

Research on the construction of intelligent park based on the internet of things and big data technologies¹

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Abstract. Intelligent park makes the best of information technologies of a new generation cloud computing, the Internet of things and decision analysis and optimization to highly integrate current information technologies of the Internet technology, sensor technology and intelligent information processing, and by monitoring, analysing, integration and intelligent response and means of sensing, connecting and intelligence, links up its dispersed physical, information, social and commercial infrastructures that had acted on their own into a new generation intelligent infrastructure in order to transform the park into an organic whole with better collaboration capabilities and capacity of regulation. Currently, the construction and development of intelligent cities in China concern with every aspect of people who work and live in the cities. Intelligent park is an important representation form and component of intelligent city, whose architecture and development patterns are miniature of intelligent city to some extent. Therefore, in order to effectively improve operation management and service levels, it becomes more and more important to study interconnection within the intelligent park as well as methods of information fusion with information system of the intelligent park. The construction of a traditional park only requires "nine connections and one levelling", i.e. completion of basic infrastructure while information and intelligent construction will be carried out realized by the settled-in enterprises and units on their own, and with the rapid development of information technology and the demand of intelligent city construction, the efficient functioning of various enterprises and administration of the park are faced with requirements of new intelligence and global operation.

Key words. the Internet of Things, Big Data, Intelligent Park, Information System.

¹Acknowledgement - This work is financially supported by Scientific Research Project of Hebei Science and Technology Department, China (No. 16214707)

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1. Features and Technology Mechanism of Intelligent Park

1.1. Features of Intelligent Park

The intelligent park, is capable of "sensing" and "thinking", and through various sensing facilities deployed within the park, it effectively captures relevant information of various departments and areas within the park, and promptly generates comprehensive information products after processing at remote and service terminals, provides corresponding users with reference information and assistant people with their decision-making. Intelligent park generally has 4 following features: ?? Demand driven: collects demand of various units and departments within the park, analyzes and categorizes the collected demands, take these demands as original driving forces to introduce some advanced development and design philosophy and adopts various high-tech measures and methods to satisfy demands of various units and departments within the park;?? Comprehensive sensing: by deploying various types of sensors, use advanced sensing technology and wireless sensor network to detect various information within the park, such as vehicles, environment, people and others in real time, and by means of intelligent analysis, demonstrates data situation of various levels within the park;?? Improvement from within: innovation is crucial to intelligent park, the sustainability of innovation is capable of keeping promoting a sustainable development of intelligent park, which requires various components themselves within the park to keep satisfy demands of innovative development;?? Multi-vector coordination: by improving communication and exchanging network, set up exchanging platform to form an efficient collaborative work in order to realize full exchange of information and efficient interaction between component[1].

1.2. Technology Mechanism of Intelligent Park

The technological regime of intelligent park mainly relies on the support of the Internet of things, cloud computing and related technologies, and as information technology continues to make breakthroughs and develop, the Internet of things has realized high intelligence, and by adoption and deployment of intelligent network, intelligent navigation, WSN, intelligent connection and other technical means, the intelligent park has achieved high efficient connection and communication among various component units within the park and used some intelligence related processing algorithms and technologies such that precise recognition, accurate monitoring, accurate position indication and real time situation estimate have been achieved[2].

Currently, cloud computing, WSN, RFID technology, nano-technology, intelligent processing and analysis and expert systems have been widely used. And among them, the operational mode of cloud computing mainly makes the best of network resources to break down the colossal demands of processing and computation, according to certain rules, into some small programs capable of running on small unit or single chip microcomputer, and after relevant computing and processing, addressing and analyzing, pushes the results to the needed users. The functions of cloud computing are all demonstrated in the form of cloud services, so to speak, cloud

services is value embodiment of cloud computing.

2. Architecture of Intelligent Park

Based on the architecture of International Telecommunication Union, the intelligent park system adopts related technology system of the Internet of things, such as sensor technology, packet optical transport network and technology of application layer. On the basis of this architecture, the architecture of intelligent park is divided into for four layers: perception layer, network layer, platform layer and application layer. By adopting uniform standards, various systems achieve interconnection and shared resources. Architecture of intelligent park is indicated as Figure. 1[3][4].

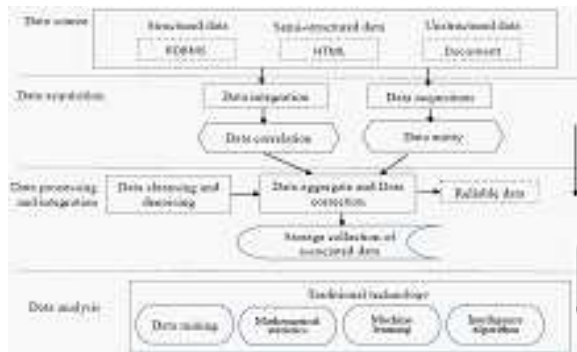


Fig. 1. Architecture of Intelligent Park

2.1. Perception Layer

This layer is the source layer of original data. In accordance with the park's needs, various occasion and spots are deployed with appropriate sensing devices, such as video supervising equipment, RFID equipment and navigation and positioning module to capture video information, staff attendance, traffic information and vehicles access of different spots of the park. The spots and sensor types of such deployment require selection and consideration in advance, and the quality of deployment directly influences data effectiveness.

Mainly realize provision of pathway for data transmission. Adopts different transmitting methods according to different application occasions, such as fiber-optical, WiFi and 4G wireless communication, effectively cover data capturing spots, and provide a smooth path for data transmission.

2.2. Platform Layer

Platform layer, the "brain" for intelligent park, is an importance component of the intelligent park, includes information service center and information decision center, its engineering construction is mainly information service center, which is a basic



Fig. 2. Process Flow of Big Data in the Intelligent Park Network layer

platform for realizing administration and application of the park, the foundation for realizing true intelligent park. The main contents of construction are: setting up IT platform, deployment of platform software, and deployment of management software. The platform conducts unified deployment and management of hardware resources while provides various supports of developing, running, monitoring and safeguarding for upper layer applications, and mainly includes: (1) Distributed service framework; (2) Shared components services; (3) Data service; (4) Application runtime environment service.

2.3. Application layer

Application layer is the part that makes intelligent response to the data analysis of platform, and represents the intelligence and informationalization of the park. With the development of technologies, expansion of platform and diversification of data, the intelligent services of application layer will become more and more. The main contents of construction are: client access of platform and top layer application service software, etc.

3. Application of Big Data Technology in the Information platform of Intelligent Park

3.1. Designing Process Flow for Big Data

According to the needs of Intelligent Park, the whole process flow is mainly divided into three steps: the first step is to obtain information data needed from data source. As the structure of data source is very complicated, various special methods must be adopted to carry out data processing and integration; the second step is to further process the obtained data, and the purpose of the processing is to perform standardized and uniform treatment on these data; the third step is to choose appropriate method to present analysis results of data to users through visualization technology. Analysis and processing of big data is the key of the whole treatment process, because the data types of big data are over complicated, targeted selection must be made in the process of treatment[5].

3.2. Design of Distributed File System

Currently, Google is the only company, either at home or abroad, that is capable of handling well data of great volume and varieties. The Intelligent Park adopts a Google File System (GFS), as indicated in Figure. 3.

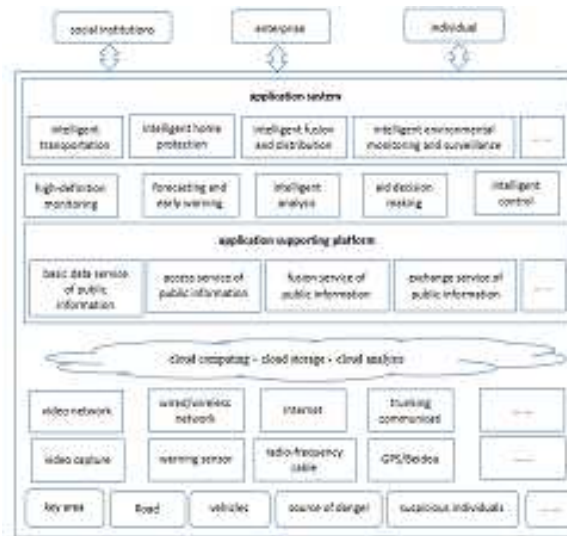


Fig. 3. Architecture of GFS

The system includes three principals:

(1) Client: is an access interface provided to application programs by GFS, and a set of specific interfaces that do not follow the rules of POSIX and are provided in the form of library files;

(2) Master: is the management node of GFS, mainly for storage of meta data but not Chunk related to data files;

(3) Chunk Server: is in charge of overall storage, and is used for storage of Chunk.

3.3. Distributed and Parallel Database

By data processing, relevant data could be obtained from data source and mainly stored in distributed file system, but the problem is that users now can only access file through database, which has consequently caused failure of traditional database to meet storage needs of big data era and required re-design of data. In order to better cater demand of big data storage, Google designed a new database, named BigTable. From the diagram, it can be seen that the database comprises of five parts, which are Master Server, Client, Subtable Server, Chubby and GFS. The Intelligent Park also adopts this technology accordingly[6].

4. Design of the Key Application System of Intelligent Park

According to actual demands of intelligent park and by function, typical information systems of intelligent park could be divided into several sub-systems: intelligent transportation, intelligent environmental monitoring, intelligent home protection and intelligent fusion, etc.

4.1. Design of Environment Monitoring and Surveillance

Through the environmental monitoring and surveillance unit and module (smog and harmful gas), monitor real time environmental information (temperature, humidity and contents of harmful gas) of various parks of the intelligent park, sum up through transportation network to the application supporting platform.

Currently, Zigbee technology is developed mature and widely used, providing a new approach for monitoring and surveillance in wireless conditions. On some occasions, exchange capacity of data is not very large, and data format is relatively simple, and Zigbee technology is very suitable for such occasions. In normal conditions, Zigbee wireless sensor network comprises of following components: process computer, signal collector and acquisition terminals. And among them, acquisition terminals are used to capture wireless data, and as nodes, take charge of sensing and processing data; in the distributed conditions, signal collectors take charge of collecting radio frequency signals sent from various nodes and send the information to process computer and through serial port RS-232, realize storage and processing of data on process computer.

By deploying multiple monitoring nodes, realize acquisition of environmental data, and by means of wireless Zigbee technology, send the captured data to sink node, then through cable or wireless network, sum up to processing system and realize the analysis, processing and storage of data. The analytical results, complemented by video network, are sent to relevant management staff of the park, promoting monitoring efficiency as well as responding and processing speed of staff.

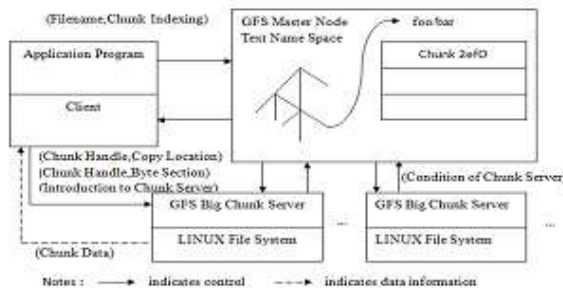


Fig. 4. Diagram of Intelligent Environmental Monitoring and Surveillance

4.2. Intelligent transportation

By the integrated GPS/BEIDOU module and RFID module of vehicles in the park, monitor real time positions of vehicles in various parks, statistically generate real time situation of various road sections in the park and sum up through transmission network to application supporting platform. After certification, the park staff could call real time information of various road sections to select the best route or site to conduct vehicle maneuvers. The certified vehicles of the park could realize enter and exit without stopping through RFID certification.

The GPS/BEIDOU modules integrated on the vehicles of the park, achieve real time monitoring vehicles within the park, and complemented by video network, when traffic congestion presents in the park, data set and comprehensive communication platforms will promptly push traffic congestion messages to relevant management staff of the park to effectively handle the traffic congestions of the park.

4.3. Intelligent Home Protection System

Intelligent home protection refers to the video monitoring and surveillance devices at the neighboring and key areas of the park, monitor in real time and all weather various road sections, buildings and factory workshops in the park, and display directly the distribution of all video resources on GIS map, and operators may use mouse to select and quickly open videos and achieve video deployment based on GIS map. On the basis of analysis of massive video behaviors, enhance the utilization ratio and reliability of the system. Based on video deployment, intelligent home protection takes advantages of the large data volume of on-line cloud storage platform and extensiveness of cloud analysis, and comprehensively utilizes video resources to realize intelligent analysis of intensive warning on park staff, alert notification of unlawful presence around the park, alert notification of suspicious items in specific areas, etc.

4.4. Design of Intelligent Fusion Technology

Receive and fusion process alert information (such as leakage alert of noxious gas) sent by intelligent environmental monitoring and surveillance system, traffic accident sent by intelligent transportation system and illegal trespassing incidents sent by intelligent home protection system, and after communication and confirmation with security staff, take appropriate measures. With intelligent fusion system deployed in the park administration, realize park information fusion of multiple perspectives and multiple vectors to make the generated information more comprehensive and prompt, and by interconnection and interaction with multiple units in the park, municipal police system and hospitals, quickly handle the emergency events, achieve the effects of rapidly, effectively minimizing the accident hazard and solve the phenomenon of information islands formed in sub-systems. As indicated in Figure. 5.

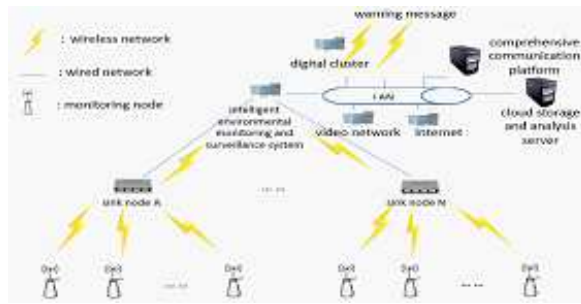


Fig. 5. Diagram of Intelligent Fusion

5. Conclusions

The rapid development of the Internet of things and the increasingly improved cloud computing and big data technology are capable of offering effective support for information construction process of intelligent park. On the premise of guaranteeing its stable operation, the intelligent park with scalability is capable of introducing new technologies and advanced managerial means of the Internet of things to improve social and economic benefits of intelligent park and to provide an effective reference for developing intelligent cities.

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Received November 16, 2017