to a variety of tasks or activities that take place during the process. An important task is documenting the internal design of the software for the purpose of future maintenance and enhancement. The various task of the system was documented to understand and work with the system. It was recommended by the expert group to design the web application by using .NET technology and SQL-Server as back end. The MVC patterns were used. The main purpose using MVC pattern is to decouple the GUI from the data. It also gives the ability to provide multiple views for the same data. MVC pattern separates objects into three important sections [19] . For example when a user is suppose to retrieve information related to pest control first it takes this data from the user interface (basically a view). Then user perform event like search and execute the actual query regarding to select operation. All these outputs are stored in data grid which is present in view of pest control. SQL Server support new data types like bigint-8-byte integer type, SQL variant. It allows the storage of data of different data types. There is also a

table data type which allows application to store results temporarily for later use. It included native support for managing XML data, in addition to relational data. It has also been enhanced with new indexing algorithms, syntax and better error recovery systems. Data pages are check summed for better error resiliency, and optimistic concurrency support has been added for better performance. Permissions and access control have been made more granular and the query processor handles concurrent execution of queries in a more efficient way. Partitions on tables and indexes are supported natively, so scaling out a database onto a cluster is easier. SQL CLR (Common Language Runtime) was introduced with SQL Server 2005 to let it integrate with the .NET Framework [23].

V. EXPERIMENTATION

Experiments are carried out on the medium sized farms mainly for different types of atmospheric and others conditions. If one parameter such as a soil type is considered the average yields for different crops are tested. It was found that the system runs successfully. Our decision support system correctly provides information about the pesticides, the proper use of fertilizers according to the type of soil. The fuzzy inference system also provides the approximately correct results of the possible yield..

VI. Data COLLECTION

Data is collected from different sources such as agriculture experts from Agriculture Department of Government of Maharashtra, Krushi Vidnyan Kendra (KVK). Some of the data was collected from the farmers directly because farmers can provide actual on site information. In addition, data from different books and news papers like Agro- One was also cited.

VII. CONCLUSION

This paper highlight software engineering issues behind development of an Agriculture based DSS. Such agricultural DSS in their widest sense have a significant role to play in taking decisions regarding plant selection. The paper draws its conclusions from the experiences of a practically developing an online DSS system.

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