



Proposal for Advanced Parking System in Indian Situations

Naveen D Chandavarkar

Department of CSE, NMAM Institute of Technology,
Nitte, India

Abstract -- *The process of Advance parking system keeps track of all the traffic in the shopping mall and plays a very important role in Automated parking facility provided to the user of this system by minimizing the man power. In-time and out-time of the vehicle is read through the RFID connected to the vehicle that is scanned by the sensor that is managed by the manager of service provider, on basis of which the users are charged. Payment of the parking charges will be deducted from account maintained with the service provider by the user of the system. Any transaction or information is noticed to the user through message on the mobile. This paper focuses on hub of mall, service provider and the users of the system that are interconnected and work as unit to achieve this system. Promotion of this APS is one of the major modules, so as to make the users to know about the availability of this facility in the shopping mall. Service provider maintains all the data; these historical data will be analyzed so as to provide the user with different offers and other required analysis is performed.*

Keywords--*Automated Parking, Transaction, Promotion, RFID, and Historical data*

I. INTRODUCTION

The concept of Advanced parking system highlights the standard of shopping malls that is one of the most important features of any shopping mall. This paper focuses on the less man power and an automated system, wherein we use sensors to scan the RFID card attached to the vehicle [5]. This RFID card is highly sensitive and is attached near the vehicles number plate, so as to be sensed by the sensors easily [1]. The time read by the sensors will be managed by the service provider. These service providers keep track the details of all user associated with this system. Users initially have to create an account with the service provider providing his details, so as to enable this APS. This account has to be recharged by the user as per the requirement.

As the vehicle enters the parking lodge of the shopping mall, in-time will be read by the sensor that will be maintained in the log file of the service provider. Digital display is used to indicate the user which slot is available for him to park the vehicle. As the customer enters the mall, he will receive a welcome message to his mobile indicating that he has parked his vehicle in the specified slot number and notify the time to vacate the vehicle. Another message will be sent to the customer just before the time limit exceeds stating that the customer has to vacate the vehicle within a particular time, if not, the user will be liable for extra charges.

As the user exits the parking lodge of the shopping mall, RFID card is again read by the sensor so as to maintain out-time. The amount to be deducted is been calculated on the bases of the in-time and out-time read by the sensors. The amount deducted from the users account will notified to the user by a message to his mobile. Service provider maintains all the details of the transactions done by the user. There is continues interaction between users, shopping mall and service provider, wherein the customer is dependent on the service provider for maintaining the track records and providing the facilities. Shopping malls are dependent on the service provider for maintaining the parking systems transactions and other details.

This paper focuses on hub of malls for which service is provided by a common RFID card and service provider that maintains the logs of each shopping mall separately. A common service provider and RFID card is used assuming that the users of this APS can visit to any shopping mall that is APS enabled. Shopping malls with APS enabled system should promote that their shopping mall is APS enabled so as to notify the users, because in a city there may be shopping malls with or without this APS system.

A Digital display will be used to display the allocated slot for the vehicle, so as to make an easy parking instead of searching for the parking slot, which may lead to traffic congestion [2]. This process will help to notify the customers with the vehicle if the parking area is fully occupied. Service provider will maintain and is responsible for allocation of the parking slots.

Data maintained by the service provider in the form of logs includes in-time and out-time of the vehicle and number of time the vehicle visited the shopping mall. These data are analyzed to see how frequent user visits the mall and mined so as to provide these users with good offers and special reservation system that enable the service provider to send a message to the customers asking if the parking slot has to be reserved for their vehicle for which the customer has to reply in the format of Y/N back to the service provider [2][4].

In the case of Y, a parking slot will be allocated for a particular time period. Data managed by the service provider will be utilized by the mall shops by filtering the data to convert user as their potential customer by offering them some special offers so as to attract them. Here the data mined will be those customers who regularly visit the mall but not interested to visit some shop.

Service providers will analyze the performance of the shopping mall on the basis of

- No of vehicle visited the mall in a particular duration.
- Amount of product purchased by that visitor.

On the analysis made by the service provider about the users of different mall, the sponsor will decide best shopping mall for his advertisement.

Assuming the data of a year, the service provider can mine the data of the users who have regularly visited a particular shopping mall for a particular product or service; on the basis of this we can forecast the behavior of the user.

In this process we have to keep a track of some issues like:

- User should recharge his or her account maintained with the service provider before entering the shopping mall.
- Indication should be provided if the parking area is full.
- Secrecy of users and shopping malls information should be maintained.

In this entire process of service provider, it maintains the log of in-time and out-time of the vehicle in the parking area of the shopping mall. These data may be used in the case of any disaster or any criminal activity as the log of the service provider contains the details of customers visiting the shopping mall.

II. RELATED WORK

Various researches have been done in the area of parking system to make the system flexible so as to make it less complex and automated. This includes the work done by Massakiwada and Shinichimatsuda (1999) that helps the development of advanced parking assistance system for assisting the driver to accomplish the parking task. The main issue specified in this paper is with regard to position sensing and human guidance. This paper pictures the approaches and hardware opted for the development of parking system. Guidance approach specified is with regard to path generation using possible parking region [1]. These issues are overcome in my paper by having no human interface, since the service provider automates the process and since we have assumed a fixed no of slots for the parking, each vehicle is assigned a slot till the vehicle has vacated from the shopping mall.

Research done by Soh Chun Khang, TeohJie Hong, Tan Saw Chin, Shengqiong Wang (2010) in this area solves the issue of the car drivers looking for parking slot all over the parking area in the existing parking system, which had led to waste of time because of no proper directions and cause unnecessary traffic congestions. This investigation results in proposal of paper on Wireless Mobile based Car Parking System using low cost SMS service by breathed first search algorithm, which enable the car drivers to receive the information regarding the available parking slots. This system is flexible to receive SMS request for assignment of new slot for parking the car [2]. This system is been replaced by a simple digital display in my paper which displays the slot number for car parking if slots are available, if not a message should be notified to the customer that the parking area is full.

In a similar research done by Yuki Hirakata, Akira Nakamura, KoheiOhno, Makoto Itami (2012) on parking slots in the parking area attached to the malls. Due to the wastage of time in searching for the parking slot, navigation system in parking area by using Zigbee network is discussed in this paper. Zigbee is expected to realize low power consumption wireless system with low cost. Zigbee can be connected by 65000 nodes as it can form ad-hoc network easily. It is suitable for large parking area wherein the shortest route to the vacant parking slot is transmitted to the vehicle by the Zigbee ad-hoc network providing a typical guide to the driver [3]. This process is cost effective when compared the simple digital display used to notify regarding the parking slot in my paper.

The work of E. Diaconu, H. Andrei, D. Puchianu, G. Predusca (2013) on Car parking service in urban area proposes an advanced software application for car parking. A modern thought on the solution for car drivers in order to reserve the slot in advance. This software application overcomes the time spent for finding the parking slot, reduces the traffic level and driving stress [4]. There may be a case wherein the drivers are not technically strong to use or operate this software application which may lead to much confusion.

III. ARCHITECTURE

The architecture shown in Figure 1 pictures all the components in this process of Advanced Parking System [6]. It is a two layered architecture wherein the first layer is for the communication of users with service provider and shopping mall with the service provider. Second layer is for the service provider wherein all the calculation and analysis of the user's data takes place.

The data read by the sensor from the user's vehicle is transformed to the manager, here all the transaction happens via manager for monitoring purpose, data collection block, that works as a database for APS and extracts the data for keeping the log for calculating the amount charged to the customer for parking the vehicle in the shopping mall and for some other processing as well.

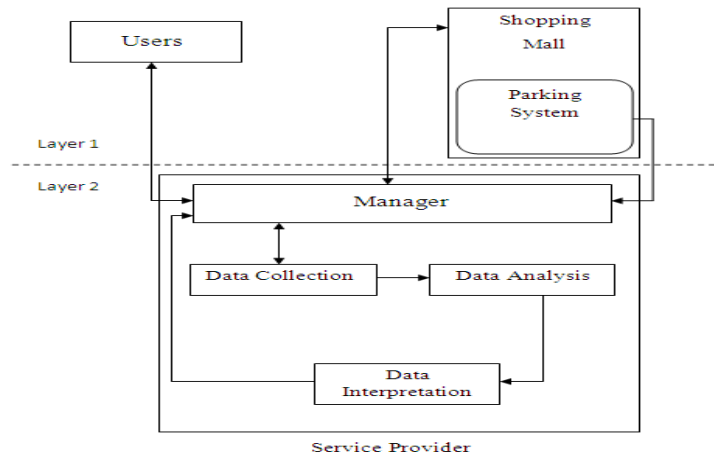


Figure 1: Architecture of APS

Data analysis block does the analysis on the data collected by the data collection block, it may include analysis on regularly visiting customers, rarely visiting customers and frequently visiting customers by providing with different types of offers so as to attract them. Data interpretation block interprets the data so that the shopping mall shop can use it on some crucial decision making or attempting to convert the customers visiting their shopping mall as potential customer for their shops by providing them with interesting offers. This interpreted data is sent to the requested shopping mall shop via the manager.

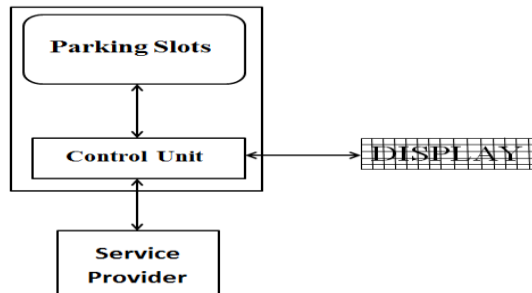


Figure 2: Structure of the Parking System

Figure 2 depicts the parking system of APS where the control unit keeps track of parking slots available and parking slots allotted to the customers, depending on the availability, parking slot number will be displayed on the digital display to notify the customers at the entrance. In the case of parking slots fully occupied by the customers a message displaying that the parking is full should be notified to the customer, so that their won't be any traffic congestion. Service Provider logs the in-time and out-time of each customers through Control Unit so as to calculate the amount to be deducted from the customer's account.

IV. ADVANCED PARKING SYSTEM METHODOLOGY

Concept proposed here is to target the customers for automated parking system who are naturally benefited and easy execution of the system without much overhead on the operator or operator delay. Creation of an account with service provider is very important module, where all customers have to create an account providing their details. There are many phases of interaction between the different components in the system, so as to make the system run smoothly.

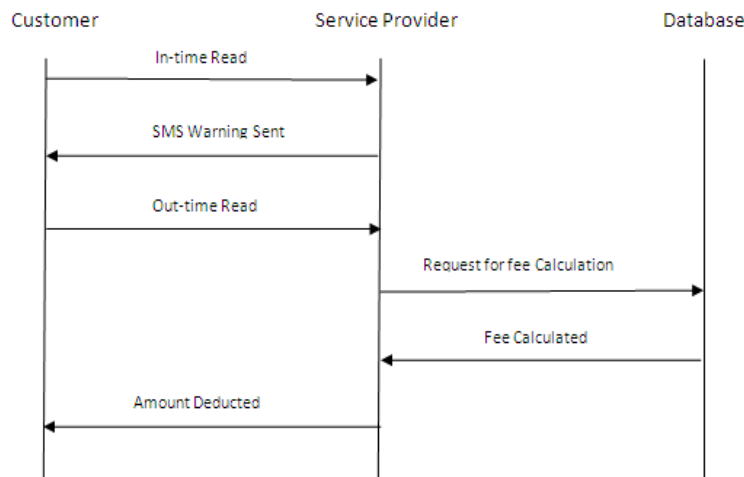


Figure 3: Interaction between the components

Figure 3 shows the interaction between the customer, service provider and database of the service provider. Wherein the in-time of the vehicle is sensed and logged by the service provider, if the time limit for parking the vehicle in the parking area of the shopping mall is T, If the customer exceeds that time limit a message is sent to the customer notifying that he has to vacate the parking area, if not extra charges will be charged. Out-time of the vehicle is read once the vehicle exits the parking area. Database is requested to calculate the amount to be charged, deduct the amount and update the customer's account. Service provider notifies the customer regarding the amount deducted and displays the balance amount through a message.

Service provider is responsible for all the transactions that happen with the customer.

- Customers have to create an account with the service provider.
- Customer's account should be recharged.
- Service provider receives the in-time and out-time.

If A is the amount recharged to the account, B is the amount deducted from the customer's account having in-time and out-time of the vehicle. Balance amount notified to the customer via message is A - B.

A. Algorithm

If Out-time is O and In-time is I,

In the case if the time limit T exceeds,

Condition 1: if $((O - I) \leq T)$,

A is the amount charged.

Condition 2: if $((O - I) > T)$

If Ad is the time limit after actual time limit T, E is the extra amount charged.

If F is the total time used and EU is the extra time used,

$EU = F - T$

$EC = (EU / Ad) * E$

Where EC is the extra charge,

A + EC

A + EC, is the amount charged.

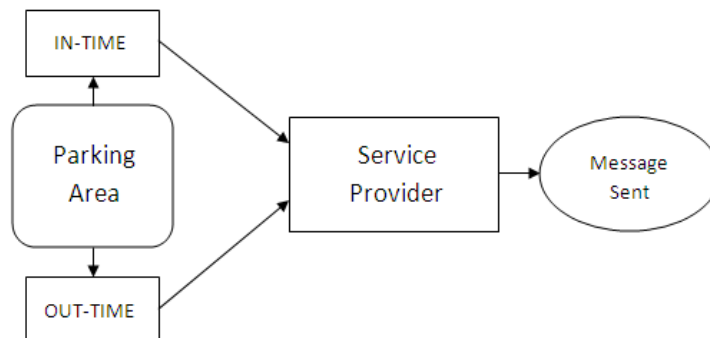


Figure 4: Processing Components

As shown in the Figure 4 the components show the processing of the entire system. In-time that is sensed from the RFID tag, RFID tag can be read from around 30 feet. Here the radio frequency electromagnetic fields are used to transfer the data. The wireless non-contact feature of this RFID tag automatically identifies the object.

The sensors available in the parking area are directly connected to the service provider, where the logs are updated and calculation of charge on the vehicle parked in the shopping mall is done. A message is sent to the customers in following case:

- Notification on the recharge of the customer's account.
- Notification for customer at time t, while the time is above to exceed the time limit T, Where t is the time before the time limit T with a predefined interval.
- Notification on deduction of amount from the account as parking charges.

It is the responsibility of the service provider to manage the parking slots in the parking area of the shopping malls. A digital display should be made available to indicate the parking slot for customers.

If there are N no of slots available in a mall, parking slots will be made available till all N slots are occupied. In this case a display should be made available to indicate that the parking is full.

Service provider assigns the slot to the customer that will be logged. As the customer vacates the slots it will be made available to other customers.

If X is the slot made available for vehicle C, once the vehicle C vacates and exits during, which the out-time is read, the slot X will be made available to the other vehicle.

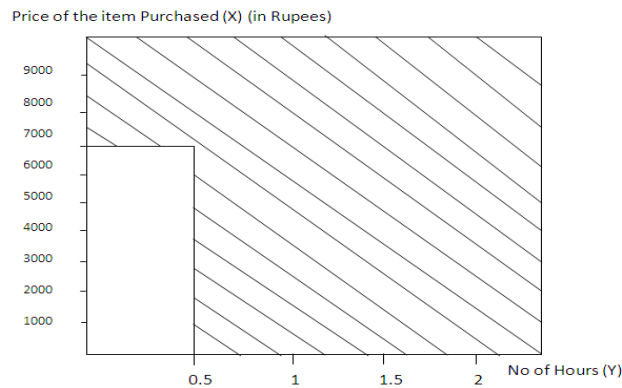


Figure 6: Selection of customers for Reservation

As shown in the Figure 6 selection of the customers to enable them with special reservation system, so that those customers fall in the shaded region will receive a message from the service provider asking for the parking slot reservation in that particular shopping mall.

Assume, X is the price of the item purchased,

Y is the No of hours spent in the shopping mall

If the customers fall in category of shaded region,

i.e. $(X > 7000 \ \&\& \ Y \geq 0.5)$

A message is sent asking for parking slot reservation has to be done, in the case of yes; they will be given more priority compared to other customers.

V. EFFICIENCY COMPARISON

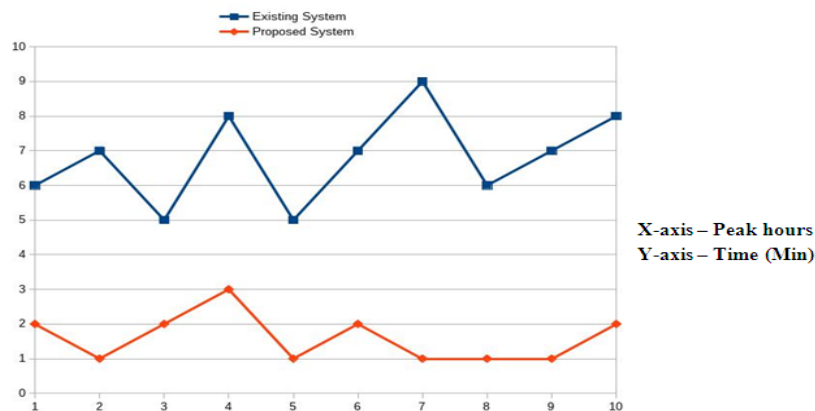


Figure 7: Graph on Survey of In-coming Vehicles

The Figure 7 depicts the graph of the survey in one of the shopping mall in Mangalore, India on average time required for the customers to park the vehicle in the parking area. The graph shows peak hours in the x-axis and time required in the Y-axis to place the vehicle in the shopping mall. It is the comparison between the average time required to park the vehicle in parking area in an existing system and average time required to park the vehicle in the parking area as proposed in this project [3]. There is a delay in the existing system as there is no proper guidance on parking the vehicle, due to which there is congestion of traffic in the parking area [2]. The proposed system is efficient as there is display that suggests the customer with location of the parking slot available and requires less time when compared to the existing system.

VI. EXPERIMENTAL RESULTS

As per the experiment conducted for the scenario of two days for a set of customers on a single shopping mall, the service provider, customer account and message sent log file has logged the details of the events. Table I presents the details of last visit by the customer including total bill amount. Table II contains the details produced by the customer during the initial account registration that is updated regularly and notified to the customers. Table III deal with the log of the message sent that include time of the message sent and type of message sent. Using Account No as a reference several events are handled that includes

- Analysis on the data so as to solve the security issues.
- Analysis on the data so as to provide good offer to the customers.
- Analysis on the data so as to enable the customers with special reservation system.
- Analysis on the data so as send appropriate message at appropriate time.

Table I: Log file maintained by service provider

Service Provider Log File					
Account_No	Last Visit				
	Date	In-time	Out-time	Amount Debited	Bill Amount
KA 19 M2340	18-05-2014	16:45	18:02	10.00	2000.00
KA 20 L2200	18-05-2014	17:01	19:29	15.00	1590.00
KA 19 P3429	18-05-2014	17:35	18:15	10.00	8200.00
KA 19 M2843	19-05-2014	16:03	17:05	10.00	5400.00
KA 20 N8902	19-05-2014	17:37	20:15	20.00	2345.00
KA 19 M9090	19-05-2014	18:09	19:05	10.00	890.00

Table II: Log file maintained for customer account

Customer Account Log File				
Name	Account_No	Address	Mobile No	Balance Amount
Rahul Mehra	KA 19 M2340	Mangalore	9902348944	90.00
Vikrant jha	KA 20 L2200	Udupi	9448435154	150.00
Asha Parik	KA 19 P3429	Mangalore	9753900950	130.00
Sachin Varma	KA 19 M2843	Mangalore	9473673412	80.00
Likith Tondon	KA 20 N8902	Udupi	9845670099	40.00
Shubha Rai	KA 19 M9090	Mangalore	9874323090	200.00

Table III: Log file maintained for messages sent

Message Sent Log File			
Account_No	Message Sent		
	Date	Time	Type
KA 20 L2200	18-05-2014	16:24	Recharge
KA 19 M2340	18-05-2014	16:45	Welcome
KA 20 L2200	18-05-2014	17:01	Welcome
KA 19 P3429	18-05-2014	17:35	Welcome
KA 19 M2340	18-05-2014	18:04	Debit
KA 19 P3429	18-05-2014	18:17	Debit
KA 20 L2200	18-05-2014	18:51	Warning
KA 20 L2200	18-05-2014	19:31	Debit
KA 19 M9090	19-05-2014	08:10	Recharge
KA 19 M2843	19-05-2014	16:03	Welcome
KA 19 P3429	19-05-2014	16:30	Reservation
KA 19 M2843	19-05-2014	17:07	Debit
KA 20 N8902	19-05-2014	17:37	Welcome
KA 19 M9090	19-05-2014	18:09	Welcome
KA 19 M9090	19-05-2014	19:07	Debit
KA 20 N8902	19-05-2014	19:27	Warning
KA 20 N8902	19-05-2014	20:17	Debit

VII CONCLUSION

In this project, we can find the service provider, shopping mall and customer work as a unit to make the shopping in shopping malls an easy go for the customers for shopping by solving the issues like

- Wastage of time searching for a parking slot
- Interaction of the mall shops with customer for advertising their offers
- Extraction of the required data for any kind of investigation

This project minimizes the man power and expensive devices that results in low cost system. Customers purchasing items worth more than 7000 in the mall will be given more benefit in terms of reserving a parking slot in the parking area of the shopping mall. With the analysis performed in this project, advertising sponsors can easily decide in which shopping mall to promote their product.

REFERENCES

- [1] Massaki Wada, Kangsup Yoon, Hideki Hashimoto and Shinichi Matsuda “Development of Advanced Parking Assistance System Using Human Guidance” International Conference on Advanced Intelligent Mechatronics September 19-23, 1999 Atlanta, USA.
- [2] Soh Chun Khang ,TeohJie Hong , Tan Saw Chin, Shengqiong Wang “*Wireless Mobile-based Shopping Mall Car Parking System (WMCPS)*” 2010 IEEE Asia-Pacific Services Computing Conference.
- [3] Yuki Hirakata, Akira Nakamura, KoheiOhno, Makoto Itami “*Navigation System using ZigBee Wireless Sensor Network for Parking*” 2012 12th International Conference on ITS Telecommunication.
- [4] E. Diaconu, H. Andrei, D. Puchianu, G. Predusca, “Advanced Software System for Optimization of Car Parking Services in UrbanArea” The 8th International Symposium on Advanced Topics in Electrical Engineering May 23-25, 2013 Bucharest, Romania.
- [5] Massaki Wada, Shinichi Matsuda, Hiroshi Masuda, “Development of Advanced Parking Assistance System” 1999 IEEE Conference Publications.
- [6] Saleem Aslam, Adnan Shahid and Kyung-Geun Lee, “An Efficient Hybrid Shopping Mall with Advanced Purchasing System”, IEEE Conference Publications, 2012.