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Author(s)	中野, 由紀子
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# Location Selection Support System for Various Building

Yukiko NAKANO

School of Information Science,  
Japan Advanced Institute of Science and Technology

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## 1 Introduction

Recently, structure of city is more and more complicated. Therefore, city planning is needed to handle enormous amount of information carefully. In the city planning, location selection of building's is important process and almost occupies most of working time. In the case of the large-scale of city planning and the re-development planning of a existing city, the location selection of the building can not be solved in accesptable. So the automated location selection of the building by the computer is needed.

In city planning, the some have been proposed automated scheme location selection by using geographic information system (GIS). Segawa has proposed a sysytem for optimal location selection that is decides candidates of child care facilities in 1996. Okunuki has proposed a mode by Huff network that decides candidates for ashop in 1997. He also has proposed the shop location optimization method in 1997. Meanwhile some researchers are handled the location selection as a decision making problem, and used AHP(Analytic Hierarchy Process) method. Abdullah applied AHP to select location for recreation facilities, and he's has also proposed method to evaluate the candidate area by three ways; one for the building, the second for the park, the third for the lock-out district in 1994. And He compared results with the plan of the present. Yurimoto has proposed a decision making support system by AHP for factories in foreign country. And he has customized the decision support system with AHP. Because only particular building is accepted by the system, it is impossible to support the whole city planning, which requires location selection of the various kinds of building.

In this research I propose a location selection system, that can accept various kinds of buildings. Conditions to select the optimum location depend on the kind of building, to accept these various buildings, proposed system directly employ the specification form users as the evaluation criteria at the first level of AHP.

## 2 AHP(Analytic Hierarchy Process)

There are some studies that handle the location selection as a decision making problem by the AHP method proposed by Thomas in 1980. He parsed a decision-making problem as hierarchically, and modeled it. The AHP can address the subjectivity and intuition, and decide obscure environment clearly. AHP also leads users help for decision making. However, the number of elements in the same layer, and users have to decide the weight for each element by pair comparison. There is Inner Dependence to address the dependency between the elements in the same layer. This model includes the quantitative dependency between the evaluation criteria or alternative solutions by pair comparison. In this paper, I propose a new method based on the AHP and Inner Dependence method for the location selection problem because the specification by users will have dependency.

## 3 Location selection support system

Proposed method for location selection consists of the next 3 step.

- In the first step, the system investigates the places where exist a building. These areas are removed from the candidates. These candidates are also inquired from the view of topography. The system selects the candidate area by using of the geographical data the candidates, current use of candidates the profile of building and the shape of the site, provided by CAD.
- In the second step, the system removes the candidates where are impossible to build specified structure by the regulations or the Building Standard Act. The regulation data include information about the application plan of the architecture, the material regulation, and the use of site (house, commerce, industry) in the candidates. The system then apply the Building Standard Act, to remove the areas where are not permitted to build the specified structure.
- In the third step, the system select the final candidates by the AHP with various specification from the user. I notice the fact that most assignment by users are regarded as the distance from the candidate to facilities such as streets or stations provided by GIS. The evaluation criteria of the best layer (level 1) in the hierarchical structure are assignment about the location from the user. The system employ following evaluation criteria that can be adapted for various buildings, “populations”, “ easiness for person to assemble”, “convenience of traffic”, “safety of neighborhood”, “low site place”. The weight are decided as the same way of traditional

AHP by the pair comparison in the evaluation criteria of the level 1. In the next level 2, the criteria specified in the level 1 are decomposed into the weight linear sum of criteria based on the distance from the a point amap to the objects in the candidate area. The number of evaluation criteria is decided by the kind of the object derived from the geography information. The weights in the level 2 are applied to very evaluation criteria in the level 1 by seven steps; “nice when it is far from the object(-3)”, “neutral(0)”, “nice when it is close to the object(+3)”. The candidate area is divided the mesh the system computes the distance from a point amap to the object in every meshes. Then the system calculates the evaluation values as the linear sum of distances multiplied by the weights. Final evaluation value is decided as linear sum of the evaluation values of the level 2 and the level 1.

## 4 The experimental result which proposed system was used for

Proposed system was evaluated simulations with Digital Map 2500 in Geographical Suvey Institute. The simulation were performed on the 1 chart lobe (2km  $\times$  1.5km). This map includes 17 kinds of public building, 4 kinds of load, a kinds of the station of the railroad as the object inside the candidate area. I assumed the “house”, “hospital”, “convenience store” and “auto-repair shop”. For each subject, the weight in the level 1 are decided. As a result, experimental result were different among subjects. It means that the proposed system could be applied for general use. In the selection processing, it took most computation time to select locations at the third step by AHP. However, it was about half of traditional AHP because the proposed system restricted the search area by the physical selection at the first step and legal selection at the second step.

## 5 Conclusions

A location selection system for the various buildings was proposed. The system can correspond to the various building by using of assignment about the location from the users, and with using the evaluation criteria at the best layer of the hierarchical structure in AHP. My system introduced the Buildeng Standard Act, to make search area narrow. As a result, it achieved high-speed processing and the realistic selection. Experimental results for 4 kinds of subjects were different. It means the proposed system can be applied for general use. Evaluations of results are remained as to fure works.