Chapter 4

Intelligent Autonomous Agents to Support Farmers

4.1 Introduction

The previous chapter described the technologies that are used in developing Agriculture Information systems. Throughout years, researches have been trying to adopt the optimal system approach to solve the problems in such domains and agent technology has rendered promising solutions in effective decision making.

Objective of this chapter is to introduce multi agent technology to cater effective decision making in Agriculture Information Systems. It is important to consider the nature of the technology, users and the processes involved in the approach of applying this technology to the Agriculture Information System (AIS) domain.

4.2 End users of the system

Users are the most important entities of any type of information system. The success of any information system depends on the usability of the system to its end users. Main end users of the AIS are Agriculture researchers, “Govi Jana Seva” officers and the farmers. These users have different type of usage of the system and they can register with the system and maintain their profile with the system.

Initially all the uses have to register with the system. Registration process required personal information to maintain a user profile which consists of name, logging information, address, “Govi Jana Seva” office, nearest town and the district. Once the registration process completed, users (specially farmers) can register their cultivations. Cultivation information will request basic information such as type of the crop, fertilizers used, planted date, irrigation system and planted medium. This information will help agent module during the process of problem solving.

4.2.1 Agriculture researchers

Agriculture researchers will add new knowledge to the domain, correct existing problems and try to harness best practices. Addition of knowledge to the existing domain is done through both local and international researches. Once such knowledge is explored, it should be stored in a knowledge base in order to utilize within the system. Researchers should enter up to date information of the domain timely in order to ensure the delivery of the same to the end users. This will ensure the quick dissemination of useful information and aide farmers to make effective decisions.

4.2.2 "Govi Jana Seva" officers

"Govi Jana Seva" officers can use the system to get information about new research and findings. They can get the latest information form any time at anywhere through the information system and it is possible for these officers to access the system with the privileges granted.

4.2.3 Farmers

It is possible for farmers to communicate with the system using Internet or mobile telephony technology, since mobile channel is available to majority of individuals in the country, it is not doubtful on the reach of this solution to ultimate end users (farmers) or the bodies supporting the ultimate end users (government agents supporting farmers). Unlike accessing the system via World Wide Web information exchange via SMS channel is highly limited due to lack of instructiveness and a real time two way communication; therefore this might act as a barrier of obtaining a bulk of information for a given problem. For an example farmers can get answers for simple queries such as market price and price variation trend for a given crop this will help him to decide the best time to sell his products.

4.3 Inputs

Inputs to the system consist of users issuing various queries on different aspects of their cultivations. For instance these queries may be about advices for certain deficiency symptoms for certain fertilizers or it may be some advices such as pest or weed controlling. Both web interface and SMS channels could be used to provide

inputs to the system. Since data structures and other components of the system is modelled with English language, it is essential to make sure the correctness of spellings when issuing queries. However for the demonstration purpose it is possible to use Sinhala language queries typed in English.

4.4 Outputs

Output of the system produce responses to the queries and these results reflect multitude of aspects for a given query. For an example output result for a plant disease such as “yellow leafs” might drastically differ from one farm land to another based on multiple aspects such as environment conditions, nutrition needs, age of the crop. Depending on the channel the user interacts with the system, output will receive from a SMS or displayed in the web interface.

4.5 Processors

The idea of the system processes is to find the optimal solution to a given problem. This is achieved by collaborating and negotiating among each system entity through effective communication.

4.6 Technology

Agriculture stands on the very complex interaction between biological, climatic and geographical factors in addition to human economic activities. The information under such a complicated system is unpredictable, unstable, subjective, site-specific and reliant on empirical decisions given the inherent variability of biological phenomena Decision making process in such dynamic domain could be achieved successfully by integrating empirical judgments by multiple experts in various aspects of the domain. In order to achieve this in an Information System environment it is required to have a system architecture which is more advanced from traditional expert systems. It is evident from the literature that agent technology is suitable for achieving the expected solution from collaboration/ negotiation between several parties.

An agent is a computer system that is capable of independent action on behalf of its user. In other words, an agent can figure out for itself what it needs to .do in order to satisfy its design objectives, rather than having to be told explicitly what to do at any given moment. A multi agent system is one that consists of a number of agents, which interact with one another, typically by exchanging messages through some computer network infrastructure. In the most general case, the agents in a multi agent system will be representing or acting on behalf of users or owners with very different goals and motivations. In order to successfully interact, these agents will thus require the ability to cooperate, coordinate, and negotiate with each other, in much the same way that human experts cooperate, coordinate, and negotiate with other people in everyday lives.

Multi Agent Technology is widely applied in information retrieval and management from repositories. Similarly it could be adopted to address communication and information retrieval scenarios in agricultural Information systems. However at the moment Multi Agent Systems (MAS) have not been used as the major technology for addressing this issue.

MAS based Agriculture Information System consider related entity as a swarm of agents such as Crop, Soil, Fertilizer, Market, Pest and Environment. Apart from these agent swarm, message agent and a system agent will be created to facilitate the communication and system management. Message agent is responsible for initialisation of the system. Apart from message agent, other agents will have their own domain ontology. For instance some of the agents may share the same base ontology with small modifications to full fill their knowledge. For example market agent swarm may consist of several agro-equipment sellers, vegetable sellers and agricultural business companies like CIC, Hayleys. They will be sharing the basic domain ontology with some additional properties and action to represent their own domain knowledge.

4.7 Features

System developed as a web based solution and deployed in a web server where users could access the system via internet. Similarly mobile based SMS channel also

enabled for the users where they can access the system be simply sending a SMS to a given number. This SMS channel only provides basic level of functionality because on the inherited limitations of the technology.

4.8 System internals

Initially users have to register with the system and after the registration they could maintain information about their cultivations. If the user wants any solution from the system they can place it thorough communication channels. Once request is placed communication module will transfer the request to the message agent and it will initialize the agent system. During the initialization, other available agents will be crated and all the Ontologies and knowledge bases will be initialized.

Depending on the request some of the agents may participate to solve the problem by displaying their response on the message console. There may be some agents who cannot contribute anything for the discussion. This will happen because they do not know anything about the requests. For example this could happen as their domain ontology do not contain required knowledge. Therefore these agents will automatically get removed from the system.

4.9 Scope

Scope of the prototype development is limited to green chilli and saladleaf crops and it is possible to expand the system to support various crops by feeding relevant information to the knowledge base.

4.10 Summary

Objective of this chapter was to provide an overview of the system and its functionalities and features. Information about the types of users, what are the inputs and outputs, technological background, processors and features of the system were explained. The next section will give information about the designing aspects of the system.