Chapter 4

An Approach to Locate Urban Public Services

4.1 Introduction

This chapter will discuss the proposed multi agent based approach to locate urban public services with reference to users, inputs, outputs, process and the technology. First, the inputs to the proposed system will be discussed. Secondly, the outputs to the system will be presented. The process of the system, which converts the input to the output is the next topic to be explained. Then, a brief description about the technology used for the proposed approach is presented. Finally, the users and features of the proposed solution will be discussed.

4.2 Inputs to the system

The proposed system has several inputs to the system. At the first instance, the human user needs to input the terrain data into the system to create the geographical variations of the land of the city environment. Next inputs to the proposed multi agent based approach are the city public services that include the buildings, transportation resources, water resources and natural resources. These inputs are fed to the system by the human user whenever these public services are created in the city environment. User has the opportunity to select a public service and is able to locate it in a temporary location in the city environment. When it is done, an agent will be created on behalf of the new public service agent and will make a request to the other agents through the message space. Thereafter, the multi agents who read the message space will respond to the request. When the input is created in the virtual environment it will be display graphically to the human user to see the changes of the environment because of the input. When the system fails to find a suitable location for a service agent, the service agent will be automatically destroyed from the system and the human user needs to create a new service agent in another location in the city. After the previously inputted service agent had been confirmed in its position, the human user can input another type of service agent in the city environment.

4.3 Outputs from the system

The output from the system will be suitable locations for public services inside the city environment. If the system fails to the output particular locations for a public service agent then the public service agent will be destroyed from the system. The output from the system is graphically represented in the screen.

4.4 Process

Figure 4.1 shows the solution which basically consists of request, resource and message agents. 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. When, the system is loaded, terrain data is fed into the system by the user. This data consists of terrain height against the location coordinates. Once the data is loaded, a terrain agent is created 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.

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.

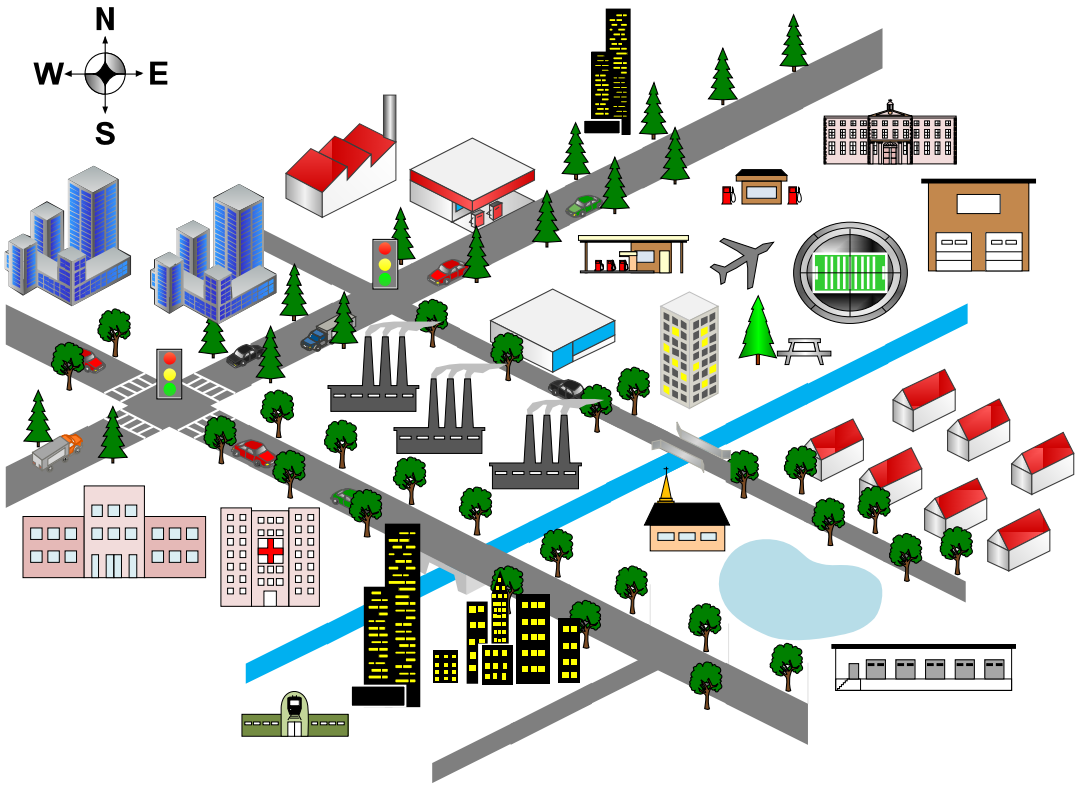

Figure 4.1: Multi-Agent Based Approach to Locate Urban Public Services

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. Sample interactions between public services are illustrated in Appendix A. 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.

If none of the existing agents find that the influence by the newly created agent surpasses the respective tolerable influence values, then the second phase of communication commences. Here, the newly created agent will find out, whether the influence by the existing agents will surpass the respective tolerable influence levels. Here again such

communication will take place only if the pair of agents fall to the category of interacting agents. This categorization may be bi-directional. For example, a cemetery agent will not mind the proximity of a super-market agent, while a super-market agent will query and calculate the influence of a cemetery agent. Here too, if the influence by any of the existing agents surpasses acceptable levels, the new agent will decide to move and the system will move him to a suitable new location. Then the communication will again take place.

If both the phases prove that the new agent's influence and the influence to the agent are acceptable, then the system allows the new agent to remain in the location.

Each public services agent has some common attributes such as location, type, environment, value, rate of decay, rate of value and tolerable influence. Values for location, type and environment is extracted from the inputs given by the user at the time of creating the public service. The value of the public service is decided upon the grading (1-100) given to type and environment of the public service. Rate of decay of the public service agent depends on height and value, so that it will be calculated by the public service agent. The tolerable influence and the rate of value of the public services agent can calculate only if, a new public service agent is activated in the city environment. The tolerable influence of each agent is decided upon the category of the other public services agents that are live in the environment. For example, if two of the public services agents are not likely to position nearby, they will be given a high tolerable influence, which is more towards the number 10. Suppose, the two public services agents are more likely to be good neighbors, then the tolerable influence will be inside the range of 1-5. If the two public services agents are belong to the same category, then, they will probably be given a high tolerable influence because, in real time, they are not supposed to stay nearby. Rate of value depends on the value of the other public services in the city environment and the distance between those agents.

All the agent details will be stored in the ontology. All the agents will be destroyed automatically from the system when they have completed their individual and group roles and updated the ontology.

4.5 Technology

The proposed solution is basically build up on the fundamental phenomena of handling the dependencies and complex interactions between public services while locating the public

services in the city environment. In the Chapter 3, the author has identified that multi agent technology as the most viable technology to implement this solution when compared to cellular automata, stochastic and virtual reality approaches .A group of proactive, autonomous and interconnected agents needs to be incorporated when implementing the hypothesis within the solution. The multi agent based solution will be developed using the Java platform and the multi agent development framework. The knowledge base that stores the information about the system will be implemented using the protégé software.

4.6 Users

End users of the proposed multi agent system will be mainly domain specific experts and technical-experts from Town and Country Planning domain. Domain specific experts will be civil engineers, architects and surveyors from the domain of problem area. Technical-experts will be software engineers, research students and the general public who are interested in this kind of system. The initial knowledge to design and develop the system is fed by experts of civil engineers, surveyors and urban planners. The system is being evaluated by both experts and non-experts from above stated domain, after they have tested the system for a particular scenario. Their comments are used to enhance the MAS.

The system will be evaluated by giving the evaluator an opportunity to build a specific city environment and to observe the interactions between different public services of the city. Thereafter, their comments about the functionality of the system and its outputs will be obtained. The evaluation results will be analysed to obtain the general feedback about the system. The general feedback will be used to identify the areas that need to be improved.

4.7 Features of the solution

Through this approach, a suitable location for a public service can be found inside a given city environment and can be implemented with use of negotiation feature of multi agent technology. The public service agents consider not only the dependency from one public service but dependencies between many public services. Those are transportation resources, building, water resources and natural resources. Details of the finalized locations of public services will be stored in the ontology for future reference. Therefore, the public service agents can reuse the stored knowledge in locating public services. So, there may be a possibility to extend this solution to implement some of the requirements of locating urban public services such as aesthetics, safety, slums, decay, reconstruction and renewal,

transport, suburbanization, environmental factors, light and sound. Further, memory consumption and hardware capacity during the processing is very limited because agents are created when required and will be destroyed when their task is complete.

4.8 Summary

This chapter has discussed proposed multi agent based approach in terms of the users, inputs to the system, outputs from the system, process and the technology. Finally, the features of the solution were explained.