

Barcode-Based Vehicle Parking Monitoring System

Edward B. Panganiban and Jenefer P. Bermusa

Abstract: The world today is full of innovations. Every year, people can see and discover different inventions such as in gadgets, machines, electronics, and many others which are timely in this generation which makes these inventions to become life easier. Technology is mostly used by people every day in school, work and offices. Through this, the authors established a paper which applied a technology for parking of vehicles. Vehicles are used to go to school, works, malls, and every place people want to go. Parking a car has always been a problem to the people, especially in the crowded cities. Sometimes it is not always safe to just leave your vehicle in the parking lot because there are people who can use a tool to steal a vehicle, and the monitoring guard will not recognize if he is the real owner. With these problems, the researchers came up with an idea, which is to develop a system entitled "Barcode-based Vehicle Parking Monitoring System". The main purpose of the system is to secure, organize and monitor the parking space in a parking area. The researchers developed the system based from the conceptual framework and system architecture established after determining the problems in the existing problem. The researchers used alpha, beta, and acceptance testing in order to test the functionality of the system. The functionalities of the system were conducted that serves as a testing process. During the pilot test, the respondents rated the system into "strongly agree" description in terms of its functionality, reliability and usability which confirmed that the system accomplished its objectives.

Index Terms: Barcode Technology, Monitoring System, Vehicle Detection, Car Park, Information System

1. INTRODUCTION

Finding a parking space is a big challenge in heavily crowded places. Motorists wasted an important quantity of time in finding an appropriate space to park their vehicle [1]. Sports arena, shopping malls, churches, schools and similar venues often feature parking lots with huge area. The parking area usually lacks the process of monitoring and recording the details of vehicle entering and exiting the premises. This leads to the risk of security of the vehicles and the owners. The authors gathered some facts pertaining to the problems being encountered in one school. The authors find out the manual system in recoding the plate number of the vehicle using the parking area. The parking administrator is having difficulty in coming up with the inventory of plate numbers and important details for monitoring and security purposes. To improve the current system, the researchers conceptualized a system entitled "Barcode-based Vehicle Parking Monitoring System" intended for a huge parking area. This is a parking system that can monitor vacant parking spots that intend to maximize the usage of parking spaces and has an impact in the improvement in terms of accuracy, efficiency and profitability [2]. Monitoring parking vacancy is a significant innovation in a well-organized parking space and supervising vehicles [3]. Some parking monitoring system involves methods such as using the image segmentation using television cameras [3], multi-camera system for detection of vehicles using computer vision [4], surveillance cameras to identify the occupancies of the parking lot or the automatic location of the vacant lot [5] and RFID based automatic parking [6]. The proposed system used a barcode system integrated with an inventory management process for records keeping of plate numbers, time in and out of the vehicles and number of available parking spaces. Barcode technology is a system of labelling with spaces and bars printed side by side on the object such as paper. The barcode comprised of dark bars and spaces that

were read thru a barcode scanner [7]. The barcode scanner then produces a set of unique numbers. This system can maintain and organize records and can also create multiple accounts for monitoring reasons. Furthermore, the system provides the system user a well-organized record for drivers who used the parking slots from the parking area.

2 EXPERIMENTAL METHODS

2.1 Conceptual Framework

Figure 1 shows the conceptual framework of the system. The driver requests for a barcode pass from the system user in the entrance gate. The system user inputs the vehicle's plate number in the system and automatically records this to the database. The printed barcode will be issued to the driver and it should be kept carefully. This barcode pass will be given to another monitoring person at the exit gate before leaving the parking area. The number of available parking lots can be determined through this system. Thus, it monitors and organize the parking spaces. The system also has records management such as the number of vehicles entering and leaving the parking area, date and time logs and the plate number of vehicles.

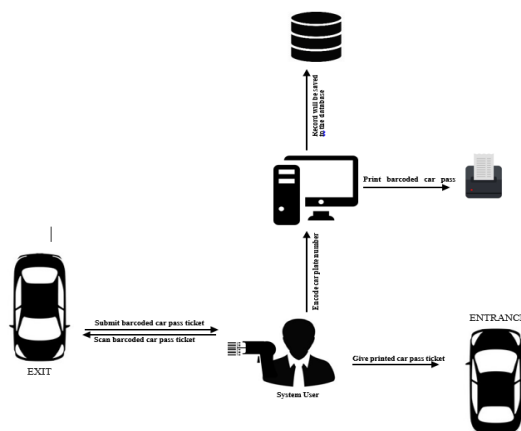


Fig.1 – Conceptual Framework

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2.2 System Architecture

Figure 2 shows the system architecture of the system. It shows how the system works, from logging-in into the system and encoding the vehicle's plate number as well as printing of the car pass ticket with corresponding barcode. It shows also the manner of capturing or scanning of car pass ticket and its process flow within the system. The system administrator or the sub-user needs to access the system to encode car plate number and the data will be stored in the systems database. The barcode scanner captures the barcode number and sends it to the system. The system verifies the barcode on the systems database. After verification, the system saves to the database the time when the barcode was scanned.

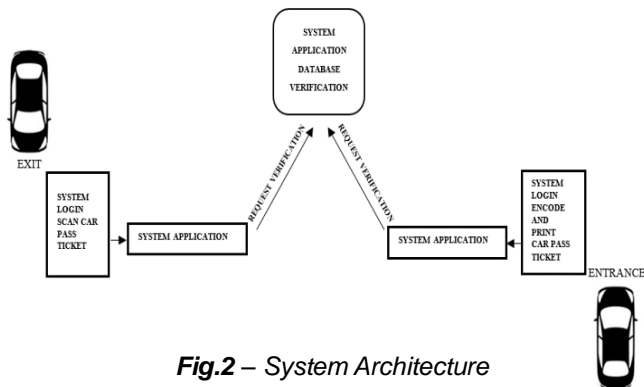


Fig.2 – System Architecture

3 RESULTS AND DISCUSSION

3.1 Software Development

Figure 3 is the actual interface of the system administrator. The system administrator is also the system user. The interface displays several functions of the system such as the administrator account function which manages all the administrator account kept in the database. The parking information function allows the administrator to manage a car park recorded in the database. The back-up and restore function allows the administrator to safeguard the database into other safekeeping storage and also allowing the administrator to retrieve the database for recovery or retrieval of the database. The interfaces also displays the name of the currently login to the system. The current date and time is also displayed on the administrators' interface. The logout function allows the administrator to exit from the system.



Fig. 3 – System user interface

3.2 Results of Testing

Administrator's account registration test

The account creation tests were conducted for accounts of administrators and sub-users as illustrated in Table 1. The table shows 3 examples of system administrator's account and 2 examples of sub-users which were successfully created in the system's database. The ACC_ID column pertains to the database account ID per record stored in the database. The LNAME and the FNAME columns are the personal information of the account owner. The UNAME and PWORD columns are about the registered security credentials to be utilized by the system administrators and sub-users when opening or accessing the system. The table is the detailed summary about the administrators and sub-users account wherein tests were done to verify its reliability.

Encoding and Printing of a car pass ticket with barcode

For encoding and printing of a car pass ticket with barcode, table 2a and 2b shows sample 10 total instances that were successfully encoded and printed. The TRIAL column refers to the number of tries conducted. The BARCODE column is the barcode of car pass per record. The PLATENO, DATE, TIMEIN, TIMEOUT column is about the information of the car. The table showed that issuing of barcode pass ticket and recording has obtained the desired output.

Table 1. Account creation test for system user

TRIAL	1	2	3	4	5
ACC_ID	101	102	103	104	105
LNAME	BERMUSA	CARANGUIAN	LARANANG	MATEO	PANGANIBAN
FNAME	JENEFER	MICHELLE	MARY	SHERYL	EDWARD
UNAME	Admin1	Admin2	Admin3	User1	User2
PWORD	ENCRYPTED	ENCRYPTED	ENCRYPTED	ENCRYPTED	ENCRYPTED
EXPECTED RESULT	CREATED	CREATED	CREATED	CREATED	CREATED
ACTUAL RESULT	CREATED	CREATED	CREATED	CREATED	CREATED

Table 2a. Issuing of barcode pas ticket and recording test

TRIAL	1	2	3	4	5
BARCODE	387346826043	751525081882	616207156115	519174130454	442149111667
PLATENO	BHY678	AAA123	BGY345	VGT876	EDR467
DATE	4/03/18	4/03/18	4/03/18	4/03/18	4/03/18
TIMEIN	07:05 AM	07:05 AM	07:17 AM	07:20 AM	07:20 AM
TIMEOUT	08:07 AM	08:08 AM	07:18 AM	08:21 AM	08:23 AM
EXPECTED RESULT	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL
ACTUAL RESULT	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL

Table 2b. Issuing of barcode pas ticket and recording test

TRIAL	6	7	8	9	10
BARCODE	442149111667	301343463265	519174130454	436515188654	107436227090
PLATENO	YUH789	KJU678	NJU765	HYU987	HYT768
DATE	4/03/18	4/03/18	4/03/18	4/03/18	4/03/18
TIMEIN	07:29 AM	09:41 AM	09:41 AM	10:28 AM	10:35 AM
TIMEOUT	08:31 AM	10:43 AM	10:43 AM	11:30 AM	09:48 AM
EXPECTED RESULT	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL
ACTUAL RESULT	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL	SUCCESSFUL

3.3 Final Prototype

Figure 4 is the prototype result of the established study. The figure includes the system hardware components used. The system software is installed in the server. The display screen

serves as an output device for managing and viewing the car park records. The barcode scanner is used to capture barcode of the car pass ticket. The thermal printer is used for printing the car pass ticket with barcode. The system keyboard and system mouse are used to navigate the system.



Fig. 4 – Final prototype

3.4 Software Evaluation

An evaluation forms were given to the respondents to weigh in the system's functionality, usability and reliability. The questionnaire was constructed with reference to the International Standard for the Evaluation of Software Quality ISO/IEC 25010:2011. The number of respondents were 200 which composed of random vehicle drivers using the parking area and the statistical analysis used is the 5-point Likert Scale. Table 3 illustrates the average perception of the respondents based on the functionality of the system. The results showed that most of the respondents strongly agree on the questions related to functionality with an overall weighted average of 4.59. On the other hand, table 4 is tabulated perception of the respondents pertaining to its usability. Summarized result showed an overall weighted average of 4.70 which indicates that the respondents describes the usability of the system as "strongly agree". Lastly, table 5 is the tabulation about the perception of the respondents in terms of the reliability of the system. The overall weighted average of 4.64 points out that the respondents strongly agree that the system is reliable.

Table 3. Functionality Evaluation Result

Criteria	Weighted Average	Description
The system registered new accounts easily and securely.	4.69	Strongly Agree
The system show error message for unsuccessful registration of accounts.	4.35	Moderately Agree
The system saves plate number, date and the time-in and time-out of car when encoded and scanned.	4.70	Strongly Agree
The system displays the car plate number when the car ticket barcode is scanned.	4.63	Strongly Agree
Overall Weighted Average	4.59	Strongly Agree

Table 4. Usability Evaluation Result

Criteria	Weighted Average	Description
The system is simple and understandable.	4.58	Strongly Agree
The system needs less supervision.	4.87	Strongly Agree
The system's functions can be remembered easily.	4.64	Strongly Agree
The system is fitted for parking problems.	4.69	Strongly Agree
Overall Weighted Average	4.70	Strongly Agree

Table 5. Reliability Evaluation Result

Criteria	Weighted Average	Description
The system is still operational even with encountered.	4.69	Strongly Agree
The system can be restarted once there is failure of functions.	4.72	Strongly Agree
The system keeps a complete and reliable record after recovery.	4.65	Strongly Agree
The system can back-up and retrieve records when there is power failure.	4.52	Strongly Agree
Overall Weighted Average	4.64	Strongly Agree

4 CONCLUSION

The "Barcode-based Vehicle Parking Monitoring System" is a system primarily to monitor the parking spaces of a certain parking area and to secure the vehicles. The main innovation of the system is the use of barcode technology for more efficient and reliable monitoring, recording and securing the cars inside the parking space. Based from the tasks engaged in the establishment of the system which includes problem identification, formulation of objectives, development, tests and evaluations conducted, it was proven that the system performs its intended functions. Featured functions of the system composed of checking the available number of parking spaces, recording the entrance and exit details of the cars as well as securing the vehicles. It was also established that the system software is easy to use and understand, presents accurate and complete data and is very useful to the parking space management.

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