

# Parking Information Acquisition, Release, Query, Reservation and Parking Navigation System Design for Internet of Vehicle

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**ABSTRACT:** Aiming the problem of parking information release is large flow, and release information is not timely and not accurately, the internet of vehicle (IOV) of the urban traffic parking system is proposed based on the parking lot sensor network and sensor combination and its electrical control circuits. This system will be use the core technology of internet of things (IOT) and combinate the timer and elastic pressure switch with a pressure sensor and its electrical circuits to realize the parking information acquisition, release, query, reservation and parking navigation with reliable and accurately. Experimental results shows the electrical control circuits will be better management the parking information with accurately and the car user uses the vehicle terminal to search the target parking lot and to receive the parking information. This system will be to alleviate the urban traffic and improve the utilization efficiency of urban parking lot, for the future of the city and social development to provide better technical support and basis.

**KEYWORD:** Internent of Vehicle (IOV); Parking information management; Internet of Things (IOT); Sensor combination; Electrical control

## 1 INTRODUCTION

With rapid development of automobile industry and improvement of people's life has brought rapid increase of urban vehicle, make urban traffic appear a series problems: 1) parking difficult, couldn't find a parking lot and although find parking lot but don't know whether there is a parking space, 2) driving difficult, car user can't find a parking space, the traffic jam caused traffic chaos and affect the image of city, 3) traffic jams cause the time waste and energy waste. Also, traffic jams increased carbon dioxide emissions, and noise, which caused great pollution on the environment. The rapid development of urban traffic and sharp increase of car, parking demand also increase gradually, especially plane parking lot and stereoscopic parking lot of urban [1, 2,11]. Although parking lot number is increased but failed to archive unified management of parking lot, the parking information failed to release to users and to decrease the utilization rate of parking lot, at the same time, car users blindly parking aggravate to the urban traffic jam [3, 4]. To alleviate the urban traffic parking problem should be realize information sharing between the vehicle, person, road and environment. According to the different functional requirements of car user, the internet of vehicle provides a good

information sharing platform. The car users are to share the internet of vehicle provides information and services by the vehicle terminal (such as on-board navigator, smart phone, and iPad, etc.). But the existing parking information flow of parking lot is big, easy to damage the frequent use of electronic devices, and the parking information timely, inaccurate, and fee increasing of the parking maintenance leads to some overcharging and users are not willing to parking, thus appeared the roadside parking at random, a serious impediment to the normal operation of the urban traffic.

This paper proposed the internet of vehicle (IOV) of the urban traffic parking system based on the parking lot sensor network with the internet of things (IOT) and electrical control especially combine the timer and elastic pressure switch with a pressure sensor. This system effectively reduces the network traffic, the information clear and reliable, combine to use the timer and elastic pressure switch with a pressure sensor, information accuracy, timing accurate, and high cycle life, the floating car bracket can eliminate caused by deformation of garage framework of information and can reduce the maintenance cost etc.

## 2 SYSTEM OVERVIEW

The IOT of parking system composed by the radio frequency identification (RFID) module, the infrared detection sensor module, the global positioning system (GPS), the laser scanning module, the pressure signal conversion module, the information storage module, the information release module, and many other modules. The city traffic information management center connect to the internet, the radio and television network, and the mobile communication network to form the global internet of things (GIOT) and to release the parking information and to make reservation at the same time parking space, as shown in Fig.1.

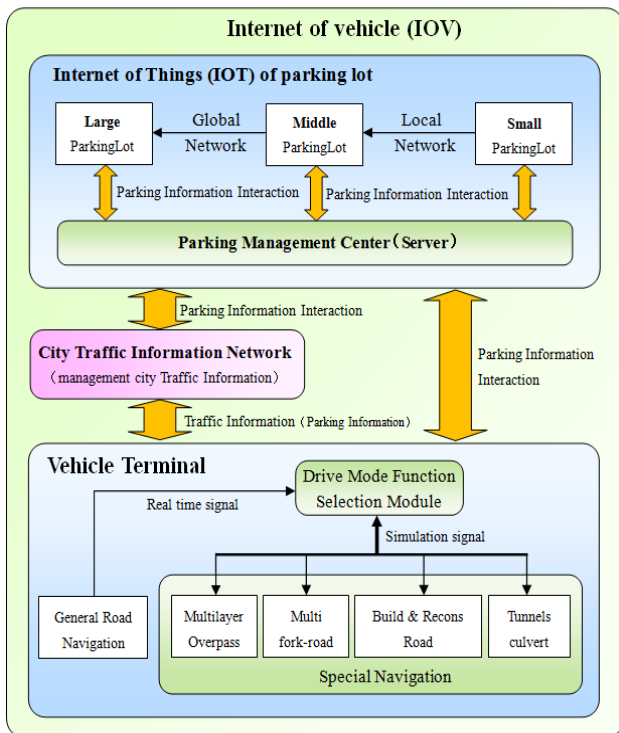


Figure 1. Parking system structure schamatic

In order to obtain simple, reliable and accurately parking information, this paper used the pressure signal conversion module and the signal conversion module connected to the city traffic information management center through the dedicated network interface. The parking unit composed by the floating car bracket (1), the stereoscopic parking lot framework (2), the spring (3), the pressure relay (4), and the parking unit connected to the internet of things of parking lot system [5], as shown in Fig.2.

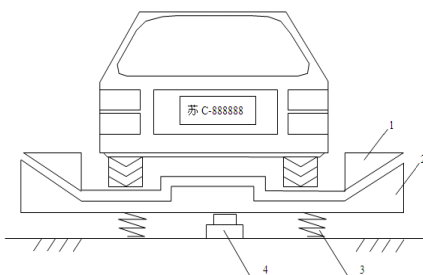


Figure 2. Parking unit schamatic

The floating car bracket with guide rail, the whole plate stamping; spring uses the pressure spring; pressure relay for elastic pressure switch with a pressure sensor, that is integral pressure sensor, when the pressure reaches the pressure value, the pressure relay action, touch the pressure relay contactor action, to obtained the parking information.

## 3 PARKING INFORMATION MANAGEMENT

The parking information acquisition, release, and reservation is realized by the electrical circuits with the pressure signal conversion zone, the information storage zone and the information release zone. The electrical circuits of the three regions effective use the characteristics of programmable logic controller (PLC) [6].

### 3.1 Parking information acquisition

**Pressure Signal Conversion Zone:** Floating car bracket drive to the car, car along the guide rail frame into the stereoscopic parking lot, overcome the spring pressure under elastic pressure switch with a pressure sensor, when the external pressure exceeds the preset pressure value, the pressure relay start to action and touch pressure relay contactor (YJ) to action, make the car parking number intermediate relay (M) is power ON, as shown in Fig.3.

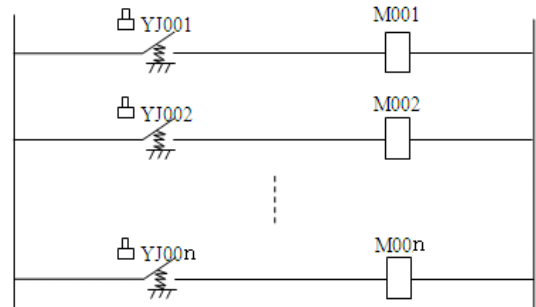


Figure 3. Pressure signal conversion electrical circuit

**Information Storage Zone:** After Power ON of the car parking number intermediate relay (M), the status register (S) started to power ON, and the timer (Y) and measuring car weight register (D) is worked. Effect of measuring car weight register (D) is according to the car weight reasonable to distribute the car position, so as not to cause the deformation of the frame structure caused by uneven stress. The electrical circuit is shown in Fig.4.

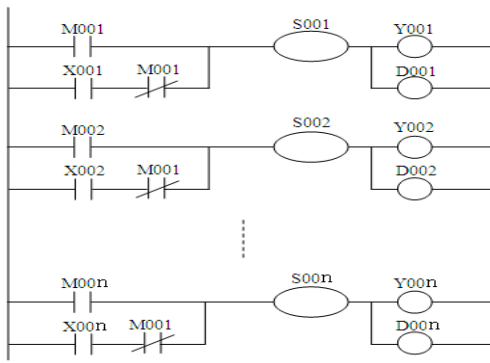


Figure 4. Parking information storage electrical circuit

**Information Released Zone:** After power ON the status register (S), the pulse light (⊗) is power OFF, then stopped the information release, the electrical circuit is shown in Fig.5.

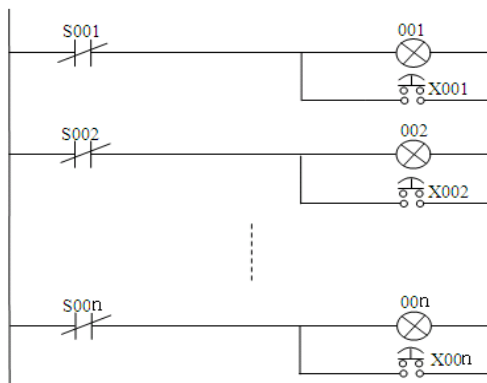


Figure 5. Parking information release and reservation electrical circuit

### 3.2 Extracting parking information acquisition

**Pressure Signal Conversion Zone:** Floating car bracket to drive cars, car along the guide rail to exit the stereoscopic framework, and to reset the parking lot pressure relay elastic pressure switch with a pressure sensor. Then the car parking number intermediate relay (M) is power OFF, the electrical circuit is shown in Fig.3.

**Information Storage Zone:** After power OFF the car parking number intermediate relay (M), the status register (S) and the timer (Y) is power OFF and the measuring car weight register (D) is power OFF, the electrical circuit is shown in Fig.4.

**Information Released Zone:** After power OFF the timer (Y), the pulse light (⊗) are connected. Electrical circuit release to the parking information and to prepare remote booking and positioning, the electrical circuit is as shown in Fig.5.

### 3.3 Parking information reservation

**Information Released Zone:** After determine the parking information, press the input signal button (X) of parking information reservation, then the delay switch are connected and power ON the normally open contact of parking information

reservation input signal button (X), the electrical circuit is shown in Fig.5.

**Information Storage Zone:** After power OFF the normally open contact of parking information reservation input signal button (X), the status register (S), timer (Y), and measuring car weight register (D) are worked, the electrical circuit is shown in Fig.4.

**Information Released Zone:** After power ON the status register (S), disconnect the pulse light (⊗) and to stop the information release, then the time count are started and successful parking information reservation, the electrical circuit is shown in Fig.5.

When extracting the vehicle, in Fig.3, the car parking number intermediate relay (M) is power OFF, then the normally open contact of car parking number intermediate relay (M) is power OFF and to ready for the next information reservation or the parking.

## 4 PARKING NAVIGATION ALGORITHM

In Fig.6, using maps API the parking navigation algorithms are completed and implemented.

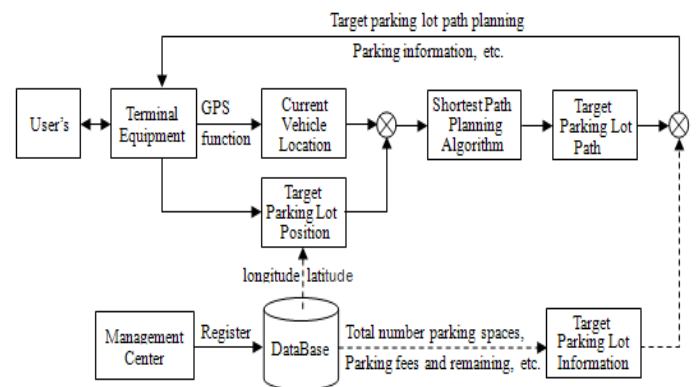


Figure 6. Experimental system construction

The parking navigation algorithm implementation steps are as follows:

**Step1:** Parking lot is registered by management center, registered basic information including the longitude, latitude and total number of parking spaces, parking fees and remaining, etc.;

**Step2:** Using GPS function of terminal equipment (on-board navigator, smart phone, iPad, etc.) to obtain the current vehicle location of the user's;

**Step3:** User select the target parking lot and to obtain the path route diagrams of all kinds of parking lot through the getNaviPath() of RouteSearch class in the map API;

**Step4:** By the current vehicle location and target parking lot position, the planning route data is obtained using callback function of the getNaviPath() method;

**Step5:** Using the step4 result data to calculate the distance of target parking lot, according to this

distance determine the minimum distance parking, that is closest parking lot, the result is shown in Fig.7.



(a) Different fork road



(b) Cross fork road

Figure 6. Parking navigation path planning result

## 5 SYSTEM SOFTWARE STRUCTURE

By the internet of vehicle (IOV) worked information service platform and management center to complete the user on the navigation in the vehicle parking, parking enquiry and booking, payment and internet search, parking information release, parking management center, etc. [8,9,10], The car user's interaction system software structure is shown in Fig.7.

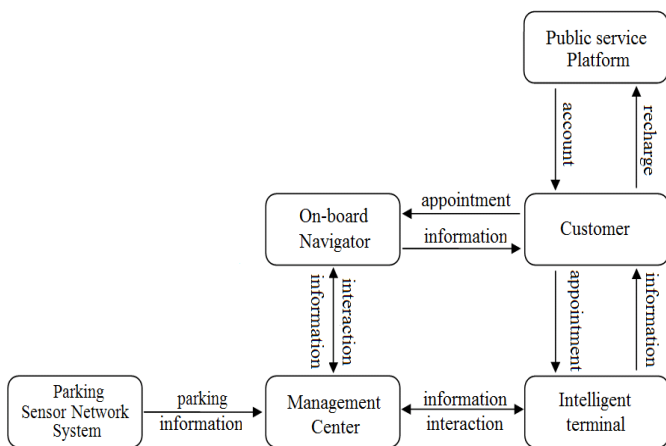


Figure 7. Software structure of car user's interaction system

➤ **vehicle terminal:** the terminal is placed on the car of a visual operational interaction of electronic equipment, specific functions include; query

function, you can query all current network location of the parking lot, opening time, charge standard, the total parking spaces, the current vacancy and other detailed information, the vehicle navigation terminal will query request submit to the management center, management center of the data in the server after the access to information feedback to the vehicle navigation terminal interface; reservation function, can send booking to the designated parking lot parking information, such as license plate, estimated time of arrival, through the management center issued to the corresponding parking lot management system; GPS navigation, the use of on-board navigator for current vehicle's geographic coordinates, terminal deployment map and marked on the map coordinates of the parking lot, customer goal setting parking lot, navigate to the destination, etc.

➤ **Public service platform:** this platform include the business transact function, main processing internet of things parking card and the authorization issue of vehicle terminal, prepaid phone, report the loss, cancellation, drivers can be dealt with in the nearest point to register the first time to buy, you can query consumption, prepaid phone records, Internet query function, it is used to provide the public via the internet on the computer" distribution, real-time parking lot status" and so on information inquiry; Parking information release function, used for outdoor parking spaces in the urban traffic information system, according to the real-time release of a large screen parking situation of main road, alleviate traffic pressure, data transmitted through special interface design, etc.

➤ **Management center:** this center is mainly responsible for integrated parking lot management system, vehicle terminal system, public inquiry system, specific functions include Personnel management, the main set involved the system account, information, etc; parking space management, on the vehicle of internet to upload for centralized management of the mobile position information, contains the parking spaces number, empty parking state; vehicle management, mainly to buy vehicles parking card of internet of things and vehicle terminal information for centralized management, include vehicle license plate, the basic information, such as model identification card and terminal information, etc.

## 6 EXPERIMENTAL RESULT

Using the above electrical circuit methods and software process for the navigation route and target parking lot parking information operation steps and the results are as follows:

**Step1:** Select URL, click to enter service platform, through the intelligent terminal (smart



phone or iPad) or on-board navigator display the current location, and shows the target parking lot, the current position search result;

**Step2:** Click options and to reach the parking lot, through the vehicle terminal system to select the target parking lot travel route, the target parking navigation route search result;

**Step3:** Click filter, respectively charge at least, at least, the most open, click on the target in the parking lot, according to user's request and display parking information (such as parking number, remaining parking, and parking quotation, make an reservation time), target parking information search result is shown in Fig.8.

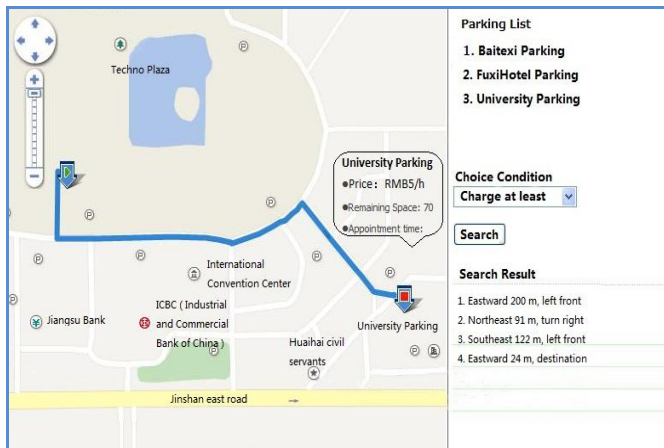


Figure 8. Search result of target parking information

Through above experiment is concluded following results:

(1) Using above electrical circuits will be obtained accurately and better parking information and through the parking sensor network system send to management center and internet of vehicle;

(2) The internet of things of parking system better received the parking information, and through the internet release to vehicle terminal of car users accurately;

(3) At the same time also can see through the shortest path algorithm to search the target parking lot and to navigate the best parking path.

## 7 CONCLUSIONS

This paper proposed the internet of vehicle for the urban traffic parking system. This system will be make use the core technology of internet of things and combination of timer and elastic pressure with a pressure sensor and its electrical control circuits to realize the parking information acquisition, release, query, reservation, and parking navigation with reliable and accurately. The system implementation has following characteristics:

(1) Parking lot has a parking space or appointment only the output or the input the signal, so the signal network without overlapping, reducing network traffic;

(2) Parking information acquisition electrical circuit combine to use the timer and pressure relay, the information is reliable and accurately, accurate timing, and have a long service life;

(3) Floating car brackets and measuring weight register can eliminate the garage frame deformation, making the information more accurately;

(4) Using the parking reservation input signal button to make a reservation by mistake.

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