WebGIS based community services architecture by griddization managements and crowdsourcing services

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Abstract. Along with the fast economic development of cities, rapid urbanization, population surge, in China, the social community service mechanisms need to be rationalized and the policy standards need to be unified, which results in various types of conflicts and challenges for community services of government. Based on the WebGIS technology, the article provides a community service architecture by gridding management and crowdsourcing service. The WEBGIS service architecture includes two parts: the cloud part and the mobile part. The cloud part refers to community service centres, which can instantaneously response the emergency, visualize the scene of the emergency, and analyse the data from the emergency. The mobile part refers to the mobile terminal, which can call the centre, report the event, collect data and verify the feedback. This WebGIS based community service systems for Huangdao District of Qingdao, were awarded the “2015 national innovation of social governance case of typical cases”.

1. Introduction

Along with the fast economic development of cites, rapid urbanization, population surge, the social community service mechanisms need to rationalize and the policy standards need to unify, which results in various types of conflicts and challenges for community services of government. To address the issue, in China, the local governments at all levels start to build community service platforms for the public.

The community service platforms are considered as a centre of collecting the social information, publishing the governance information, responding the emergency calling, and dispatching the cases. The platforms should provide all kind of the authoritative data which includes not only government service contents but also associated spatial data such as coordinates, geocoding data and etc. The data is so massive that it is a challenge for managing these data, updating the data dynamically and responding the service request immediately. Therefore, the WebGIS technology is applied into the community service platforms for the public. The paper provides an architecture of WebGIS based community services, which mainly realizes the following functions.

- A platform of addressing the social governance problem. The platform service as a centre of managing the social governance information, receiving the report of emergency events and dispatching the community services.
WebGIS based urban griddization management system. The WebGIS technology provides the web browser for positioning the service location and the server for responding all geographical services by gridding the management.

A mobile application for crowdsourcing services. The mobile application can be deployed to iOS and Android smart phones. It can be used for collecting the social governance information, submitting urban management or emergency events and receiving the service tasks.

2. WebGIS based community services architecture

The WebGIS based community services architecture is based on the network infrastructure platform, hardware and software platforms, and resource information sharing platform. The digital social governance information system plays the core role in the service architecture. The government websites and mobile application give convenient access methods for the community services.

The WebGIS based community services architecture includes database clusters, standard platform, software and hardware infrastructure. There are five layers and two frameworks as following (see Figure 1):

- present layer,
- service layer,
- platform layer,
- data layer,
- hardware layer,
- standards framework,
- security framework.

![WebGIS based Community Services Architecture](image)

**Figure 1.** WebGIS based community services architecture

- **Hardwar layer**
  In the hardware layer, an office centre for administration should be constructed. High-speed broadband network should be established for connecting social governance centre and departments of government. A hardware platform of labs, servers, switches and terminal equipment should also be built.

- **Data & platform layer**
In the data & platform layer, a unified database should be built for spatial and non-spatial data, which consist of basic topographic data, urban infrastructure, geocoding data, land information data, planning data, landscaping data, transportation data, and business data.

- **Service layer**
  The service layer provides data exchange platform, middleware, workflow engines, third-party software, and so on, which supports system development, deployment, operations, and application.

  The WebGIS based community services architecture introduces the three key technologies: WebGIS, urban griddization management, and crowdsourcing services.

### 2.1. WebGIS-based community services

The WebGIS based community services can publish the spatial and non-spatial information on the server side. The public can explore these information through the web browser such as IE, Firefox and etc. The database in the backend can provide the geo-data and non-spatial data. The WebGIS framework play a core role in community service architecture. The following figure depicts the WebGIS framework for the community service.

![Figure 2. Framework of WebGIS](image)

The three layers in the WebGIS framework are data layer, logic layer and presentation layer. The following figure describes the framework in details.

![Figure 3. Three-tier of WebGIS framework](image)
Data Layer: storing spatial data, attribute data, text and other format data.

Logic Layer: performing the data services and various business processes.

Presentation Layer: presenting and visualizing the data and business operations to the user.

A standard is built for mutually accessing data in three layers, and the security control system can ensure the security of data. The three-tier structure separate the data from the logic layer. It is convenient for the extension of system and the reuse of code. The tasks are centralized into logic middle tier so that the business logic of the system is independent, that is, when the user's needs change, you can quickly build platform update business logic in the middle tier (application server), without submitting the updated applications to PC terminals.

Flexibility and scalability in the future are characteristics of the three-tier structure design for WebGIS based community services platform. The platform would not refactor the architecture when the requirement of a digital society governance changed greatly.

2.2. Griddization management

Griddization management is an administrative policy that employs divide-and-conquer strategy. It firstly divides the administrative region into grids. And then the community services are deployed into these different grids. An administrator for the community services should be dispatched into each grid. Through the gridding technology, the social governance should be better in practice. The formation of the grids follows these principles.

1) Region management principle
Each grid only belongs to one and only one community, and the boundaries cannot across to other communities.

2) Geographical distribution principle
The grid layout fits the city's geography, such as streets, alleys, courtyards, public green spaces, squares, bridges, rivers and etc.

3) On-line management principle
Courtyard managed by the self-management unit should not be split, but in accordance with specified standards for independent courtyard.

4) Convenient management principle
The division of the road and alleys should follow the travel habits of their neighbour courtyards.

5) Object management principle
The management target is the individual objects of the city which cannot be split into parts.

As an example, in community service systems for Huangdao, the district is divided into grids according to the above principles (see the following figure).
2.3. **Crowdsourcing services**

Crowdsourcing services refers to the service mechanism that deploy mobile application for community services to smart phones. So the mechanism crowdsources the community services into the grid administrators equipped with smart phone. The smart phones of the grid administrators are installed the community service application, which guarantee that the grid administrator carry out the service task.

The mobile application provides a condition that the grid administrator can participate in social governance anywhere and anytime. The smart phone with the community service application became a mobile terminal which could take photo, position and call on the spot when urban management event happened. By the mobile application, the grid administrator can collect data, submit a report and recheck the task, which greatly facilitates one’s daily work. On the other hand, a mobile application for photo anywhere is available to the public. Everyone can take photo for helping the grid administrator through this application if he downloads the application into his smart phone. Therefore, a pattern of crowdsourcing the governance services is given. Each grid administrator as well as the individual with the smart application became the sources of the social governance services. The following figure give an illustration of the mobile applications on the smart phones.

![Figure 4. Gridding management](image-url)
3. Conclusion
Based on the WebGIS technology, this article provides a community service architecture by gridization management and crowdsourcing service. The WebGIS service architecture includes two parts: the cloud part and the mobile part. The cloud part refers to community service centre, which can instantaneously response the emergency, visualize the scene of the emergency, and analyse the data from the emergency. The mobile part refers to the mobile terminal, which can call the centre, report the event, collect data and verify the feedback.

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