Chapter 5

Analysis & Design

5.1 Introduction

The intension of the design chapter would be to give a basic idea on what the proposed solution would actually do. This will be done through analyzing the system requirement specification of the proposed system. According to the system requirements specification, the components of the system will be identified. The top level architectural design of the multi agent based urban public services locating system will be discussed and then, the interactions between those components will be identified. The design of individual components will be demonstrated stating what each module does and its interaction with other components.

5.2 System Requirement Specification

Under the System Requirement Specification (SRS), the functional requirements of the system are identified.

- Handle terrain details of the virtual city environment
- Monitor the inputs to the system(public services)
- Based on the inputs, initialize public service agents that belong to buildings, water resources, natural resources and transportation resources
- Locate the public service agents in suitable locations in the city

5.3 Analysis

According to the functional requirement identified in the SRS, three main modules of the proposed system are identified.

- Geography module
- Building services module
- Water services module
- Natural services module
- Transportation services module

5.3.1 Geography module

The geography module is to basically maintain the terrain data that is fed into the system by the user. This data consists of terrain height against the location coordinates. Once the data is loaded, an agent is created representing the terrain module and he draws the terrain map on the screen. Any other public service agent can request the terrain agent to provide the terrain data of any point in the map.

5.3.2 Building services module

This module will initialize public services agents on behalf of the buildings created in the city environment. These public services agents represents airport, bank, bar, buddhist temple, cemetery, cinema, car repair, catholic temple, factory, football stadium, government office, gas station, hospital, hostel, hotel, library, museum, pharmacy, post office, police, power station, restaurant, school, shopping mall, small house, stadium, town hall, TV station and zoo. These agents have the common agent rules to initialize on request, kill automatically after executing its tasks and calculate influence between other agents when locating a new agent. The public services agents that belong to building services module are more concentrated on the concepts regarding structure, safety and effective land usage when locating buildings in the city environment.

5.3.3 Water services module

The water services module initialize public service agents on behalf of the water resources created in the city environment. This type of public services agents represents lakes, ponds, rivers and bridges of the city. Water resources cannot be moved when required. So that, it's a special case of public services agents and even though the influences on other agents are high, some of the public services that belong to water services module cannot be relocate its position. In that kind of a situation, other public services agents may shift their positions and can solve the issue or else the agents can only do a value change and leave the agents at their positions.

5.3.4 Natural services module

This module initializes agents on behalf of the natural resources created in the city environment. This type of public services agents represents trees, parks, forests and marsh

lands. Like water resources, natural resources cannot be moved when required. So that, it's also, a special case of public services agents and even though the influences on other agents are high, these types of public services agents cannot be relocate its position. In that kind of a situation, other public services agents may shift their positions and can solve the issue or else the agents can only do a value change and leave the agents at their positions. These type of agents are more concentrate on the aesthetics and safety of the environment to avoid unexpected situations such as landslides, when calculating influence and updating agent's value.

5.3.5 Transportation services module

The transportation services module, initialize agents on behalf of the transportation resources created in the city environment. This type of public services agents represents bus stop, cross road and roads. When considering these agents, only the bus stop is moveable and the cross road and the roads cannot be moved. Therefore, when locating new public services in the city environment, only moveable public services that belong to the transportation services module will only shift their positions as per the requirement, while, unmovable resources will only update their values when no agent is there to shift their positions on behalf of unmovable public services. These resources are more concentrate on the hydrology of the environment to minimize exceptional situations such as flooding, when calculating influence and updating agent's value. These resources are more concentrate on the accessibility and safety of the resources, when calculating influence and updating agent's value.

5.4 Design

The design part of this chapter will present the top level architecture diagram of the proposed agent based approach to locate urban public services. The components that have been identified through SRS and the interactions between these components are modeled as a top level architecture of the urban public services locating system as in Figure 5.1. As the proposed system is a multi agent based approach and because of the components are operate as agents, the components of the diagram were represented using agents. Therefore, the geography module is represented as a geography agent and the building services module, water services module, natural services module and transportation services module were represented as building services agent, water services agent, natural services agent and transportation services agent respectively.

Whenever the user selects a location for a public service in the map, an agent of the corresponding public service is created. Certain details such as the type and environment are fed into the system. The geography 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. 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.

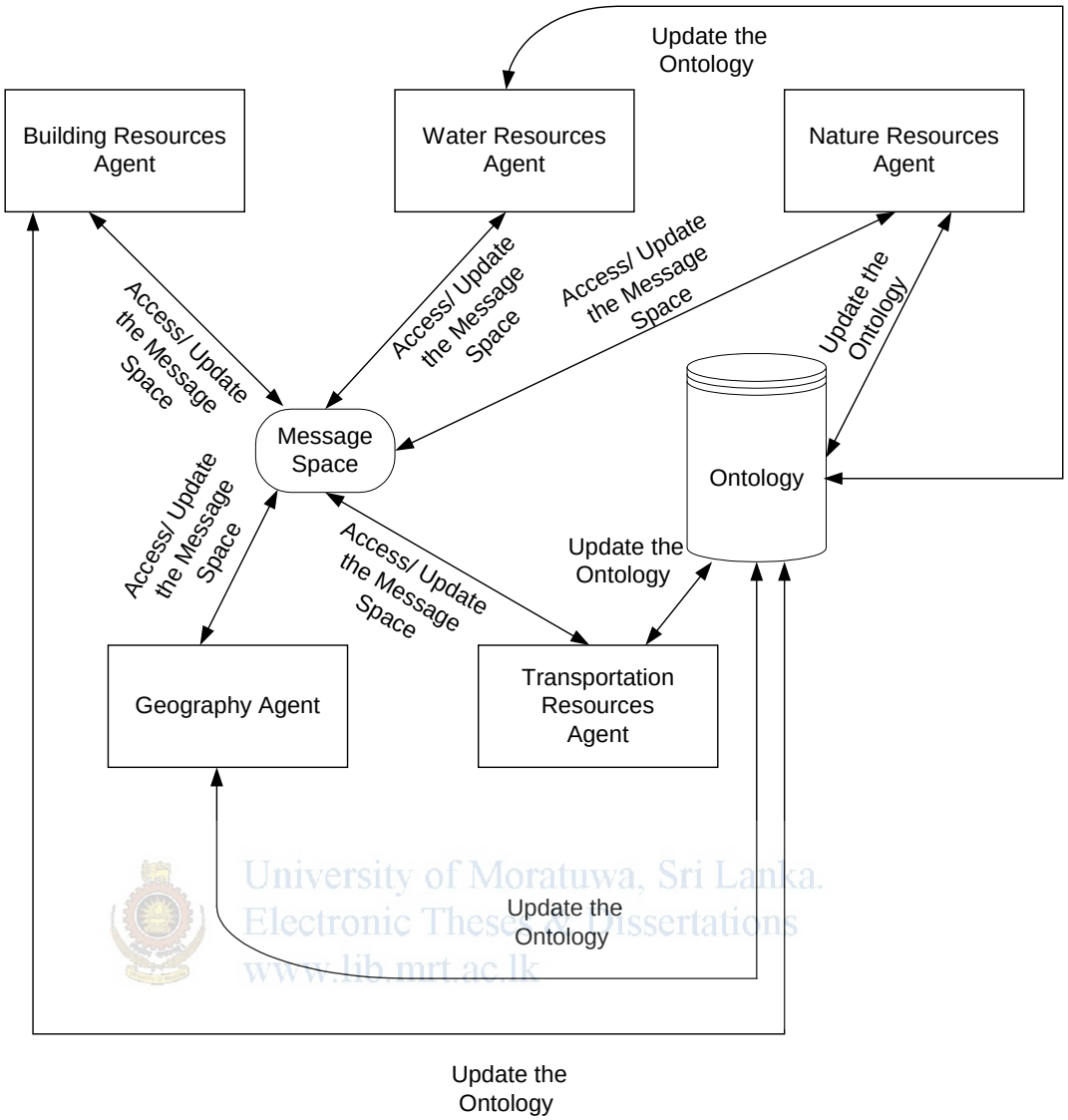

Figure 5.1: Top level architectural diagram of the Public Services Locating System

5.5 Ontology

The public services ontology is one of the most important components in the proposed agent based approach to locate urban public services because it stores the initial knowledge to initialize the public services agents. Moreover, it stores the inputs to the module and outputs from the module. The x and y coordinates with the individual parameter values of building services, water services agents, natural services agents and transportation services agents will be saved in the ontology. This information will be reuse during the locating of urban public services. Hierarchy of the public services ontology will display in the Table 5.1. The public services ontology will be updated by the public services agents after they have finished their tasks.

	Knowledge Category	Parameter value
1.	Building Resources Knowledge	
	Airport Agent	Airport_x, Airport_y
	Bank Agent	Bank_x, Bank_y
	Bar Agent	Bar_x, Bar_y
	Buddhist Temple Agent	BTemple_x, BTemple_y
	Cemetery Agent	Cemetry_x, Cemetry_y
	Cinema Agent	Cinema_x, Cinema_y
	Car Repair Agent	CRepair_x, CRepair_y
	Catholic Temple Agent	CTemple_x, CTemple_y
	Factory Agent	Factory_x, Factory_y
	Football Stadium Agent	FStadium_x, FStadium_y
	Gov Office Agent	GOffice_x, GOffice_y
	Gas Station Agent	GStation_x, GStation_y
	Hospital Agent	Hospital_x, Hospital_y
	Hostel Agent	Hostel_x, Hostel_y
	Hotel Agent	Hotel_x, Hostel_y
	Library Agent	Library_x, Library_y
	Museum Agent	Museum_x, Museum_y
	Pharmacy Agent	Pharmacy_x, Pharmacy_y
	Post Office Agent	POffice_x, POffice_y
	Police Agent	Police_x, Police_y
	Power Station Agent	PStation_x, PStation_y
	Restaurant Agent	Resturant_x, Resturant_y
	School Agent	School_x, School_y
	Shopping Mall Agent	ShMall_x, ShMall_y
	Small house Agent	Shouse_x, Shouse_y
	Stadium Agent	Stadium_x, Stadium_y
	Town hall Agent	THall_x, THall_y
	TV Station Agent	TvStation_x, TvStation_y
	Zoo Agent	Zoo_x, Zoo_y
2.	Water Resources Knowledge	
	Bridge Agent	Bridge_x, Bridge_y
3.	Natural Resources Knowledge	
	Garden Agent	Garden_x, Garden_y

4.	Transportation Resources Knowledge Bus Stop Agent Cross Road Agent Road Agent	 BusStop_x, BusStop_y CrRoad_x, CrRoad_y RoadL_x1, RoadL_y1, RoadL_x2 ,RoadL_y2, RoadValue, RateOfValue

Table 5.1 : Hierarchy of the public services ontology

5.6 Summary

The analysis part of the chapter has discussed the System Resource Specification by highlighting the high level requirements of the system and identified the main components of the system. The design part of the chapter, identified the interactions between each of the components using the top level architectural design of the agent based urban public services locating system. Finally, the structure of the public services ontology was discussed.