Chapter 1

Introduction

1.1 Introduction

According to Alain Bertand, an urban planner with over 35 years of professional experience in operational urban planning, in most cities in the world the planning is done by sectors. This means that different and distinct groups of professionals are responsible for sectors such as transport, water, sewer, land etc. These professionals in general are competent in their respective fields, and hence they are capable of performing good intra-sector management. However, it is not enough to manage individual sectors independently. In reality these sectors interact heavily, and hence the necessity would be to plan with an emphasis on inter-sector interactions. This could be done only with urban planners, who are able to tread across sectors and interpret the problems across sectors [5].

The efficient and effective location of Public services within a modern city is a subset of Urban Planning. The efficiency and effectiveness has become important here because of scarcity of these resources. With the immense growth experienced in modern cities around the world and the ensuing heavy demand for the Public Services, the planned location of the same within the city has become very important.

In society, people struggle to achieve their objectives while interacting with each other. Societies exist in cities because of opportunities they provide to achieve objectives of the people. A city is a place where people interact. The key words here are movement, dynamism, traffic, exchange, interaction, connections, and people. A city is where wealth and opportunities are created.

If a city is static and governed by strict laws then it puts a damper on its capacity to grow. If the people who live in a city are free and if they are governed by free market policies, the city too should be free to grow according to the demands of its users. People in modern cities confront the issue of limited accessibility to public services especially because of the limited availability of these resources. These public services include water, electricity, transportation, buildings and telecommunications. Even if a static urban planner had a city to provide a maximum amount of benefits to people in the city, due to dynamic nature of sharp growth of population, the urban structure changes from time to time. So, that there is

a necessity for the urban planners to renew the urban structure to maintain the level of accessibility to public services such as water, electricity, transportation, buildings and telecommunications. Due to this reason, one of the most essential factors in urban planning is to effectively locate the public services in a dynamic manner, so, that a majority can access those public services easily. Also, some of the public services such as hospitals and schools need to be located far from each other to minimize the influence to each other. Therefore, many factors need to be considered in locating public services. As the scenario changes rapidly in a modern city this becomes more and more complex and laborious. Hence, locating public services effectively is not an easy task. This is because, as pointed earlier, most of the public services are dependent on each other. When locating public services, urban planners need to consider both influence between public services and their influence on the economy after locating the public service. Due to rapid rate of change of the environment of a city and needs and aspirations of its people, the interaction between the public services cannot be done manually. The improper locating of public services may prove disastrous and result in collisions between these services. Due to this reason, a software based methodology is essential to locate public services effectively in a dynamic city environment.

The author has conducted a literature based survey to identify the currently available computer based mechanisms to locate urban public services. During the literature survey four main categories of methodologies to locate urban public services have been identified, viz., Agent based approaches [21], Cellular automata based approaches [13], Stochastic approaches [19] and Virtual reality based approaches [6]. Each of the approaches were analysed considering their positive strengths and negative weaknesses.

It was noticeable that most of the current approaches to locate urban public services are agent based approaches. However, the author has identified that most of agent based approaches used agents only to represent objects with certain characteristics as active objects with a lesser amount of interactions between these agents [21]. In some of the agent based approaches [1], once the agent is located in a position, the agents do not interact or involve with other agents' operations inside the city environment.

While analyzing the suitability of cellular automata [13] approaches to locate urban public services, the author has identified that cellular automata technique can only be used to locate public services either in a static environment or can respond to dynamic behaviors of

the environment only if the complexity of the environment is generated by the technology on its own.

Stochastic approaches [19] are based on the probability of the possibility of locating the public services on a particular location. It is difficult to use this approach to maintain the interactions between the services, after locating those services in particular locations.

Virtual reality based approaches [6], are based on the human operations to locate public services in the virtual environment. Therefore, whenever, a human does a change in a location of a service, the other services may respond to it by adjusting their locations but cannot interact with the human. This is because, here, the human is considered as an agent who has a very high level of knowledge.

Comparing & contrasting all these factors, the author has decided that the capabilities of the current approaches to locate urban public services are limited and there is need of proposing a new approach to locate urban public services in a dynamic city environment.

By considering the requirements of locating urban public services such as handling the dependencies and complex interactions between different public services in the environment, the author has decided that agents are the most suitable entities to represent public services. The suitability of using multi agent technology was decided upon comparing the advantages and disadvantages of applying this technology for locating urban public services.

When a public service is represented by an agent, these agents can communicate, negotiate to solve issues between them while maintaining their functionalities independently. For this reason, the human can save their time and effort in locating public services. The multi agent technology possesses remedies for some of the situations that the human is not cable to deliver. However, the author has identified some of the disadvantages of multi agent technology as well. Multi agent technology can be used only in the process of finding a suitable location for the public service because it cannot accomplish all the tasks done by the humans as it is programmed to learn from past experiences or to do a specific task. Also, less user interaction and less user control are some minor disadvantages. However, the advantages of using multi agent technology is far greater than it's disadvantages, and as such, multi agent technology has succeeded in implementing systems for different categories of complex environments over the past history. The author has selected multi

agent technology as the technology to locate urban public services. Author can ensure that multi agent technology would provide a potential technology basis to implement interactive and self organized application to locate urban public services.

1.2 Aim

The aim of this research is to apply the negotiation feature of multi agent technology to solve the issues of current approaches to locate urban public services during the process of planning dynamic city environments.

1.3 Objectives

- To do a detailed study on basic concepts of locating urban public services. Thereby, the author would obtain a better understanding about the problem domain and identify the current approaches to locate urban public services.

- Analyze the current approaches to locate urban public services to find out the issues behind them. At the same time, author would identify the main problem to be addressed through this research.

- Make a comparison between various techniques of structural programming and Artificial Intelligence (AI) techniques to identify a suitable technology to solve the issues identified.

- Build a hypothesis to solve the earlier identified problem using the selected technology. Construct a proposed solution by expanding the hypothesis.

- Make a design for the proposed solution by breaking it into sub models. Thereafter, implement those models using java and the agent framework.

- Test the system for valid and invalid parameters, get the results and compare them.

- Evaluate the system using both experts and non-experts by enabling them to use the system and to obtain their feedbacks.

- The thesis would be documented in such a way that it would be able to reflect the problem and the solution clearly for a reader of any level of knowledge.

1.4 Proposed Solution

The proposed solution 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 creates a public service in the city environment, 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. 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. Here too, if the influence by any of the existing agents surpass 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.

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.

End users of the proposed Multi-Agent System (MAS) will be mainly experts and students that belongs to Civil Engineering, Architecture and Town & Country Planning domains. Therefore, the initial knowledge to design and develop the system is fed by experts of civil engineers, surveyors and urban planners.

1.5 System Requirements

To implement this work, a computer with at least a processing power of 2.00GHz of speed, 1GB RAM and 80GB hard disk capacity is needed.

NetBeans IDE 3.8 was used as the editor to build the system and Java was used as the programming language. Madkit 4.0 was used to implement agents in the system and AWT and SWING packages were used to implement the graphics components of the system. Protégé was used as the ontology software.

1.6 Structure of the thesis

Chapter 2 of the thesis discuss about the current approaches to locate urban public services and compare them to identify the issues of the current approaches. Chapter 3 highlights the suitability of using multi agent technology to locate urban public services. Chapter 4 proposes an approach to locate urban public services. Chapter 5 present the design of proposed multi agent based urban public services locating system. Chapter 6 discuss about the implementation of the proposed urban public services locating system. Chapter 7 presents the experimental setup and the evaluation results. Chapter 8 makes a brief discussion about the overall achievements and future enhancements of the system.

1.7 Summary

The first part of the chapter has provided a basic introduction with some background and motivation on the problem area. Later on, the aim and objectives of the project were discussed. Then, proposed solution to the problem was identified. After that, system

requirements to implement the proposed solution were discussed. Finally, the structure of the thesis was presented.