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# Intelligent Soybean Disease Tutor System

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## ABSTRACT

*Intelligent Soybean Disease Tutor System is developed using ASP.NET as a sub-system of Expert System of Soybean Diseases at Directorate of Soybean Research. The dynamic knowledge base is implemented using SQL server. This paper presents the development of Intelligent Tutor System for Soybean Diseases. The methodology used for development of the system is discussed. The importance of the system as an effective training tool for different clientele is described. The functionality of the system is explained with the help of user interface for better understanding of the system. This system can augment the conventional educational methodologies in specific courses in plant pathology. The current tutor system will pave a way to transfer the disease management technology in user-friendly manner.*

**Key words:** Intelligent tutor, knowledgebase, knowledge acquisition, soybean disease and training tool

Soybean crop suffers from several diseases caused by bacteria, fungi, viruses, physiological disorders. Annual yield losses due to these diseases are in the tune of 12 per cent of total production (Gupta and Chauhan, 2005). Information on management of all the major diseases of soybean crop is needed by different clientele like students, research scholars, research workers, extension personnel, disease trainers, entrepreneurs and farmers. Therefore, Intelligent Soybean Disease Tutor System is developed to provide the information in different easy-to-understand ways.

Intelligent Soybean Disease Tutor System is a sub-system of Expert System of Soybean Diseases developed at Directorate of Soybean Research. It serves as an audio-visual soybean disease training tool. It provides information on useful disease aspects like pathogen, geographic distribution, economic impact, favourable climatic conditions, detection methods and effective integrated management practices. It is a useful and interactive audio-visual training tool for providing pathological trainings with the help of multimedia effects, colour pictures, videos, texts, and graphics with capability of text-to-voice interface.

## MATERIAL AND METHODS

Intelligent Soybean Disease Tutor System is developed using the system architecture (Fig. 1.) consists of i) disease knowledge base, ii) knowledge acquisition system, iii) audio-visual tools and iv) teaching parameters. It facilitates provision of pathological training services to different clientele. Knowledge engineers with the help

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of domain knowledge provided by disease experts and using knowledge acquisition system forms the disease knowledge base. This knowledge base provides all the knowledge for giving training to the end users. Tutor can use audio, videos, disease photographs and text-to-speech conversion tools to provide training in attractive manner.

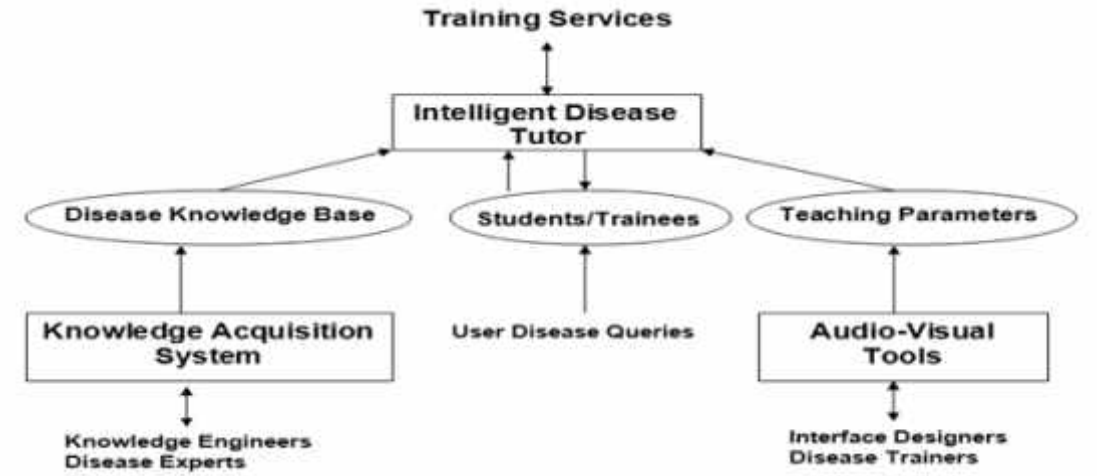


**Fig.1. Intelligent disease tutor system architecture**

**Software development**

The system contains the disease knowledge about twenty five soybean diseases. The development of multimedia intelligent interface was done as follows.

*Software selection*

The interface is developed using the ASP .NET and C# for development of the system (Harvey *et al.,* 2001; MacDonald, 2005) as the concepts of text-to-speech translation can be easily used with applications built using the Microsoft .NET framework using 3-tier web architecture.

The dynamic knowledge base is implemented using SQL server. Fig. 2 explains pictorially how our intelligent tutor system employs the three-tier web architecture using .Net technology (Active server pages) and SQL server. The .NET software development platform is based on virtual machine based architecture. The entire .NET programs are independent of any particular operating system and physical hardware machine. They can run on any physical machine, running any operating system that contains the implementation of .NET Framework.

Database contains thirty-one database tables. The tables store facts and knowledge required for the knowledge base. A part of the database relationship diagram is shown in Fig. 3.

*Software Modules*

The tutor system contains different modules for – (i) disease detail, (ii) disease comparison, (iii) new user registration, (iv) disease picture gallery and (v) disease video gallery.

The Disease detail module helps the user to view detail information on different aspects of soybean diseases. The user can compare different soybean diseases on multiple aspects for in-depth comparison of

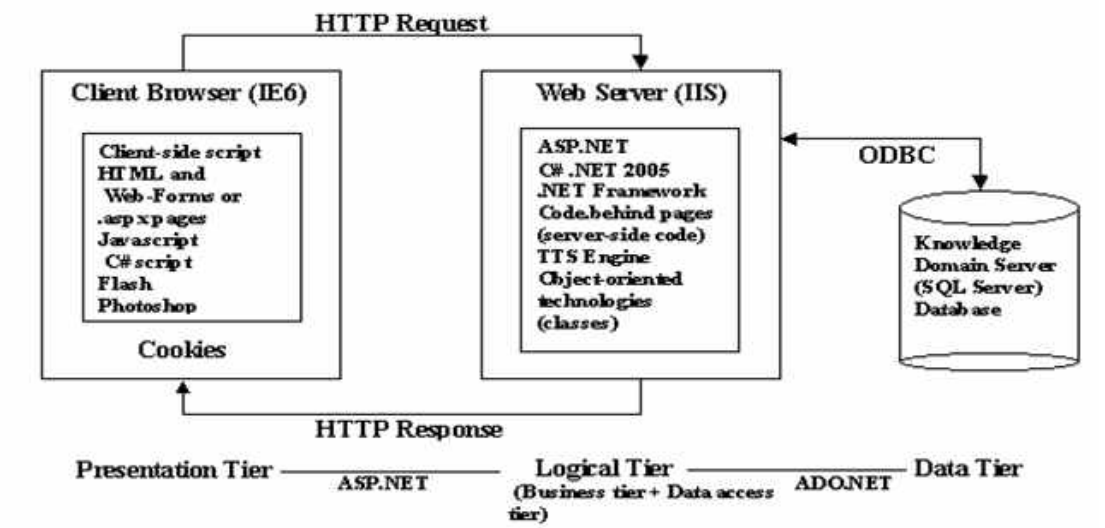


**Fig. 2. Three-tier web architecture of the system (Savita *et al.,* 2011) Database Design**

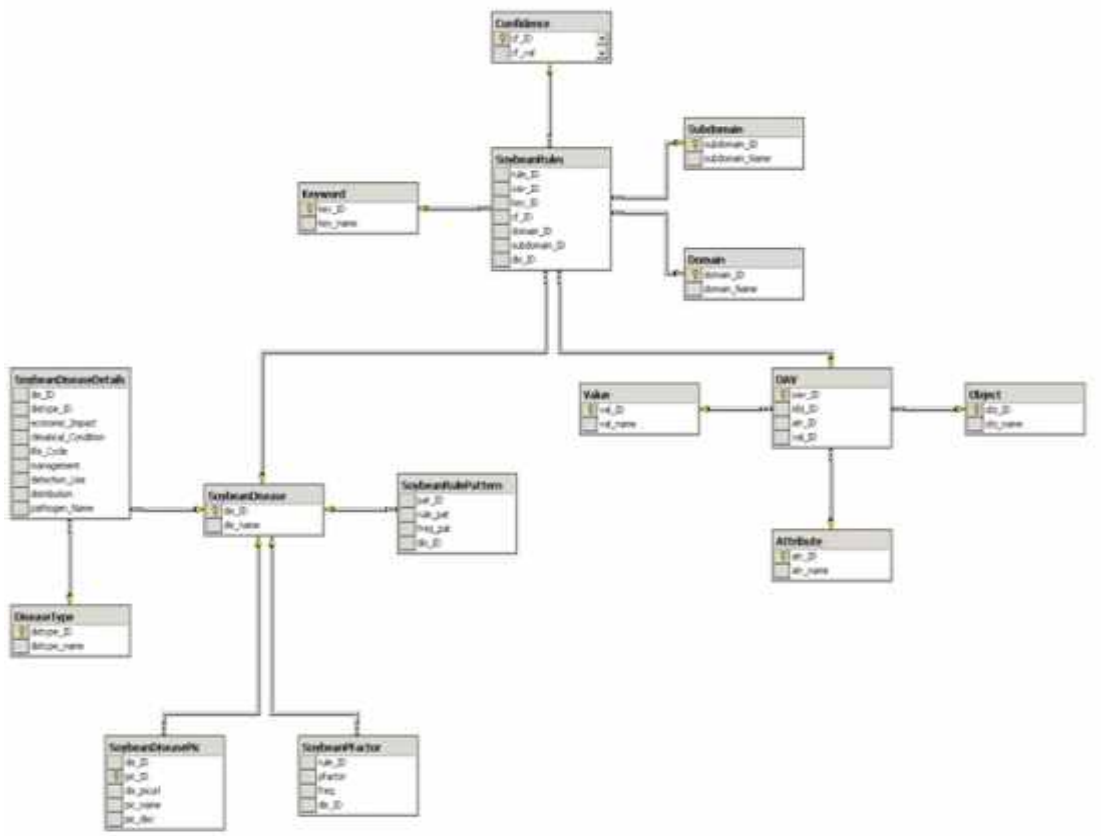

**Fig. 3. A part of the database relationship diagram showing relationship between different database tables**

different diseases by using disease comparison module. The new users can register for getting authorized access of the system by using new user registration module. The main users are students, research scholars, research workers, extension personnel, disease trainers, entrepreneurs and farmers. The registration is free for them for non-commercial, academic and research purpose. The users can view the pictures of different disease infection for giving correct disease symptom inputs by viewing disease picture gallery. The users can also view different disease videos by visiting disease video gallery.

*Text to speech (TTS) translation*

Automatic speech recognition (ASR) is commonly described as converting speech to text. The reverse process, in which text is converted to speech (TTS), is known as speech synthesis (Holmes, 2001). Speech synthesizers often produce results that are not very natural sounding. Speech synthesis is different from voice processing, which involves digitising, compressing (not always), recording, and then playing back snippets of speech. Voice processing results are very natural sounding, but the technology is limited in flexibility and is disk storage-space-intensive compared to speech synthesis.

Looking to this, our system includes the concepts of text-to-speech (TTS) translation and these features can be used comfortably with applications built using the Microsoft .NET framework.

The Microsoft Speech SDK is used to develop text to voice software applications [Microsoft speech API]. This SDK provides a collection of methods and data structures that integrate very well in the .NET 2005 framework.

*Knowledge acquisition system*

A web-based and interactive knowledge acquisition user interface is developed. It allows the expert to enter knowledge directly into the knowledge base, which means without an intermediary. This way of direct interaction of the expert increases the accuracy of the resulting application because errors of communication between knowledge engineers and experts are eliminated and as a result, we get a more reliable knowledge base.

The knowledge of different disease symptoms along with the knowledge on other disease related information like causal organisms, geographic distribution, economic impact, favorable climatic conditions, detection methods and effective integrated management of practices are entered using the web-based user interface of this subsystem. These are collected from literature, pathological experimental field trials, disease compendiums (Hartman *et al.*, 1999), books, scientific papers, disease bulletins (Bartaria *et al.*, 2001; Ghewande *et al.*, 2002; Gupta and Chouhan, 2005) and photographs of different diseases and interviews of plant pathologists.

## RESULTS AND DISCUSSION

The interface is used by end-user by clicking menu-option "Intelligent Tutor" on the main user interface shown in fig. 4.

The user can use the system by doing login in the web form shown in fig. 5. The user gets the information in different ways by clicking menu buttons *viz.*, complete detail, disease comparison, image gallery and video gallery (Fig. 6). The user can get complete information of soybean diseases on different aspects like pathogen, geographic distribution, economic impact, favourable climatic conditions, detection methods and effective integrated management of practices

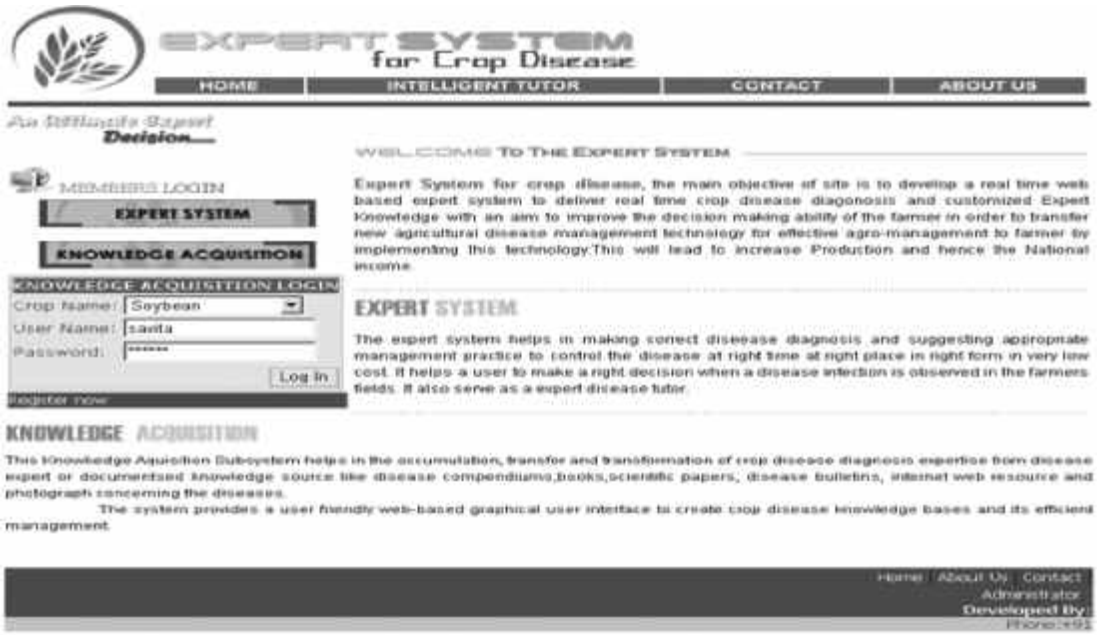


**Fig. 4. Main web page of crop disease expert system**


**Fig. 5. Login page of intelligent disease tutor**

by clicking complete detail menu button (Fig. 7). The user can compare different diseases on aforesaid aspects by clicking disease comparison menu button and by selecting desired options for comparison (Fig. 6). The disease knowledge is obtained in the form of comparison table as shown in Fig. 8. The user can view different videos and pictures to view disease expert knowledge on different diseases according to their interest and choice (Fig. 9). This helps to visualize the disease symptoms and picture-based confirmation of the diagnosed diseases.

This intelligent disease tutor system would provide real time, context-appropriate and cost-effective training enabling learners to perform appropriate disease related tasks in the right manner and at the proper time. In doing so, such an intelligent tutor system would decrease the time required to migrate learners from novice to disease expert, while increasing the number of disease trained personnel successfully reaching a more knowledgeable level. It includes complete, comprehensive disease knowledge expressed to the user effectively with the help of multimedia effects, colour pictures, videos, texts, and graphics. The users could use the system comfortably and found the working with interface satisfactory. Thus, it is a useful and interactive audio-visual training tool for providing pathological trainings. It can augment the conventional


**Fig. 6 Web page for taking inputs to get complete disease details**


**Fig. 7. Web page showing complete details of selected disease**

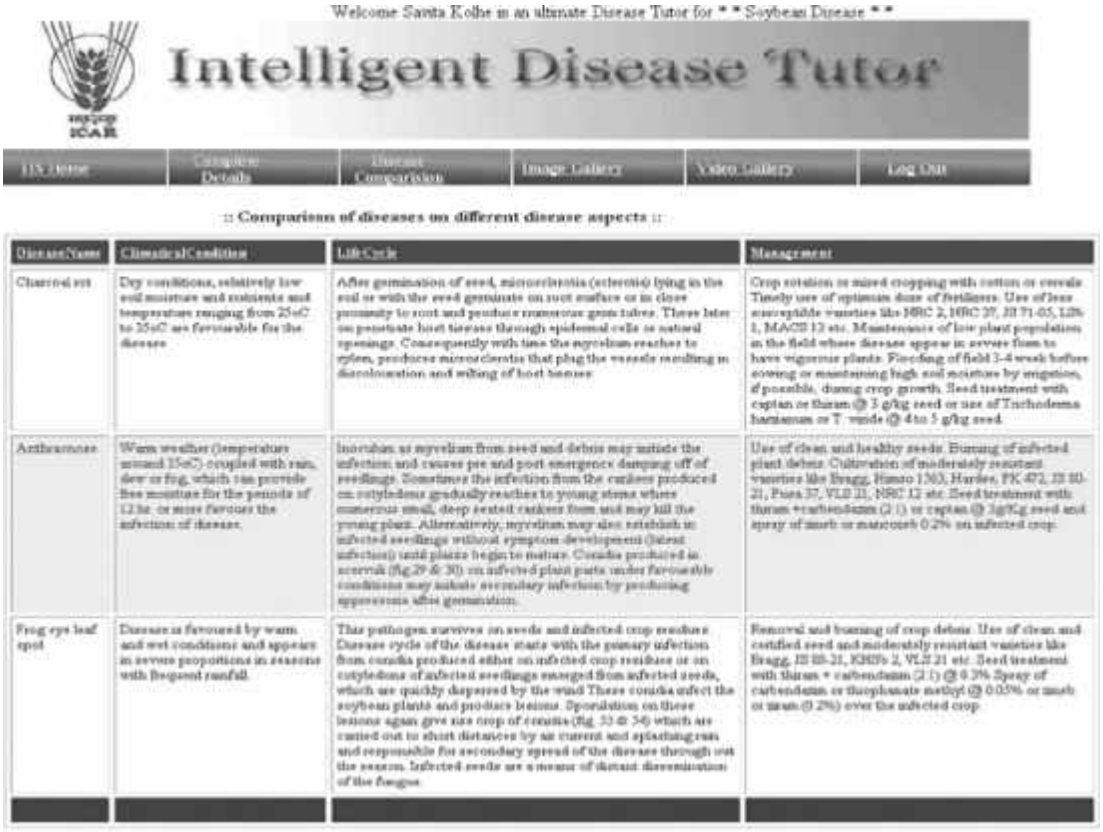


**Fig. 8. Disease comparison on different aspects**

**Fig. 9. Web page displaying disease image of Anthracnose disease**

educational methodologies in specific courses in plant pathology. It can prove to be a powerful means for transfer of technology of agriculture pathological technologies to practices.

Presently, the system generates knowledge in English, but in future it can be integrated with TTS engine of Hindi language also.

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