Research on Real-time and Dynamic Urban Traffic Information Service System

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Abstract

With the acceleration of urbanization and the rapid growth of private cars, the traffic congestion is increasingly becoming a “chronic illness” for urban development. This paper describes what exactly the real-time and dynamic urban traffic information service systems. Furthermore, the pieces of technology needed and the benefits of the system will be discussed. Finally, we conclude with issues and problems that to be resolved in order to have a fully functional system.

Keywords: information service, information system, traffic information

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1. Introduction

With acceleration of the urbanization and rapid growth of private cars, traffic congestion plagues every major urban area in the country, costing millions of dollars annually in lost time from delays and contributing to serious air quality problems. Traffic congestion is increasingly becoming a “chronic illness” for urban development. Traffic congestion on road networks is characterized by slower speeds, longer trip times, and increased vehicular queuing. Along with the social economic losses caused by the traffic congestion, most drivers have the needs to get "traffic congestion information with high accuracy at anytime and anywhere” [1].

To solve such problems, the government puts its focus not only on road infrastructure construction, but also on transportation information service system. While many approaches to these issues have been tried - including building more roads, creating high occupancy vehicle lanes, and promoting car pooling and public transportation - none has achieved more than modest success. Different technologies are there to detect traffic congestion and making congestion management more efficient [2-7]. But these technologies have several drawbacks, such as installation problems, complexity, cost, etc. In this paper, we have researched construction of the real-time and dynamic urban traffic information service system.

2. Architecture of System
2.1. Key Technologies

We use the key technologies as follows:

- GPS technology. Global positioning systems (GPS) provide a real-time spatial and time measurement of a location. The advantages of GPS includes being able to find the fastest, most efficient route between two locations. The system uses equipment which is becoming
standard in automobiles, such as on-board navigation systems and cellular telephones. A central database includes travel time information for each street segment and transition between street segments in the map database. Based upon the travel time information in the database, a route from a current location to a desired destination, or series of destinations, can be planned in order to have a minimum travel time.

- GIS technology. Geographic information system is one of the essential conditions to alleviate the traffic jam and guide the traffic flow rationally. GIS platform support services provide users with corresponding value-added services. As the development of traffic management and geographic information system, using GIS is leading the trend in traffic management system to enforce the management affectivity. GIS for Traffic can be used in equipment management, traffic planning, intelligent traffic, and navigation. GIS can operate, manage and analyze spatial data effectively. A system located in an automobile provides personalized traffic information route planning capabilities.

- P2P traffic identification technology. The essence of P2P technology is to change the way of processing and storage from centralization to decentralization. In identification technology, the packet exchange patterns are analyzed without being dependent on the port numbers and signatures, and it is utilized for the traffic control. When this technique is applied to the traffic control system, the traffic can be precisely identified for any applications traffic that deteriorates the traffic quality. We build the rule database for identifying P2P traffic through the research on the payloads of the request packet, and present an efficient method to classify P2P traffic based on packet classification algorithm.

2.2. System architecture

Real-time and dynamic urban traffic information service system focuses on developing supporting platform for traffic information services, integrate and fuse massive dynamic traffic data and legacy traffic systems, construct high performance computing platform and dynamic parallel traffic information service platform. The architecture of system is as follows:
3. Implementation of Information Services

3.1. Functions of the System

The information services that the system provides are: Services for travelers; Services for traffic participants; Services for functionary government departments; Services for related logistics and vehicle services companies [8]. The functions of the system are as follows:

- Road Information. The system could provide services such as traffic management, police services, real-time traffic, SMS, illegal inquiries, provide information support for the traffic control, and making a new interaction between people, vehicles and roads, enabling real-time, accurate, efficient, safe, energy-saving for urban road use. Many kinds of commonly-used traffic information of city roads are provided. And various kinds of road events, like traffic block, construction, signal break, disaster, accident and so on. For example, the route guidance allows you to avoid the traffic congestion and arrive at destination in a shorter period of time. Advanced traffic information service system not only provide timely and accurate traffic information for traffic management personnel who can effectively adapt the traffic management control system to a variety of traffic conditions and road network capacity, but also help road users, effectively avoiding traffic jams, reducing traffic accidents.

- Route Guidance. The system can assist users in planning an appropriate road. Users are allowed to assign the start point and end point by clicking the map or querying. They also can require the system to avoid national freeway or event point. The system would display the appropriate route on the map and the details. The system provides static and dynamic traffic information services for traffic managers and travelers, through integration of traffic management data and data mining, with many forms such as texts, voice, SMS, pictures, videos, and maps, and so on. We provide the traffic congestion information with high accuracy according to various traffic conditions. Moreover, we can provide the times required for traveling different route with high accuracy by calculating the congestion level at right or left lanes from the information.

- Alternative Routes. The function shows descriptions and locations of these alternative routes to facilitate the public to avoid traffic jam. Providing the most accurate real-time traffic information and broadest coverage available, featuring: real-time reporting of traffic flow information for major roads, compatible with all map databases, support for traffic message channel, timely reporting of accidents and construction alerts, easy implementation through provides flexible delivery to people via SMS text alerts, e-mails, Web, cell phones, satellite and terrestrial radio, TV, personal and in-car navigation devices, and other devices [9].

3.2. Functional Modules

The main function modules of the system include:

- Data processing. Under growing pressure for improving traffic management, collecting traffic data has been evolving considerably and the access to real-time traffic information is becoming routine more important. The use of traditional onroad sensors for collecting data is necessary, but not sufficient because of their limited coverage and expensive costs of implementation and maintenance [10]. Intelligent transport systems require a new kind of data acquisition methods to fulfill the demands of today’s traffic management. Prediction of traffic, dynamic routing, off board navigation, and standardization of traffic flow parameters are the challenges we are faced with. Traffic data is required in the study in order to provide an independent measure of the loads that are applied to the individual pavement sections being studied. We use the methods based on the vehicle location which are a promising cost-effective solution to cope with some limitations from fixed detectors. We also collect data from “in-vehicle” devices through mobile phones or GPS. A common problem in many applications is the sparsity of real-time traffic data. We use of intelligent processing, or data integration tools, to overcome the data sparsity problem and make the best use of existing data resources.

- TMC (Traffic Message Channel). It is technology which offers traffic information those information are transmitted through a dedicated radio channel. It is traffic information service that continuously broadcasts digitally coded traffic information by radio. Users can listen to this information, view it on a display or store it. It is a technology for providing traffic and travel delay information to drivers. It is a digital data stream that informs the satellite
navigation device about road closures and congestions. These messages are carried as part of the RDS data by FM radio stations and are regularly downloaded to the device. The downloaded traffic alerts are then used by the navigation application to recalculate your travel time and, if available, plan an alternative route avoiding those problems. Traffic is monitored and analyzed with traffic detectors that are also used for traffic control systems on federal motorways. It is a service which delivers information about traffic conditions to suitably equipped GPS navigators including heavy traffic, delays, accidents, road works, black spots and speed cameras. When integrated into route calculations traffic information gives a driver options for alternative routes to avoid delays saving time and fuel.

- LBS (Location-Based Services). We have introduced a new type of information technology called Location Based Service. Many people are familiar with wireless Internet, but many don't realize the value and potential to make information services highly personalized. The LBS application would interact with other location technology components to determine the user's location and provide a list of restaurants within a certain proximity to the mobile user. Location based services are developing rapidly in the mobile and information technologies fields, location based service which is a mobile telecommunications operator by radio communication network, or external positioning for mobile end-user location information. It has: voice-guided in-car navigation, voice-guided pedestrian navigation, mobile maps, mobile maps applications (weather, restaurant guides, traffic, etc.), people tracking, location enabled search and advertising, and other applications. Increase demand to modern technologies and interest in utilizing geospatial information servers to provide useful information and services to mobile users though wireless networks plays a very important factor to LBS advancement.

3.3. Functional Implementation

The system provides the traffic information services by the tools as follows:

- Mobile transceiver. Transceiver technology is enabling more technology to be placed inside a vehicle. Information about the version of the stored data or data groups in the memory allocated to the mobile transceiver, and/or the manufacturer of the stored data or data groups and/or the issue date of the stored data or data groups is transmitted to the base station in the traffic-information query, so that in the return message of the traffic information, the base station can undertake the coding in such a way that the coded data can be well utilized on the basis of the stored data in the vehicle [11]. A method for requesting and for processing traffic information, in which a traffic-information query is transmitted by a mobile transceiver and at least one traffic message, is provided by a service provider via a base station, the traffic message being transmitted as a brief coded message. In this manner, even given changing data, it is ensured in all events that the mobile transceiver is able to interpret the coded traffic messages.

- Vehicle information terminal. Some remarkable high performance and highly sophisticated car navigation systems have been produced in recent years. They are equipped not only with navigation functions but they also incorporate a television receiver, DVD player and audio player functions. So many functions are available with these systems and a connection with a mobile phone completes the in-vehicle information terminal. It's an in-vehicle information terminal system. We developed for the purpose of realizing audio, visual, navigation and communication functions as an in-vehicle information terminal with the car navigation system as the main feature. It's a system created with the intention of balancing a high performance with sophistication. Realizing various functions of in-vehicle information terminal systems focused on car navigation. It has been designed aimed at sufficient performance to control in-vehicle information terminals, interface function with outside, integration of each conventional function of in-vehicle information terminals.

- Variable message board. Often abbreviated VMS, CMS, or DMS. Variable information board is a large ultra-bright LED dot matrix display for real-time changes in the weather, road traffic or other alerts rewritable display format can be transformed to facilitate the driver to predict in front of the traffic situation and weather conditions. Variable message boards can release real-time traffic information for the public to provide free services, but its information disadvantage is also obvious, embodied in the variable information board targeted, the user can not access, independent information can not be stored. Variable message signs are the safest means for notifying motorists of changes in traffic patterns and road conditions.
Message signs are ultra-bright and highly legible, with a variety of functions for any application: lane closures, highway construction, work zones, parking lots, and more. It’s an electronic traffic sign often used on roadways to give travelers information about special events. They may also use for vehicles to take alternative routes, limit travel speed, warn of duration and location of the incidents or just inform of the traffic conditions.

- SMS. SMS has emerged as a popular means of communication between mobile users. We obtain distributions of certain properties of the SMS traffic such as its arrival process, departure process, and service times. We presents a SMS-based urban public traffic query service model offering exact transfer query service, it can be integrated into WAP-based and WEB-based systems. We practice individual approach to every customer offering flexible and mutually profitable rates combined with privacy and invariably high quality and reliability of services. The real time traffic congestion information and the traffic congestion forecast information are widely provided to not only drivers but also many users through SMS. It could provide traffic information (past, current, future), notification of traffic situation forecast by email, route guidance, and exchange information service among groups, etc. The advantage of this approach is the network coverage, good coverage, a small investment, and can be two-way through the short message; the drawback is the small capacity of peer-to-peer communication, transmission of information delay.

- Traffic TV. Traffic TV is a traffic and traveler information resource available on cable television. TrafficTV receives traffic congestion information from the regional intelligent transportation systems. A computer program fuses the data, adds digital video effects, and supplies the resulting presentation to a cable television provider for cablecasting. It is application that warns you of traffic on your route, shows how fast traffic is travelling through busy sections of the road network. People could see it and provides you with speed camera locations. We use data sourced from a leading traffic supplier, mobile phone networks, vehicle fleets and government agencies, to accurately tell people where delays are. This accurate live traffic information can now be delivered direct to mobile with traffic TV, enabling people to see exactly where the traffic delays are before they set off on their journey. It’s a downloadable application lets people see where jams are building up, the speed of vehicles at hotspots, and live pictures from thousands of roadside cameras. The system of video services consists of such basic parts: video complex, system of processing of the video data, a complex of management of services and the client equipment on a network of the operator.

4. Conclusions
Traffic information services and its’ technology have developed rapidly nowadays in the modern society. The public wants to obtain required traffic information instantly to plan their routes. Mobile information services will play an important role in our future work and private life. Enabling mobility in urban and populous areas needs novel techniques for individual traffic planning. Therefore, how to quickly provide real-time traffic information for the public has become a big issue. We should apply more new technologies to effectively integrate various types of real-time dynamic and static traffic information in one platform. The public can spend less time searching information and obtain more appropriate information in a new and fast way.

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