A Web Based Centralized Vehicle Parking System Using GSM Security

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ABSTRACT

Wireless technology is an emerging technology. This paper discusses about the centralized secure car parking and reservation system using wireless technologies. The system includes three modules, parking lot vacancy monitoring module, parking lot reservation module, and security module and Central Server. Parking lot vacancy monitoring module includes infrared sensors and Zigbee modules which are interfaced with PIC Microcontroller. Vacancy monitoring module detects the presence of vehicle in the parking areas and provides the status to the users in real time. Reservation module includes GSM modem which is interfaced with a coordinator system. The user can book their parking spots through SMS. Security module includes set of rules which ensures the security of user’s vehicle parked in their reserved parking spots. Security is one of the main concerns in this paper. If user’s vehicle has been accessed by an unauthorized person, SMS based indication will be provided and also the system will not allow the vehicle to exit from the parking bay. This system suits well for multilevel and closed underground car parking systems.

Keywords: Smart Parking, Security, Zigbee, Xbee, GSM, SMS, Parking Reservation.

1. INTRODUCTION

As the number of vehicles increasing day by day, the vehicle theft is also getting increased on a same scale [5]. The main problem to the previous parking system is the database is not centralized, user has to send the SMS to the dedicated system installed in the particular area for finding the empty space, if the user switch from one to another city he has to register for the for the another system. In the proposed centralized system since the database is centralized the user can easily find empty slot while moving from one city to another without any new registration. Centralized parking lot management system will provide a solution for these issues which is clearly framed out in this paper.

Present smart parking system uses camera and load cell based vehicle monitoring system, which is not cost effective and also does not provide full scale security to the vehicles also it maintain information about single apartment or malls. This proposed work will solve this issue by providing two way password securities, and the system will be very much cost effective. The block diagram of the proposed Centralized car parking management and reservation system is shown in the figure 1.

Figure 1 Previous System
In the above figure, users will send the request for the parking to the centralized web server. The server in turn checks the nearest parking empty slot available in the different systems for the users, if the slot is available, the web server will send the response message, i.e., authentication message to the user.

2. WORKFLOW

a. Parking Lot Monitoring Module

The flow diagram of vehicle detection module is shown in the figure 2. The parking lot is provided with infrared sensors and is allowed to sense the parking area continuously 24x7. If it detects any vehicle in the parking lot, it will indicate the presence of vehicle to the microcontroller to which it is interfaced. The microcontroller will in turn send the status information to the Zigbee node which is also interfaced with the microcontroller. The Zigbee node in turn transmits the status information to the end Zigbee node which I interfaced with a coordinator system at the entrance of the parking bay. Then the parking lot status is updated in the database system. Continuous update will take place as the system works continuously.

![Vehicle Detection Flowchart](image)

For multilevel parking system, multiple Zigbee nodes will be used one for each level and a network is formed between the Zigbee nodes. In this proposed system, PIC 16F877A series controller and Digi International’s Xbee nodes are used [6].
b. Parking Lot Reservation Module

The flow diagram of parking lot reservation module is shown in the figure 3. When the user wants to reserve a parking lot in advance, user has to send a reservation SMS. When the coordinator system receives the SMS from the user, it will start to check whether there is any vacancy in the parking lot. If lot is available means the control unit will send an acknowledgement message along with the entry password to the respective user who has requested for parking lot reservation. A timer will be started for that reservation. Before the timer expires the user has to reach and enter the password, if not means the reservation will get expired and the expiration message will be sent to the user. If lot is not available means lot not available SMS will be sent to the user. If user reaches on time means, he has to enter the entry password in order to access the parking lot. An access system which is available at the entry of the parking bay is used to provide the password. If the password is correct means the barrier gate will get open and allow the user to enter the parking level. Once the user parked the vehicle in the respective parking lot allotted, the user has to press a key, which is available in the parking lot which enables the security monitoring of the vehicle. For 24x7. A display device is provided at the entrance of the parking bay which helps the users to identify whether the parking lot is available or not. This scenario suits well for single level.

![Reservation Flow Chart](image)

Figure 4 Reservation Flow Chart

c. Security Module

The flow diagram of security module is shown in the figure 4. When the user park their vehicle in their respective reserved parking lot means, that particular parking lot number and user’s phone number will be stored in the database system for that particular lot and the sensor will sense the presence of vehicle in the parking lot. If the vehicle is taken out from the parking lot means the infrared sensor will indicate the controller and the controller will in turn indicate the coordinator system through Zigbee nodes. The coordinator system will in turn send an exit password to the user’s mobile phone which is stored in the database system. If the vehicle is taken out from the parking lot by the user means the user has to enter the exit password which he will be receiving once he takes out the vehicle from the parking lot.
If the vehicle is taken out from the parking lot by an unauthorized person, (He/she may think that the entry password and exit password will be the same but not so.) he/she is not allowed to get out of the parking bay as the barrier gate will not get open until correct exit password is entered. At the same time the original user will receive an exit password in his mobile, and he will come to know that some unauthorized person is trying to access his/her vehicle.

3 DESIGN OVERVIEW

The secure car parking reservation and management system includes access control unit (normally a PC), PIC 16F877A series microcontroller, Zigbee nodes, keypad, barrier gate, and display unit. As mentioned earlier this system has three modules; parking lot monitoring module, lot reservation module, and security module. Each parking lot will be provided with infrared sensor, whose function is to monitor the parking field 24x7. The infrared sensors are interfaced with the PIC microcontroller to which Zigbee node is also interfaced. The lot status is continuously transmitted to the coordinator system where the database is maintained. A barrier gate is provided to each level of parking bay. Each level may have number of parking lots. UART communication is carried out between Zigbee node and the microcontroller. On the other hand the access control system (coordinator system) will have Zigbee node and GSM modem interfaced with it. Dot Net framework is used to construct the access system.

3.1 Zigbee

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory.

ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 kilobits/second in the 868 MHz frequency band to 250 kilobits/second in the 2.4GHz frequency band.[6]

3.2 PIC Microcontroller

PIC (Peripheral Interface Controller) is an 8 bit Microcontroller used in this system. PIC16F877A series controller used here seems to be efficient and cost effective for this parking management system. The Microprocessor basic building shown in Figure and consist of the following:
- CPU - the part that does all logic and arithmetic functions
- RAM - storage for programs and/or program variables
ROM - read-only parts of programs
I/O - connection to external devices

3.3 GSM
GSM (Global System for Mobile communication) is a wireless communication device used to receive the user’s request for reserving the parking lot and also for sending the entry and exit password to the user for accessing the parking lot. SIM300 V7.3 version modem issued in this system. AT command sets were used to access the GSM modem [3]. GSM modem is interfaced with the coordinator system using RS-232 COM connection. GSM is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It became the de facto global standard for mobile communications with over 80% market share.

3.4 LCD
LCD is a display device interfaced with the microcontroller which is placed at the parking level. The LCD is used to display the value entered by the user.

4. Conclusion
This system holds good for smart parking system, as it provides higher level of security for the vehicles parked in the respective parking spots. This system also reduces the traffic and congestion in finding the available parking spots. The two way Password protection module ensures the security of the vehicle and the experimentation result proves that the system provides higher level security for the parked vehicles and is easily implementable in real time. On the whole this system proves to be cost effective and highly secure.

References
[6] XBee™ ZNet 2.5/XBee-PRO™ ZNet 2.5 OEM RF Modules ©2008 Digi International Inc.