

Analysis of Expressway Intelligent Service Area for Better Vehicles/Passengers Service

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Abstract. Expressway is known as a bridge for a country to modernize and is the only way to develop the modern transportation industry. Traditional expressway service area is difficult to meet the needs of current users, thus in order to improve the service level of the service area and meet the current high-level demand of the society for the service area, a set of highway intelligent service area integrated management system based on cloud computing and big data technology is proposed in this paper, which can fully and reasonably schedule resources, facilitate the use of user, and improve the user's experience of the service area.

Keywords. Expressway, service area, intelligent transportation, planning and design

1. Introduction

The expressway service area provides necessary travel services for passing drivers and passengers [1], which is one of the important infrastructure of expressways to ensure driving safety, smooth roads and relieves driver and passenger fatigue. With the rapid development of expressways, the functions of service areas have gradually improved, however, the construction and operation of expressway service areas in China are still in the stage of exploration and practice due to the short development process [2-4]. Meanwhile, there are still some problems in the construction and operation of individual service areas since the unbalanced regional development, the positioning and understanding of service areas in different regions and departments are not uniform.

Therefore, the cloud computing [5], big data [6] and internet of things (IoF) [7] are applied to the information construction of service areas in this paper, which is built a set of intelligent service area platforms based on cloud applications and Internet architecture. It will further improve the construction and operation of the service area, greatly improve the management level and economic benefits of the service area. Besides, it also provides specialized, humanized and high-quality services for travelers that give full play to the

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economic and social benefits of the expressway, and better promote the development of expressway transportation.

2. Service Area Intelligent Management

2.1. Management of Passenger Flow

The needs of people who is driving on expressway for service areas are different from these in urban areas. Usually, the passenger flow on expressways is dominated by drivers, passengers and expressway managers, and they mainly use expressway service areas for short stops and rest. Therefore, in order to view the heat distribution data of the number of people in each area, it is necessary to realize the function of passenger flow statistics, and then the number of customers in supermarkets, restaurants, boiling water rooms, and toilets can be analyzed in real time. Through the intelligent management and scheduling of staff, the rationalization of resources can be achieved more accurately.

2.2. Management of Traffic Flow Characteristics

The traffic flow through the expressway service area should be the focus of the service area. Effectively identify the type, model, body color, license plate, vehicle category information of the entry and exit of each service area, and analyze whether it is a yellow-label vehicle and whether it is a dangerous vehicle, etc. If it is, the staff in the service area should be informed immediately and the corresponding measures must be taken. Besides, the traffic flow is counted and analyzed to obtain the heat distribution of the traffic flow in each province, city and section, which can provide business analysis for managers, it could be used for precise classification and management of service areas, and then providing basic business information for drivers and passengers, which is helping service area to improve the soft power of the business environment and upgrade service levels.

3. Key Technology and Method

3.1. The Whole Composition of Intelligent Service Area

In order to realize the analysis of vehicle/person flow, the intelligent management and intelligent platform of service area is constructed in this paper, as shown in Fig. 1, which is consisted of three layers, named application layer, transmission layer and perception layer. The perception layer refers to the data acquisition sublayer and the sensor network networking and collaborative information processing sublayer, which usually uses external hardware devices to collect information data. We set up high-definition (HD) cameras, vehicle monitoring equipment, structure monitoring equipment, ETC equipment and gas monitoring in the intelligent service area to collect data, and then transmit the collected data to the cloud platform through the network transmission layer, which can conduct big data analysis and provide the best decisions to the staff for application. Through the decision-making cloud platform, the operation management of the service area will be rationalized, the driver and passenger service will be further

commissioned. In addition, we can also provide certain business opinions for merchants in this intelligent service area, according to the characteristics of the flow of people and vehicles obtained from the analysis, so that the merchant operation can be expanded and better bring economic benefits to the service area. Therefore, a complete of intelligent service area IoT system is set, which mainly provides a more perfect management system and high-quality services for the management departments and drivers. It should be noticed that we are focus on the analysis of flow vehicle and person in this paper, the detailed method of drivers and passengers service in intelligent parking lot, changing for electric vehicles (EVs) and ETC refueling service is shown in our other paper due to the page limits.

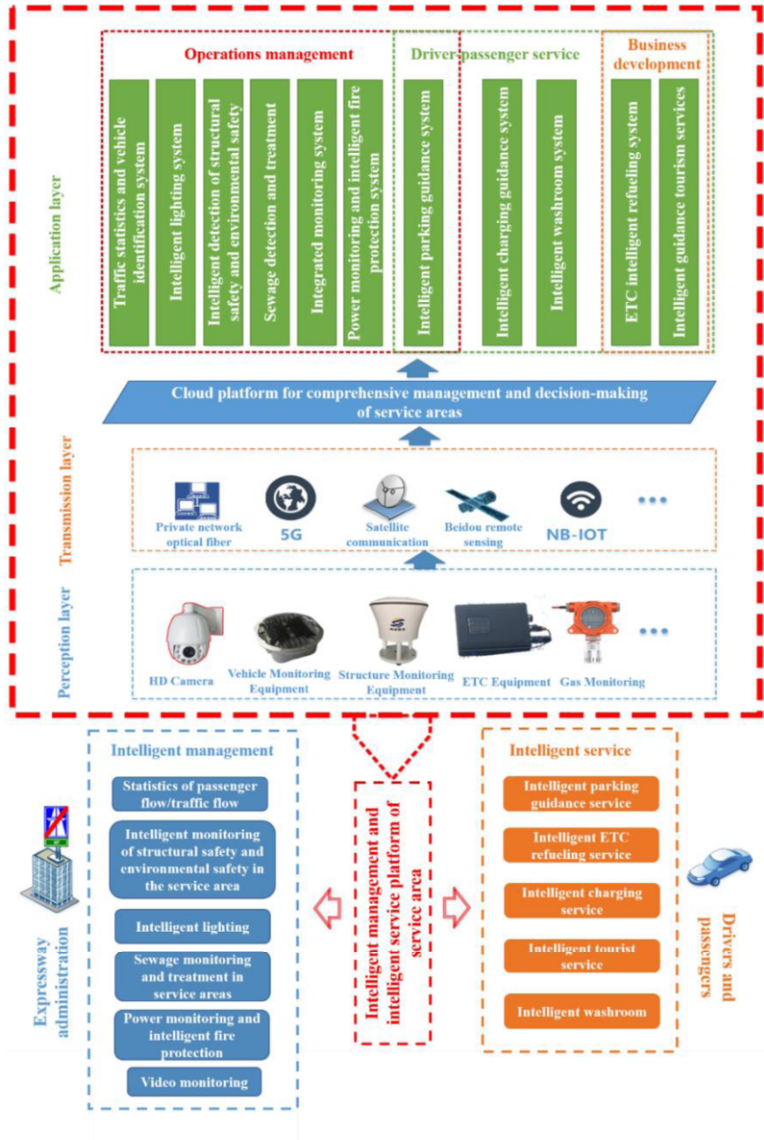


Figure 1. Technical solutions for the overall system.

3.2. Passenger Flow and Traffic Flow Statistical Analysis

Based on machine vision technology and head-and-shoulder sequence pedestrian recognition technology, vehicles are identified and the vehicle/person dwell time and behavior trajectories are then analyzed, as shown in Fig. 2. The data is mainly derived from the HD camera of intelligent service area, which is mainly divided into three categories: trucks, passenger cars, and private cars to analyze the service needs of male and female passengers entering the service area, such as the length of stay in each area such as fueling, toileting, catering, supermarkets, and car repairs. It could be used to provide the customized services for drivers and passengers through statistical analysis of data, and generate corresponding data sets and service area sets according to the corresponding characteristics of merchants to help merchants accurately expand their scale and further improve the operating benefits of service areas.

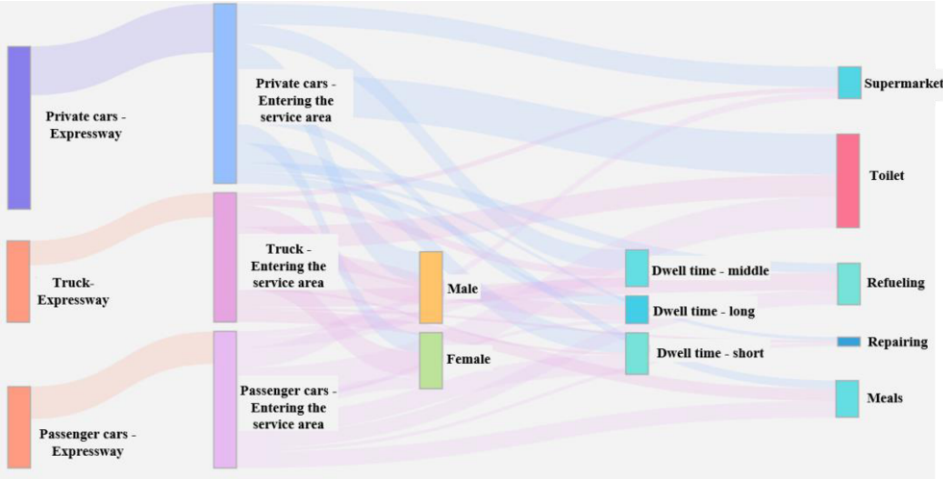


Figure 2. Vehicle/Person dwell times and behavior trajectories.

Besides, the analysis of vehicle/person dwell time and behavior trajectories can also be applied to intelligent security and the identification of dangerous behaviors. During the peak period of passenger flow in the service area, it is inevitable that unsafe factors will occur, resulting in uncontrolled behavior of personnel and conflict. Through the behavior recognition engine to provide positioning, analysis, screening, early warning capabilities, cooperate with the front-end capture engine to achieve real-time detection and analysis of video stream behavior. For abnormal behavior, including waving sticks and knives and other dangerous movements, raising hands to call for help, fighting, robbery, smashing, group fighting, mutual pushing, intrusion detection, tripwire detection, etc., it could be realized real-time alarm and notified on-site management personnel to deal with it, which improves the personal safety of drivers & passengers and reduces driving risks.

4. Conclusion

The expressway intelligent service area can further improve the service level of the service area and meet the high-level needs of users at this stage through reasonable

personnel scheduling. Based on cloud computing and big data technology to statistics and analysis of traffic/people flow, a set of intelligent highway service area integrated management system is constructed in this paper, which uses the analysis data to make reasonable suggestions to merchants to achieve contactless consumption, so as to form an intelligent business circle. At the same time, the system can also be well applied to peak hours, which could be reduced unnecessary congestion during peak hours, and further provide high-quality services for various vehicles and drivers and passengers on the highway to achieve the integration of communication and travel.

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