Research on Intelligent Service Area of Urban Green Highway

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Abstract: The intelligent service area can meet the needs of passengers for convenient, efficient and personalized services. High quality and high standard service area can improve the service level for passengers, also can improve the services for the management. Based on this, an advanced technology, such as the internet, web of things, image recognition and GIS, is proposed. Taking the expressway from Huadu to Dongguan as the research object, this paper focuses on improving the informatization level of expressway service area and creating intelligent service area. The overall framework of the smart expressway service area is constructed, the infrastructure configuration requirements of the intelligent expressway service area are put forward. The research results have important reference value to promote the industry development.

1. Introduction
Green highway is an important part of green transportation. According to system theory and cycle cost theory, the main purpose of green highway is to use the least resources and have the least impact on the environment. Green highway’s construction runs through the whole cycle, including planning, design, construction and operation.

With the rapid development of cloud computing, web of things, internet, big data, artificial intelligence and other new-generation information technologies, Internet + convenient transportation will be rapidly promoted. Expressway service area problem has been enough attention. It is not only one of the main contents of constructing intelligent expressway, but also one of the business models of innovating expressway service. This paper takes the expressway service area between Huadu and Dongguan as the research object, and puts forward the overall thinking of constructing the intelligent service area, which has important reference significance for promoting the development of the intelligent service area.

2. Study area
The Huadu-Dongguan expressway project is a key construction project of Guangdong province and Guangzhou city, and it belongs to the seventh important highway in Guangzhou high speed expressway network. The route starts from the south exit of Baiyun airport in Guangzhou and is connected to the airport expressway. It goes east through Renhe town and Zhongloutan town in Baiyun district, Zhongxin city and Jiu long town in Huangpu district, China-Singapore town, Yongning Street, Xiancun town and Shitan town in Zengcheng district, and ends at Shitan town and is connected.
to Zengguan Shenzhen expressway. The completion of this project will better enhance the traffic capacity of Baiyun international airport and is of great significance to the economic development of Guangzhou airport economic zone, China-Singapore knowledge city and Zengcheng national economic development zone.

Yongning service area covers a total area of 987,000 m². The service area is equipped with gas stations, complex buildings, dormitory buildings, repair rooms, equipment rooms, charging Spaces and other service facilities.

Figure 1. Map of Yongning service area in Huadu to Dongguan expressway.

3. The concept and overall framework of smart service area

Highway service area is set on the highway, mainly for vehicles, drivers and passengers to provide service places and construction facilities. Expressway service area integrated with the Internet. It is forming the online and offline interaction, demanding and resource matching. Intelligent expressway service area is also an important part of intelligent expressway. The smart service area includes industry authorities, highway operators, travel service providers, traffic information service providers and the public.

Table 1. Service level table of intelligent service area.

| The service sector                  | Service                                   | The user                  |
|------------------------------------|-------------------------------------------|---------------------------|
| Service area operation management  | Dynamic information monitoring            | Highway operators         |
|                                    | Infrastructure management                 |                           |
|                                    | The energy management                     |                           |
|                                    | Main line and service area coordinated management |                       |
| Service area management            | The operation and                         | Travel services providers |
|                                    |                                           |                           |
management

Service area publicity

Catering, accommodation, entertainment management

Car refuelling, charging management

Wifi service

Highway operation information

Service area operation information

Intelligent terminal induction service

Toilet, accommodation, consumer services

The Public

(1) Perception layer is the foundation of constructing panoramic information environment of intelligent expressway service area. The main means of perception include flow detection system and intersection. Flow detection system, parking space detection system, mobile phone signal data analysis system, HD monitoring system.

(2) Network layer including Wi-Fi, 2G/3G/4G/5G, optical fibre communication, such as communication and transport facilities, is responsible for the raw data transmission layer perception to the service operation management system.

(3) Cloud computing and big data technology are introduced to process, integrate, mine and store multi-source heterogeneous data in the service area. Basic database, business database and subject database are built to provide standard data support for the application layer.

The main functions of intelligent expressway service area mainly include fine management, quality service and precision marketing. Among them, fine management is the foundation, quality service is the core, and precision marketing is the key.

4. Functional design of intelligent service area

4.1 Management
(1) To provide basic data guarantee for management and service, dynamically perceive all kinds of information in the service area.

(2) Through multi-source and multi-dimensional data analysis, strengthen the management of infrastructure in service areas, including the upgrading, transformation and improvement of toilets.

(3) By using intelligent lighting, sewage treatment, garbage treatment facilities, all kinds of power-saving and water-saving equipment, to achieve scientific energy saving and emission reduction, and create a "green ecological service area".

4.2 Quality service
(1) Realizing the full coverage of Wi-Fi network in the service area, the constructor should provide free Wi-Fi network services for managers and travellers.
(2) Via mobile intelligent terminal APP, multi-functional self-service terminals, broadcasting, information display all kinds of traffic information service for the traveller, including highway running information service, service information service, the safe warning, a key to "help" service, information query service, ticket reservation service, online booking rooms and catering services.

(3) Set up ETC service outlets in the service area and expand the application scope of ETC card in the service area; relevant services should support mobile payment, quick payment, etc.

(4) Provide transfer, intelligent parking guidance, new energy vehicle charging, vehicle and personnel assistance, service area guidance, entertainment, lost and found and other travel services. Provide other value-added information services such as local specialties, special food, peripheral tourism, promotional activities and real estate project promotion.

4.3 Precision marketing
(1) Based on multi-source data, conduct multi-dimensional analysis of social public's travel needs, travel rules, behavioural preferences, and the construct should serve business managers in making decisions.

(2) Through online publicity and image display, extract the cultural connotation of the service area and build a famous service area brand.

4.4 Development prospect of intelligent expressway service area
The construction of intelligent expressway service area should follow the concepts of "combination of virtual and real, collaborative innovation", "green ecology, simple humanity", "intelligent analysis, precise operation". In the future, the development of intelligent expressway service area will present the following trends.

(1) Unified technical and operational standards shall be formed.
At present, the technical and operational standards of expressway service area are still lacking, let alone the technical and operational standards of intelligent expressway service area. Therefore, relevant organizations need to take the lead to speed up the formulation of industry/group standards related to smart expressway service area, so as to promote collaborative innovation of technology, service and business model.

(2) Pay attention to good online and offline interaction.
In the construction of intelligent expressway service area, the time and space limitations of physical service area (offline) should be broken through virtual service area (online).
To the new business model, business scene and service experience, at the same time must not ignore the improvement of offline service quality. Through the interaction and integration of online service and offline experience, better customer flow guidance and user habit cultivation can be achieved, and the overall operating efficiency of expressway service area can be significantly improved.

(3) To build a multi-win-win business ecosystem, the expressway service area has the geographical features of "multiple points, long lines and wide coverage"
Location characteristics: expressway operators can make full use of information technology and intelligent technology to carry out unified network and platform operation and management, realize the professional, chain and large-scale operation of its service areas, provide better services for the public, and create a well-known brand that is deeply rooted in people's hearts. According to the local conditions and cultural characteristics of different regions, it is necessary to build a win-win business ecosystem with multiple industries, such as roads, tourism, culture, logistics and real estate.

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