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CHAPTER I

INTRODUCTION

1.1. Background

In a world which technology has progressed rapidly each day, computer simulations are considered as an important tool in modeling and simulating real-world phenomenon. It's also considered as the best tool which gives accurate information in a virtual time without much impact to the real objects. By using a simulation tool, one can achieve a similar result in much faster time than from real-world analysis.

For the purpose of building a simulation tool, multi-agent system is an alternative for modeling simulations. Multi-agent system is developed from a traditional object-oriented method where every object in the simulations are agents which are autonomous, goal-oriented, and can interact with other agents. This paradigm has proven to be more effective, flexible, and more realistic. A multi-agent simulation system for agriculture phenomenon by Schreinemachers and Bergers has shown a more dynamic and accurate result than usual object-oriented methods (Schreinemachers & Berger, 2011). Previous researches have also shown that multi-agent systems have better implementation towards complex systems. Researches that support this thesis can be viewed below.

Table 1.1 Previous Researches

Author	Field	Language / software	Focus	Algorithm
Djennas, Benbouziane, & Djennas (2012)	Supply Chain Management	-	Supply chain activity with artificial intelligence	Genetic Algorithm
Pepijn (2012)	Agricultural System	C++	Understanding in agricultural system and technology	-
Figueredo, Joshi, Osborne, Byrne, & Owen (2013)	Cell Population	Chaste Framework	Testing mechanism for cell population	-
Author of this thesis	Social (Shopping center)	Unity3D C#	Implementation of multi-agent system and automated tools for mall developers	Fuzzy Logic

In this paper, the author proposes a simulation prototype with the subject of shopping centers. The author chooses shopping centers because nowadays, it is a center for commercial and social settings (Stillerman & Salcedo, 2012). It is also one of the places that most people visit and can serve as target for social sciences analysis and research. Therefore, a simulation of shopping centers could provide a wide range of knowledge and information in technology and social sciences. The simulation tool is created for mall managers and developers as an automated tool for developing and simulating shopping centers.

Agents in simulation need to imitate the real-world objects as similar as possible. For that purpose, there is a need for knowledge-based agents and an artificial intelligence (AI) algorithm for simulating the behavior of the agents. In this paper, the author chooses fuzzy logic method with fuzzy association rules (FAS) for simulating the

behavior. FAS method has proven to simulate complex consumer behavior towards marketing with imprecision goal (Orriols-Puig, 2009).

There are not many accurate social computer simulation tools that could simulate a real-world social phenomenon. Mainly it is because there is no “best way” in doing a social science simulation and it depends highly in the context and purpose of the subject of the simulation (Wilson, 2009). The author believes that computer simulation for social sciences can serve as an important factor in the many fields of science research. Simulations in social sciences give a great amount of varieties and unpredictable outcomes, which is why the simulation prototype the author made tries to generate a similar result to the real-world phenomenon with some limitations and assumptions.

1.2. Problems

The problems presented and will be solved in this paper are

1. How to build a multi-agent simulation system for shopping centers?
2. How fuzzy logic could determine agents' behavior in the simulated environment?
3. How accurate does the simulation prototype describe the real-world phenomenon in shopping centers?

1.3. Limitations

Several limitations and assumptions made in this research are

1. Simulation will run in a 3D environment with multi-floors shopping centers
2. Simulation does not include areas outside shopping centers, such as parking area, roads, and traffic.
3. The 3D representation of agents is not realistic and use basic 3D shapes, such as cubes, spheres, etc.

4. Simulation is developed in a virtual environment with virtual time and virtual agents.
5. The people in a shopping mall are represented by agents and their behaviors are simulated with the basis of three demographic categories: age, gender, and incomes. These three quantitative attributes are the most deciding attributes for people in the shopping center in deciding which activities they like to do.
6. The simulation prototype does not cover the mobile agent's navigation to the extent of collision avoidance and coordination.
7. The simulation does not cover any event-related or unusual activities in the shopping center.
8. The simulation does not implement any qualitative or abstract attributes.
9. The simulation implements promotion system which will affect impulse buying process.

1.4. Purposes

The purpose of this research is

1. To build and implement a multi-agent simulation system for shopping centers.
2. To simulate the agent's behavior as realistic as possible in simulation environments by imitating the behavior of the people using fuzzy logic as the AI algorithm.
3. To prove that the result of the simulation can be useful by experts' point of view.

1.5. Benefits

The author hopes that this research could benefit readers such as

1. The result of the simulation can be used as a supporting factor in decision-making for mall managers.
2. The multi-agent system can simulate the behavior of the agents accurately and as realistic as possible.

3. Opening a path to more simulation researches and techniques in social sciences.

1.6. Systematic

The explanation of each chapter in this paper is as follow

Chapter I explain the background and the problems viewed and solved in this research. The sub-chapters are Background, Problems, Purposes, Benefits, and Systematic.

Chapter II contains the literature articles, citations and references which serves as the basis of the research. The sub-chapters are Theory of Computer Simulation, Multi-Agent System, Artificial Intelligence, and Shopping Center.

Chapter III contains the methodology used and the time and location of the research. The sub-chapters are Research Methodology, Time and Location.

Chapter IV contains the analysis of the simulation system will be built including the classes, graphical user interfaces, and the artificial intelligence. The sub-chapters are System Model and System Architecture.

Chapter V contains the implementation and the validation of the simulation, which includes the analysis of the result of the simulation and the questionnaire. The sub chapters are System Implementation and System Evaluation.

Chapter VI contains the conclusion and suggestions for future researches. The sub chapters are Conclusion and Suggestions.