Chapter 3

Multi Agent Technology

3.1 Introduction

This chapter will first identify the requirements of locating public services. Then the suitability of using multi agent technology to locate urban public services will be identified. Finally, how multi agent technology can be use to locate urban public services will be discussed.

3.2 Requirements to Locate Urban Public Services

As discussed in the previous chapter, one of the main requirements of locating urban public services is to handle the interaction between public services such as water, electricity, transportation, buildings and telecommunication while locating these public services. Another requirement is to control the factors such as aesthetics, safety, slums, decay, reconstruction and renewal, transport, suburbanization, environmental factors, light and sound. As there is only a limited time is allocated for this research, all the requirements of urban public services locating could not be addressed and it is mentioned in the previous chapter, that the author had identified the dependency of resources as the key issue to be addressed.

3.3 Suitability of Multi Agent Technology

As in the previous chapter, the dependencies and complex interactions between public services when locating the public services in the city environment is identified as the key issue that need to be addressed through this project. Considering the use of cellular automata approaches [14] to locate urban public services, the main benefit of the using the cellular automata approach is that it can predict the future environment of a city and locate services accordingly. However, the complex interactions between the public services are not counted when calculating the future predictions. Therefore, it is difficult to maintain the interactions between the public services using this approach. This may lead to a under utilization or an over utilization of land in the city environment by the public services.

The stochastic approaches [15] uses the concept of possibility of using the land slots by different services and includes a probability to represent the predicted possibilities. These probabilities may vary when different public services occupy the land slots in the city. However, when a public service needs to change its location then it would be a problem to the system to change the probabilities of allocating a new land slot and to releasing the previously occupied land slot. In addition, when multiple services had targets to locate in the same location of the city environment, then there will be collision in the system to select the suitable service to locate in the particular position.

When using virtual reality approaches [22] to locate public services in the city environment, the human is able to locate different services in the city and the objects may respond to it by changing its locations. However, the objects can not interact with the other objects or with the humans. Therefore, less chance emergence through the system can be expected because of the lack of interactions between the objects. It is difficult to implement the dependencies between the services and that is the reason to not selecting this approach as the technology to implement the proposed solution.

Considering the use of multi agent approaches [21], the author has identified the potentiality of using multi agents to handle the dependencies and complex interactions between the public services. Basically, the multi agents are capable of communicating with other agents and perform a specific task according to the initial knowledge stored in the ontology. Therefore, when considering the interactions of the public services, if each public service is recognized as an agent with certain characteristics, then these agents may be able to communicate with each other when deciding a suitable location in the city environment. However, the multi agents need to be proactive agents to perform operations as to minimize the collisions between the services in the city environment and need to be learning agents to improve their initial knowledge while performing interactions with others.

3.4 Usage of Multi Agent Technology

Multi agent technology basically consists of a request agent, resource agents, message agent and the ontology. As in Figure 3.1, these agents make interactions through message parsing. Request agent is responsible for handling requests to the system and informs the message agent about the request. When the message agent has updated its message space with the request, resource agents respond for it by updating the message space. When there are multiple alternatives, agents will negotiate and take the best decision.

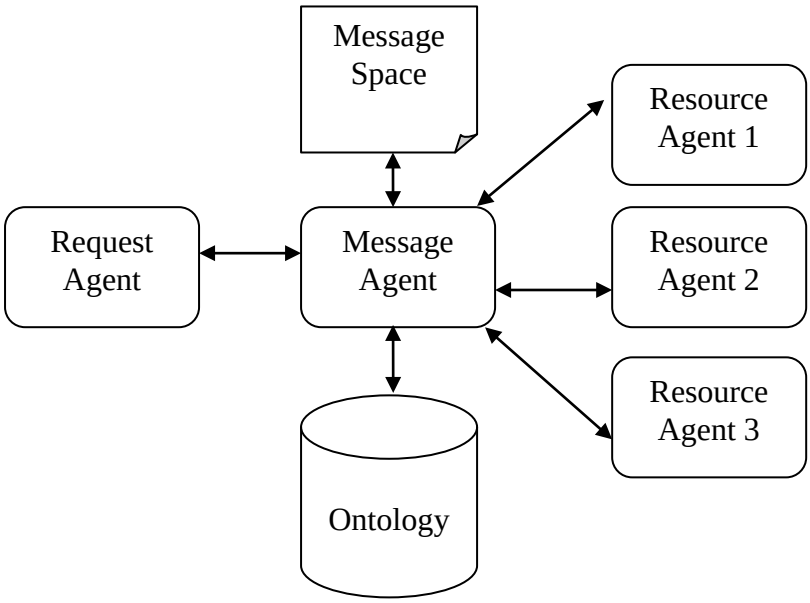

Figure 3.1: Multi Agent System architecture

Let's consider the usage of multi agents to solve the problem of locating urban public services in the city environment. Each public service of the city environment can be consider as an agent. These agents will contain their own characteristics according to the category they belong to. Any public service agent can function as a request, resource or message agent, in a suitably appropriate manner. All agents are collectively called the public services agents. Whenever the user selects an icon of a public service and clicks a point in the map, an agent of the corresponding public service is created. Certain details such as the type and environment are fed through a dialog box. The terrain agent locates and identifies the location coordinates of the newly created public service agent.

The other existing public service agents having noticed the creation of the new agent commence communication with him. The location, the value, the rate of decay of influence will be queried. However, this communication will take place, only if there is interaction between the Public services. For example a Hospital and a Cemetery will not have interactions and their positions within the city can be independently decided. During this phase of communication, each existing agent will find out whether the influence of the new agent will surpass the tolerable level of influence. Each agent will have a unique value of tolerable level of influence generally defined at a point of 1 km towards the other agent. If any of the existing agents find that their tolerable influence is violated, then the system will message the newly created agent to move from the position. The system will suggest and

move the newly created agent to a new position. And after that fresh communication will take place.

The communication between the public service agents will maintain the dependencies between service agents. Also, it will minimize the disturbances to the interactions between the resources.

According to literature on multi agents [1], when several agents collectively work as a team they can achieve higher goals than individually. An emergent behavior can be experienced as a result of the interactions between these agents. Therefore, multi agent approach is more powerful than single agent approaches. For this reason, public service agents of the proposed approach can be build as groups such as building, water resources, natural resources, transportation resources and these agent groups can be assigned with rules to behave in the environment and to accomplish a common goal as a team or individually.

Even though some of the current approaches use reactive agents [6] for the inside processing, these approaches do not allow the agent to make decisions by their own. Therefore, multi agent technology was not used in a proper way in those scenarios to achieve effective results from the system. When implementing agents for the proposed approach, one of the essential factors would be to implement proactive agents instead of reactive agents to maintain the communication between the service agents and to allow them to make decisions about the locations of other agents in the city.

It is evident from the literature that agent technology has been used to plan dynamically changing and complex city environments , for example, in Rebuilding New Orleans: An Agent-Based Modeling Approach [1], agents are used to identify the conditions of the buildings after the city faced with a natural disaster. These agents will collectively build the city as to minimize the hazards in a situation where another disaster arrives in future. Therefore, the author has a confidence of applying multi agent technology for the application of An evolutionary approach to locate Urban public services that hypothesize the concept of negotiation of MAS to solve the issue of resource dependency and complex interactions between public services during locating the public services in a dynamic city environment.

3.5 Summary

In the first part of this chapter, the requirements of locating urban public services were identified. Then the suitability of multi agent technology to fulfill the identified requirements was discussed. Finally, the usage of multi agent technology to locate urban public services in a dynamic city environment was discussed.