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ONE TYPE OF URBAN ENVIRONMENT ANALYZING METHODS

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This article will briefly introduce the ontological approach and graph theory in the current popular urban environmental analysis system, as well as their practical application in urban environmental analysis.

Principles and characteristics of methods commonly used in urban environmental analysis. In the process of urban environment development, the quality of environment directly affects the production and living activities of urban residents. So, the analysis result of urban environment can greatly affect the life cycle of urban, includes generate, exist, develop, prosper, and sustain [1].

The urban environment is the sum of the human and natural conditions that are interrelated with the city as a whole. Most of the time, the urban environment mainly refers to the physical environment and its components can be divided into two parts: the natural environment and the artificial environment. The former includes the elements of geology, landform, hydrology, climate, animals and plants, soil, etc. The latter is composed of industry, architecture, transportation, communications and recreational facilities, etc. [2]. These are also the main contents of the current urban environment analysis.

Nowadays, currently one of the most popular ways of describing the urban environment is the use of the ontological approach [3]. The created ontologies for cities assume the most complete description of the entities and components of the urban environment as a whole [4, 5] or within the framework of individual subject areas [6].

In the whole analysis process, it can be assumed that $\{f_1,f_2,\ldots,f_n\}$ is the collection of urban facilities / buildings and $\{s_1,s_2,\ldots,s_n\}$ is the collection of services that the city can provide. If f_i is one of the urban buildings $f_i \epsilon \{f_1,f_2,\ldots,f_n\}$, S_i is the service that the facility can provide $S_i \epsilon \{s_1,s_2,\ldots,s_n\}$. Then they should have the following relationships [6]:

$$i \rightarrow S_i, \text{ even if } F(i)=S_i \quad (1)$$

Of course, it is necessary to analyze whether a building can provide more perfect services, at least the following additional parameters for the following subject area should be considered in the analysis process:

1. Building location. That is, the location or coordinates of the facilities providing services in the city.

2. Scope of services. That is, the scope of influence of the services provided in the city. It is usually distinguished according to the time or distance to the facilities. It is generally divided into three levels: Level I walking ≤ 1 hour, level II walking in 1~2 hours, and level III walking ≥ 2 hours. However, due to the different spatial layout and facility levels of the city, the classification is also different.

3. Service quality. Including most people's senses of the facility environment, service attitude, service scope, etc. It has [1,2,…,10] levels, 1 is the worst and 10 is the best.

4. Service complementary buildings. Whether there are other building facilities that can enhance the service of the facility within the influence of the facility providing the service, or whether it is within the influence of other advanced or auxiliary facilities.

Graph theory is often used in the ontological approach. Because in the model construction of the whole urban environment, we often regard each building in the city as a vertex, and the road is the edge between each vertex. From one building to another is from one point to another. Assuming that the vertex of each facility $\{f_1,f_2,\ldots,f_n\}$ in a graph is $\{f_1,f_2,\ldots,f_n\}$, the route from f_i to f_j is the path from p_i to p_j in the graph.

In the process of using the graph for analysis, due to the geographical factors of the city, we need to pay attention to at least the following points:

1. The vertex of a graph. It is various facilities in the city. Because of the geographical environment and other factors, not all urban buildings can be represented by plane. We also need to pay attention to their spatial height distribution, such as Chongqing, China. Moreover, urban traffic is complex, and different road intersections should be regarded as special facilities.

2. The edge of graph. It is the road connecting each building. Because many urban buildings are not well planned in advance, they are often on multiple roads, but these roads are not connected, so the edges of some vertices in the figure can be disconnected. It is also necessary to consider that some roads have restrictions on people or vehicles.

3. The weight of the graph. It is also the distance between facilities.

4. The direction of the graph. Whether the road where the facility is located is two-way or one-way.

5. The path of the graph. The path is the travel plan from facility fi to facility FJ.

6. Connected graph, subgraph. Connectivity graph and subgraph can help analyze the service scope and influence scope of facilities in the city.

Appling of urban environment analyzing. In fact, examples of applications of the ontological approach and graph theory in urban environmental analysis are close to us, such as map's address or service search function, navigation APP, urban rail transit ticket purchasing system, and so on.

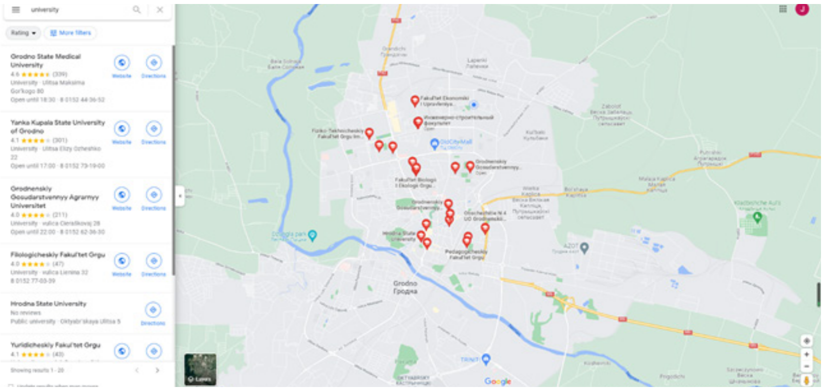

Figure 1 – Search for «university» on Google Maps

The use of the ontological approach in building data models for urban environments enables systems to easily differentiate the service capabilities of facilities and better locate facilities that provide search services through service capabilities. For example, if we search for «university» on Google Maps, Google Maps will show the location of universities on the map, which is a reverse query of the location of the facility through the services provided by the facility (figure 1).

As for graph theory, it is often used to query paths between buildings in a city. The most well-known feature is the route navigation function of the map. By providing the map with the location or starting and ending points of the trip, the map analyzes the geographic map stored in the system, finds the path, and calculates the weight of the edges contained in the path to get the shortest path, which is the shortest journey from the starting point to the ending point (figure 2).

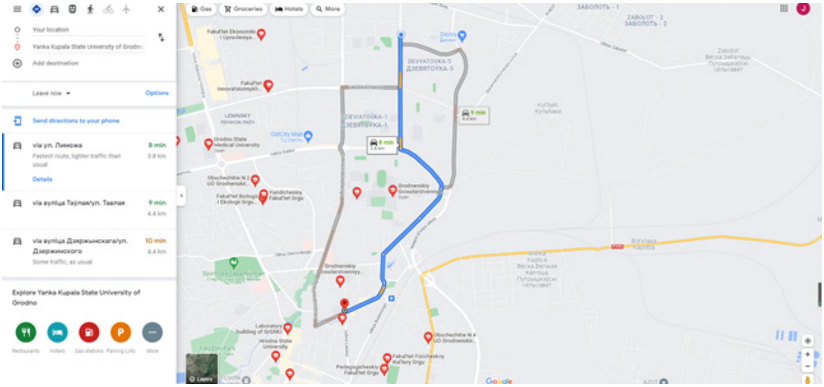

Figure 2 – Find ways by car from home to university on Google Maps

Conclusion. This article outlines the general methods of urban environment analysis using the ontological approach and graph theory. the ontological approach is one of the mainstream methods to study the urban environment. It starts from the object itself and connects the same or similar characteristics of the objects, so that the system can have a higher efficiency in the analysis of the objects with the same characteristics. Graph theory makes the relationship between the subjects closer and more prominent. The most striking examples are address or service queries and road navigation capabilities provided by electronic map applications.

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