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INTEGRATED HIGHWAY MANAGEMENT SYSTEM USING RADIO FREQUENCY TECHNOLOGY BASED ON ARM

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Abstract

In this work we describe the integrated highway management system using RF technology. In country like India the highways plays a vital role in social and economic development. Recent years with the rapid development of our economy ,the growth of highway becoming faster . To overcome the highway management issues we propose the integrated highway management system based on the radio frequency identification (RFID) technology in which we will be tracking vehicles and Electronic toll collection system will be implemented. The electronic toll collection system offer the possibility of charging road vehicles in more flexible way and allow infrastructure charging policies to be implemented. It is vital for such system to be interoperable across national highway to avoid creating new obstacles to traffic flow. The manual toll collection at tollbooth is found to be cumbersome since it requires number of persons to manage the peak time rush. Implementation of an electronic toll collection will be solution for managing the fare collection. The system can realize the effective vehicles supervision, no parking fee . It can effectively solve the existing expressway management problems and make the use and management of highways become more efficient, safe and reasonable
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Index Terms: technology; integrated management; highway; traffic supervision; no parking fee system; path recognition

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1. INTRODUCTION

Electronic toll collection (ETC) is a technology enabling the electronic collection of toll payments. It has been studied by researchers and applied in various highways, bridges, and tunnels requiring such a process. This system is capable of determining if the car is registered or not, and then informing the authorities of toll payment violations, debits, and participating accounts [2]. The most obvious advantage of this technology is the opportunity to eliminate congestion in tollbooths, especially during festive seasons when traffic tends to be heavier than normal. It is also a method by which to curb complaints from motorists regarding the inconveniences involved in manually making payments at the tollbooths.

Highway is an important auxiliary booster of the development of a country's national economy and also an important symbol of traffic modernization in a country. At present, with the rapid development of our national economy, the highway also presents the momentum of robust growth. However, with the continued increase of highway traffic mileage and complexity of road network structure, highway management faces enormous challenges [1].

First of all, today, for the supervision of vehicle in highway, it is basically relying on the traditional road patrol management. However, the number of vehicle in highway increases day by day, which brings huge pressure to the department of road patrol management so that it sometimes occurs improper monitoring and dispatching of vehicle, making the vehicle management in chaos. Moreover, some unexpected events and the areas with a lot of traffic lines often cause traffic jams, leading to traffic delays. Second, highways in our country basically are the toll roads. At each toll station, vehicles are basically parking for paying fee, so sometimes drivers face the experience of queuing to make payments during rush hours, which is a serious impediment for the highway's fast and efficient function, and also causes environmental pollution and the waste of energy. Furthermore, at this stage, although highway in our country extends in all directions, the distribution of it in the provinces are very uneven, and the development and the terrain of highway are not same, so road network structure becomes more and more complex. All of these have resulted in binary-path problem in the process of actively promoting highway into couplet net and implementing a one-stop toll collection. Traditional solutions of 'charge according to the shortest path' and 'fuzzy split method' that solved this problem get more and more queries from proprietor because of their deficiencies in economic interests, rationality and objectivity, so they are facing more and more challenging[2]. Finally, the informatization level of highway in our country is low. Many information resources of highway do not obtain the effective integration and use, so it can not provide the necessary information services and support for the demanders of information resources. The existence of these issues has seriously hindered the healthy development of the future highway, and simultaneously has also brought the very disadvantageous influence to the fast and steady development of national economy. Meanwhile, the information expressway is the future development trend of expressway, so it is urgent to achieve the informationization, networking and intelligence

of highway management. In order to effectively settle these existing issues and achieve the intellectualized management and the efficient use of expressway, in here, we introduce the radio frequency identification (RFID) technology. The technology has the unique advantage of long-distance, automatic and efficient identification of targets, and also has strong environmental adaptability and high reliability so that it can accurately identify a target in a variety of harsh environments. Just because of these numerous merits of the technology, so applying it to the highway management can achieve good results. The article proposes a highway integrated management system based on the RFID technology combining the application of RFID technology. It improves traffic efficiency in highway and simultaneously ensures the safety of vehicle in the highway and the rationalization and transparency of charge work. In short, it makes freeway management become more efficient, standardized and intelligent.

2.THE OVERVIEW OF RFID TECHNOLOGY

Radio Frequency Identification, is a technology used for the automatic identification and tracking of goods, animals and people. A typical system consists of a three parts – a transponder, a reader, and a controlling application. Transponders hold data on whatever person or object they are attached to, usually containing a unique code used for identification, such as a serial number. When within an appropriate range of a reader, the transponders transmit this data to the reader using radio waves[5]. The reader decodes this radio signal into digital information, which is then relayed to a computer application that makes use of it. RFID technology is extremely widespread, used in many different applications such as security systems, public transport payment systems, the tracking of commercial goods, and livestock identification.

In uses waves to transmit the identified information in a two-way communication, rapid conduction of identifying target and exchanging data information, no limitation in space and supporting batch reading and remote reading. RFID system generally is made up of three components: tag, reader, RFID middleware and its application software. Its working principle is: attaching electronic tag that contains certain information about the identified object to the object, when the target appears in the region of radio-frequency signal launched by RF reader, electronic tag attached on the target will be activated and automatically sends the own information out, and then reader decodes the received information that is sent by electronic tag and transmits them to the background main system for further processing so that it realizes automatic identification of target[3]. At present, RFID technology is increasingly and widely used in warehouse management, production automation, container and package management, visualization management of parts and inventory, library and document management, location and object tracking, situational awareness and security checks and many other fields. Along with the development of large scale integrated circuit technology and unceasing expansion of its scale of production, the cost of radio frequency identification products is also getting lower and lower. So RFID technology will obtain more and more applications in more domains.

3.THE INTEGRATED MANAGEMENT SYSTEM OF HIGHWAY

Integrated management system of highway based on RFID technology consists of a series of subsystems, including the monitoring and controlling subsystem of freeway, the freeway subsystem of multi-path identification and tolling split account management, the highway toll collection subsystem of RFID and the comprehensive information management platform of resource sharing. Moreover, various systems carry on the exchange and transmission of data information using the computer networking technology and they are all monitored and managed by the total management centre system of highway. Besides, they can provide powerful data support for the movement of their respective system and achieve the sharing of information resources.

3.1 .The monitoring and controlling subsystem of freeway

In order to enhance the effectiveness of highway management, this paper proposes a traffic monitoring and management system of highway based on RFID technology. The specific operations of the system are as follows: It consists of two parts. In the control point, it is composed of the RF tags which are attached to the vehicle and contain the information of ID card, vehicle brands, driver's name and others, the readers that are installed in the various control points and antennas. It can achieve automatic identification of vehicle identity and the supervision of vehicle, and simultaneously transmits the monitoring data to the total control centre server through the network. In the highway's total control center, we carry out the binding of radio frequency cards and driver's identity to realize the information management of vehicle, which includes checking the payment records of vehicles, the legitimacy of the vehicle, etc.. Moreover, according to the ID number of RF card attached on the vehicle and the IP address of the receiver, and combining with GIS and GPS technology, managers can timely and intuitively understand the traffic condition and determine the position of vehicle to realize the tracking of traveling vehicles, the real-time control and scheduling of vehicle, the optimization of traffic routes and the alleviation of traffic congestion. With this advanced traffic monitoring tool, it makes the level of scheduling, command and management in highway get greatly enhanced. The monitoring identification system of highway based on RFID technology is shown as figure 1.

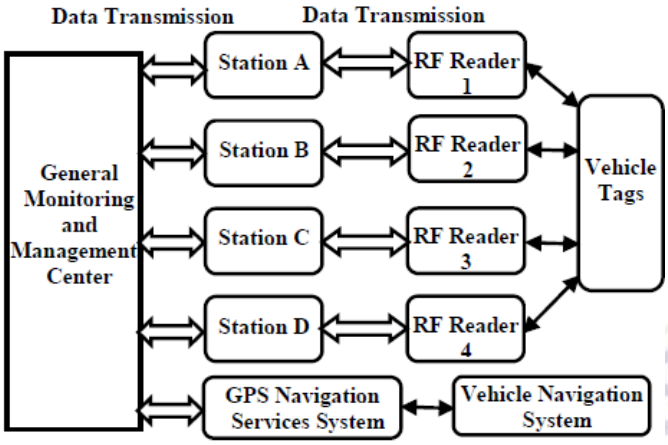

Figure 1. The monitoring identification system of highway

3.2.The freeway subsystem of multi-path identification and tolling split account management

Because of the particularity of our country highway in construction and management, our country has formed a situation in the certain range that the owners in highway are not the only and toll booths are many, which leads to the issue of toll fractionation in expressway networking toll. Currently, the fractionation of toll is usually using the shortest path method, which caused the certain loss of toll and some disputes about profit-sharing. Using the freeway subsystem of multi-path identification and tolling split account management can avoids these problems[6]. The concrete operations are as follows: The system consists of vehicle electronic tag, path-identifying stations, data processing centers, card senders, card readers and other equipments. In the intersection of highway, we set up path identifying stations and install the reader in there. Besides, it is need to attach electronic tag contained certain information to the vehicle. When vehicles get through the path identifying stations of RFID, the location information passed through will be written to the electronic tag and then the information will be uploaded to the central toll system of total management center. It will provide data support for radio frequency identification toll subsystem. Therefore, we can according to the position of path-identifying stations passed exactly know the traveling route of the vehicle and conduct accurate toll collection, and accurately carry out toll liquidation for the proprietors in the net [4]. Adopting this system, it not only identifies the path of the vehicle, but also records the vehicles' travel mileage, so we can use this as a basis for profit sharing. Therefore, even if a vehicle escapes the charge, it only affects the profit-sharing of the companies that appeared the phenomenon of escape from fee. However, the loss of other companies will be made up by the companies that appeared the escape cost phenomenon[7]. So in this way, it reduces the leakage of tolls in the whole expressway net. The path identification system based on FID technology is shown as figure 2.

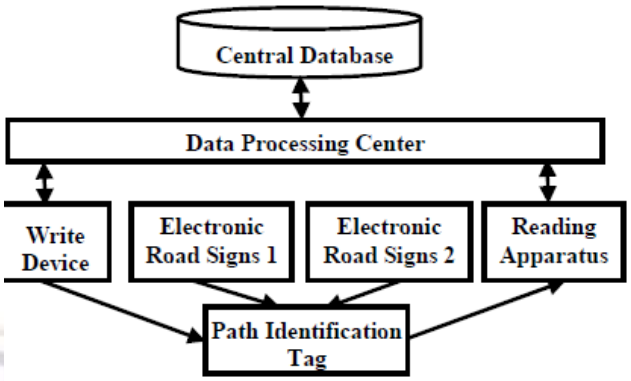

Figure 2. The path identification system of highway

3.3.The radio frequency identification toll subsystem

In here, we put forward highway radio frequency identification toll system based on RFID technology. It can achieve the collection of charges without stopping in the condition of vehicle running in high speed. The concrete operations are as follows: It is need to install equipment required by the system in each expressway toll station, namely, installing reader, intelligent controller, the data transmission unit, intelligent remote non-contact charging machines and other facilities in the engine room of toll station, installing antenna and installing the electric fence, lights, alarms and other devices in the side of road to realize automatically the release or block of vehicle after the payment[8]. When a high-speed vehicle drives into the work area of antenna in toll station through the traffic lane, the reader automatically identifies information (such as the code of electronic tag, the code of vehicle type, the information of ownership, the code of toll station in entry ways, the date and time of getting through toll station in entry ways and so on.) that is carried by the vehicles electronic tag, and simultaneously carries on the confirmation of the vehicle identity, then the data information will be transmitted to toll collectors in the toll station using the data transmission unit after that confirmation isn't wrong. By now, the toll collector in toll station will carry on automatic collection according to the amount of collection that is confirmed by the centre toll collection system in the total management centre. After the success of collection, it opens the signal--green light and directs the vehicle to pass normally. If no signal is received or the information of vehicle type is not legal, then the warning will be given out and the toll station will execute the manual handling. Simultaneously, charging information is automatically uploaded to the total management centre system to store, preparing for others use. The highway radio frequency identification toll system is shown as figure 3.

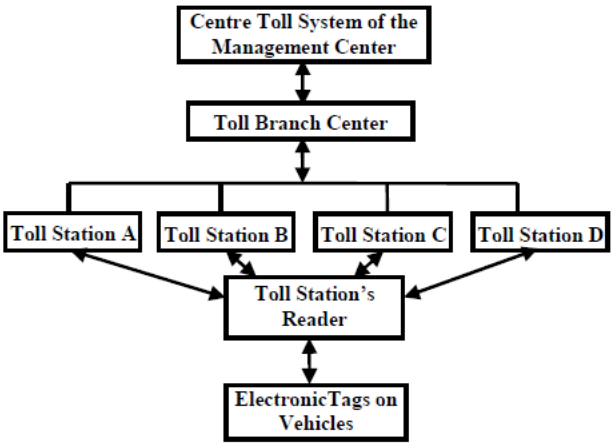

Figure 3. The radio frequency identification toll system of highway

3.4.The comprehensive information management platform of resource sharing

The informatization and intelligence are the development direction of highway management. We are based on the gathered information about vehicle, highway toll and traffic surveillance from the above three sub-system as well as the real-time history data information related with road network, using the computer networking technology and the database technology to build a comprehensive information management platform. With the application of this platform, it can achieve resources sharing and full use of information. For this system, we will use the Windows 2000/Windows XP as the operating system platform and adopt objectoriented programming method to build. Its background database is SQL Server2000 and its application mode is Client/Server mode. The system has great stability, scalability and maintainability. It is worth mentioning that individual privacy and security are very important. Thus, the system has a security mechanism that refers to a security matrix to set up personal privileges. Thus, the system only allows access to authorized data [5]. Highway transportation management department can checks the movement information of vehicle and road current situation through this platform to achieve reasonable arrangements about traffic. Highway toll management department can real-time inquiry payment situation about vehicle to enhance its supervision. The owners of vehicle may verify and check the payment situation about their own vehicles, for example: the amount of payment, payment frequency and so on. This platform system has provided the formidable support and the service for the management of the entire high-speed network. It achieved the requirement of information and intelligence in a modern highway management and greatly increased the transportation capability and the management level of highway.

3.5. Efficiency analysis of the integrated management system

The highway integrated management system based on RFID technology is the final reflect form to realize the informatization of highway. Firstly, its application solves the problems which exist in the management of highway well and greatly improves the level of supervision of the vehicles on the highway[9]. Moreover, carrying out the no parking fee on the highway, it improves the efficiency of toll collection greatly, eliminates the disadvantages of the traffic congestion in expressway and makes the efficacy of highway play to the best. At the same time, because there is no person engaging in the process of charge, so it eliminates the artificial errors and the illegal thing about corruption and so on[12]. Furthermore, it also avoids the loss of toll and makes the toll collection become more reasonable and transparent. Finally, it makes the management of highway become more modern, informationalized and intelligent.

4.CONCLUSIONS

The integrated highway management system proposed in this paper has good guiding significance for management mode of highways and an intelligent traffic management expert system with RFID technology. The system provides both practically important traffic data collection and control information and can trace criminal or illegal vehicles such as stolen cars or vehicles that evade tickets, tolls or vehicle taxes. By doing so, increased efficiency will be guaranteed since RFID is known as a highly stable technology. With the elimination of human interaction in the entire toll collection process, we can create a better ETC system to be implemented in Malaysia. It can also significantly improve the efficiency of toll stations and the traffic abilities of the toll road RFID technology will have more applications in the future field of intelligent transportation. Although the current RFID technology is used extensively, it also has some defects and shortages in the aspects of standard, communications, safety and cost. However, we believe that with the improvement and development of related applications software, RFID technology will become one of the mainstream applications in the development of intelligent transport. It will have broadly applied prospect.

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