

# **Multi Agent Approach for Agricultural Information System**



University of Moratuwa Sri Lanka.  
Electronic Theses & Dissertations  
www.lib.mrt.ac.lk

Dissanayaka, D. M. S. N

AI 08/1003

Dissertation submitted to the Faculty of Information Technology, University of  
Moratuwa, Sri Lanka for the partial fulfilment of the requirements of the Degree of  
MSc in Artificial Intelligence.

**September 2010**

## Declaration

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organization.

Name of Student

Signature of Student

Dissanayaka. D. M. S. N

Date: 15/03/2012



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

Supervised by

Name of Supervisor(s)

Signature of Supervisor(s)

Prof. Asoka S. Karunananda

Date:15/03/2012

# Dedication

To my loving wife Udari



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

# Acknowledgement

This research dissertation was completed with the assistance, ideas, guidance and encouragement from many people. First, I wish to express my gratitude to my supervisor Prof. Asoka S. Karunananda of University of Moratuwa for the encouragement, guidance and support extended throughout the research project and teaching the subject on research methodology in a very practical and methodical way.

Also my gratitude goes to Mr. A. M Ariyaratna for sharing the expertise on the domain. Your support was excellent and it helped me to form the knowledge base which is an essential part of the AIS system.

This project has become a reality with all of your support and feedbacks. I am greatly indebted to my wife for her endless patience, encouragement and support given throughout the study.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## Abstract

The field of Agriculture is considered as one of the main knowledge intensive domains because it is highly dependent on various aspects like environmental conditions, market movements, pest controlling, and crop management and soil conditions. These aspects are highly dynamic in nature, as a result agricultural domain itself can be considered as a complex system. With the industrial revolution, demand for food was increased rapidly and farmers used latest technological advances to improve the productivity. However when it comes to agricultural knowledge management all traditional ICT approaches have failed because of the complexity of the domain. People always struggled with the complexity of the domain and they came up with various ICT approaches to address the complexity. Finally AI based approaches found to be the promising technology in the areas of this nature because when it comes to real world problem solving, people survive within the complexity by being communicative with each other. This real life problem solving approach could be modelled as a Multi Agent System where each inter connected represent a separate agents such as Environment Agent, Market Agent, Seeds Agent, Soil Agent , Fertilizer Agent, and Pest Agent.

In this research we hypothesize that, by modelling interrelated areas as agents and by means of negotiating among each entity, it is possible to solve queries related to agricultural domain. Users such as Agriculture researchers, “Govi Jana Seva” officers, and farmers can access the system through Internet and mobile phones to place requests. Each agent module has its own ontological model and knowledge base to handle queries with the help of negotiation through the simple message passing. This thesis provides background information related to the problem domain. Based on comprehensive analysis on existing approaches and their limitations, technological and implementation methodology of the proposed multi agent system is presented. At last the technological and implementation details of the proposed multi agent system and an emphasis on the evaluation process concludes the acceptability of Multi Agent based approach in building information systems to meet the needs of the Agriculture field.

# Table of Contents

Chapter 1 - Agriculture Industry: Past and Present	1
1.1 Introduction	1
1.2 Background and motivation	2
1.3 Agriculture as a complex domain	4
1.4 Aim and objectives	4
1.5 Structure of the dissertation	7
1.6 Summary	8
Chapter 2 - Current Issues in Agriculture Information Systems	9
2.1 Introduction	9
2.2 Traditional Agriculture Information Systems (AIS)	9
2.3 Approaches based on Agent technology	13
2.4 Summary	15
Chapter 3 - Use of ICT in Agriculture Domain	17
3.1 Introduction	17
3.2 Complex domain	17
3.3 Use of traditional technologies	17
3.4 Modern approaches	17
3.5 Accessibility	18
3.6 Summary	19
Chapter 4 - Intelligent Autonomous Agents to Support Farmers	20
4.1 Introduction	20
4.2 End users of the system	20
4.2.1 Agriculture researchers	21
4.2.2 “Govi Jana Seva” officers	21
4.2.3 Farmers	21
4.3 Inputs	21
4.4 Outputs	22
4.5 Processors	22
4.6 Technology	22
4.7 Features	23

4.8	System internals	24
4.9	Scope	24
4.10	Summary	24
Chapter 5 - Analysis and Design		25
5.1	Introduction	25
5.2	Main modules of the system	25
5.2.1	Communication module	26
5.2.2	Agent module	26
5.3	Type of Agents	27
5.3.1	Message Agent	27
5.3.2	System Agent	27
5.3.3	Fertilizer Agent	28
5.3.4	Environment Agent	28
5.3.5	Pest Agent	28
5.3.6	Soil Agent	28
5.3.7	Crop Agent	29
5.3.8	Market Agent	29
5.4	Ontologies	29
5.5	Message Console	29
5.6	Agent communication	30
5.7	Knowledge acquisition and validation	32
5.8	Rule processing	33
5.9	User Information	33
5.10	System access module	33
5.10.1	Web front end	34
5.10.2	SMS enabled access	34
5.11	Summary	35
Chapter 6 - Implementation		36
6.1	Introduction	36
6.2	Communication Module	36
6.3	Agent Module	36
6.3.1	Agent development	36

6.3.2	Rule Processing Engine	37
6.3.3	User Information	37
6.3.4	Ontology Designing	38
6.3.5	Knowledge base implementation	39
6.4	System Access Module	39
6.5	Deployment	39
6.6	Summary	39
Chapter 7 - Evaluation		40
7.1	Introduction	40
7.2	Evaluation procedures	40
7.2.1	Scenario based approach	40
7.2.2	Information validation	41
7.2.3	System Usability	42
7.2.4	Agro product sellers	42
7.3	Evaluation setup	42
7.4	Summary	42
Chapter 8 - Conclusion and Future work		44
8.1	Introduction	44
8.2	Objective Achievement	44
8.2.1	Critical study on Agriculture domain and influencing factors	44
8.2.2	Critical study on current ICT approaches	45
8.2.3	Study on multi agent systems technologies and ontological knowledge definition	45
8.2.4	Critical study on swam intelligence and communication methods	45
8.2.5	Brainstorming with relative domain experts	45
8.2.6	Design and development of prototype multi agent system	46
8.2.7	Access to the system via web interface	46
8.2.8	Access to the system via Short Message Service (SMS)	46
8.2.9	Evaluate the proposed MAS.	46
8.2.10	Documentation of the final dissertation	47
8.3	Evaluation outcomes and comments	47
8.4	Validation of Hypotheses	47

8.5	Limitations	48
8.6	Future work	48
8.7	Summary	49
References		<b>Error! Bookmark not defined.</b>



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## List of Figures

Table 2.1: AI approaches in agriculture domain	16
Table 5.1: List of message formats used in the AIS	32



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## List of Tables

Table 2.1: AI approaches in agriculture domain	16
Table 5.1: List of message formats used in the AIS	32



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)