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# Hybrid Billing Parking System (HBPs) for service quality improving

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**Abstract** This project provides a concept of computer-based Hybrid Billing Parking System Service that could work both online and/or offline. We propose Hybrid Billing Parking System (HBPs) in which this system could work and keep the data of billing parking transaction saved digitally. The main goal of this research is design a new concept of database and computer network which includes operational procedure, unique barcode for Hybrid Billing Parking System (HBPs). We have successfully created Hybrid Billing Parking System (HBPs) which has advantages on managing system, for evaluation and financial report and also continuing parking service system. The result of this reseach that the concept that has been designed has two benefit aspects. From energy perspective, HBPs consume less energy and from simplicity procedure perspective, HBPs can be designed into universal architecture of parking system, but the unique code of barcode of each customer will be different.

## 1. Introduction

Parking service is a crucial part of improving customers' satisfaction. Human-based parking system has weaknesses in accuracy and stability. This case wouldn't be happened on computer-based parking service system. However, it has weaknesses on external trouble, for instances, malware virus, inter-system coordination failure, missing data caused by electricity or mechanism disturbance, etc. making that parking service system doesn't work properly.

One of the virtues of parking management is billing parking system. In this study, Hybrid based Billing Parking System (HBPs) is conveyed. It takes major function since the system of billing and payment commonly uses full-automatic system, or man-less system. However, man-less system is not necessarily as a solution because it highly depends on the machine communication reliability involved in the parking system by considering to incoming vehicle identification sensor, parking gate, time of parking duration, data storage of parking payment authentication which finally become a bill for parking payment. All of these cycles could work properly as long as there is no internal or external trouble.

Even though man-less system is the most widely applied system in the modern parking service system nowadays, but in case of there is system failure (malware), then the invoice billing couldn't be accessed from the server where every billing parking data is processed and stored. In such condition the conventional system becomes the solution, where HBPs is operated by manpower system, or parking billing uses manual system. The transition of man-less to man-power system becomes crucial problem



since the billing data couldn't be accessed from the server while parking customers need service immediately.

The HBPs we propose in this paper as a solution to address the problems faced by the parking billing system in general, as problem tha found in [1], which believed that the suitable parking cost decision will increase the efficiency of billing management system. Focusing on the case in [1], HBPs provide flexible parking billing system solutions where the HBPs system can automatically switch from online man-less based prosedure to offline man-less based prosedure. As a result, there is synchronization in the billing system to the system of billing parking.

HBPs has two integrated mode systems that work both online and offline system. Online man less system in which the communication of billing parking system between entrance gate and exit gate involves the server. On the other side, Offline man less system doesn't involve the server. Although in the form of offline system, the server doesn't miss the billing data. On the other side, offline man less system is where the system of billing parking between entrance gate and exit gate communicate without data from server.

## 2. Related work

The main problem in the automatic parking system is how to create a tight and accurate connection between customer and the sensor. Based on the study done by P. Christiansen, et al [1] showed that the technique of accurate billing payment system affects to the system efficiency of parking management, so that many researchers have offered solution to make the parking system more effective and efficiency. Intelligent parking techniques in which sensors communicating at close range such as Radio Frequency Identification (RFID) have been proposed on [2], while RFID technology in parking systems that produce very fast memory [3], Parking Guidance Information system in parking service known as (PGIs) is widely proposed by researchers, including in [4-6]. The parking control system using a programmable logic controller (PLC) is believed to provide a more reliable engine communication di parking system [7] reservation based [8], automatic parking system NFC based [9], [10], parking system WSN based [4] with ZigBee [11], identification of vehicle serial number technology by image processing [12-16].

Many researchers claim that the intelligent parking system is required to have the characteristics of a timeless service system, accuracy, reliability, security and able to provide security management, great reporting system, and vehicle detection at the parking area [5], survey system for smart parking system has been develope in [17] or intelligent system in wireless communication [18-19].

Those empirical studies have been discussed constitute to parking system related to the smart system to improve service quality of parking for the customers but remember that smart system highly depends on the ideal situation, which is the electricity and machine process run properly. On the other hand, manual service, semi manual service, or the real manual become another alternative way to be considered in order to keep parking service still be enjoyed by the customers in any condition and without any risk to the parking service vendor.

The combination system between automatic, semi-automatic, to the full manual service as called hybrid-based parking service system as this research proposes focuses on the manner of how identity data of vehicle can be identified both offline and online system.

## 3. Result and discussion

In this study, the hybrid-based parking system includes entrance gate station, exit gate station, the server, unique barcode in the parking ticket (figure 1), with the server as the core of data transaction. HBPs as proposed in this paper includes entrance station, exit station, and server unit. Exit gate station is equipped by independent database that is used as temporary data manager (batching). This database is used to batching process, which is temporary saving storage that works when the system is offline. The transaction of data in the exit gate station would be sent to the server if the system is back online.

In online condition, the transaction data is sent to the server via entrance gate station and also exit gate station. While in offline condition, the transaction of data is only storage temporarily in exit gate station. Offline system causes the entrance gate station not able to connect to the server, so that the

connection media is changed by the unique code in the parking ticket (figure 2). This unique code then links the information about billing parking that should be paid by the customers in the exit station. this unique code is fetched in the parking ticket in the form of barcode, so, when the system is verifying the vehicle in the exit gate station, the vehicle entered could be seen whether the system online or offline, as a result, the transaction data won't be lost. However, offline procedure highly depends on the unique code in the parking ticket.

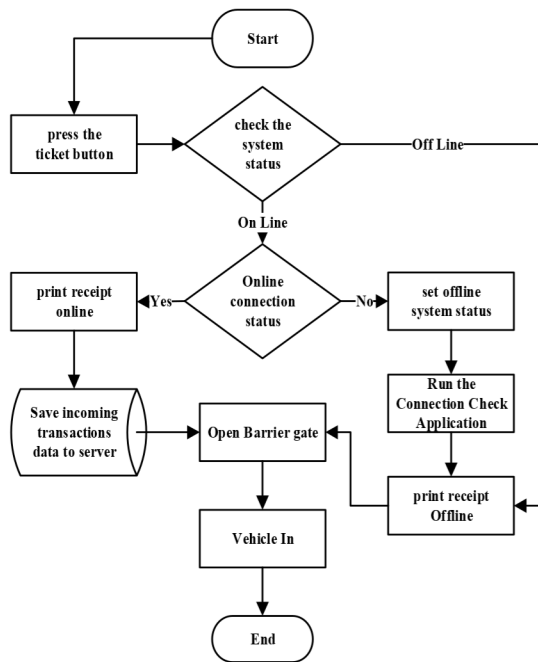
Principally, HBPs works like a parking system in general, but billing parking system works even though the system is offline, and the transaction data is saved in the temporary exit gate station before it is saved in the system when it gets back online. By using data from the entrance gate station, the system then does validation to the exit gate to print billing parking ticket. In figure 1 shows the flowchart of HBPs in the entrance gate vehicle, starting from the customers push the button of entrance gate ticket, the system validates the status whether it is online or offline. If the system condition is offline, then the receipt received by the consumer is printed using offline procedure, meaning the printer prints the receipt not based on command from the server, then the system will open the entrance gate and let the vehicle enter the parking lot. While on condition of online system, the system would check the server status first, if there is failure between entrance gate computer station to the server, then the offline procedure would be applied. If the server is online, the data of transaction would be stored to the server, and then the system let the vehicle parks.

Figure 2 shows HBPs procedure of vehicles exiting from the parking area. Started from scanning parking ticket, the system would verify the ticket to see if the ticket has the unique code that indicates the ticket is printed at the time of the system offline or online. Again, the exit gate station will check the status of the system. If the system is online, then the transaction data would be stored directly to their server after billing parking calculated, if the system is offline, the transaction data would be temporarily stored in the data base of exit gate station. And then if the system returns online, all of the data of transaction would be automatically sent to the server. This procedure keeps a lot of data and helps the manager of financial or executor for financial evaluation.

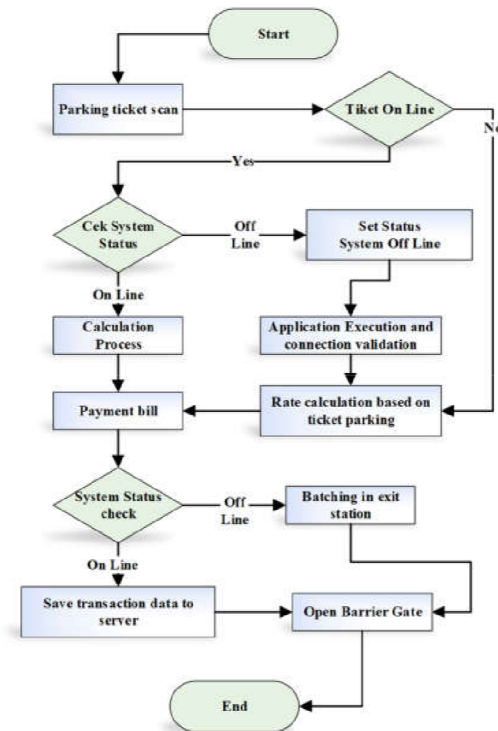
HBPs could be designed by the same architecture of general billing parking, the unique code on the barcode of the customer makes them different each other. This would be a serious concern if the customer loses the parking ticket, so that a strategy is required to avoid parking ticket lost

We offer a concept of barcode which is suitable to the HBPs. Every vehicle goes through the entrance gate station would get the barcode. This barcode functions as a tool of billing parking, by using unique code in the barcode. Exit gate station would be able to do payment transaction even though the system is offline. Figure 3 shows the concept of barcode using unique code whether the vehicles get in while the system is online or offline (figure 4). In the figure 3, it is illustrated that the online system is marked 01. While in the offline condition, it is marked 09 (figure 4). The barcode also contains code to indicate which entrance gate the vehicles come. This code is needed to know the information of entrance. This is needed as supporting information of improving service or evaluation of parking service.

The network of HBPs between between HBPs's server to entrance gate station server and exit gate station server. While the server communicates to the station occurred in a long distance. We recommend using the fiber optic based communication system, and using the Shielded Twisted Pair (STP) for in chase short distance.



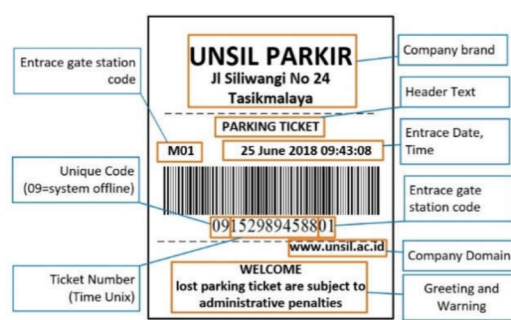
**Figure 1.** Flowchart of Hybrid Hybrid Billing Parking System (HBPs) entrance validation of vehicle.



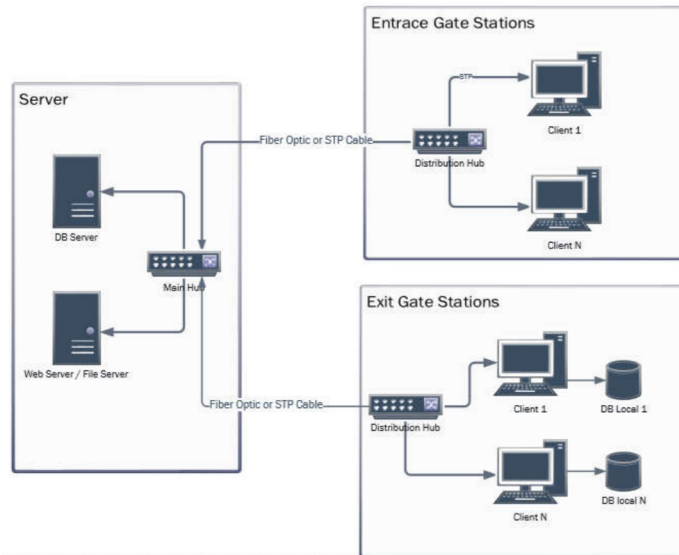
**Figure 2.** Flowchart of Hybrid Hybrid Billing Parking System (HBPs) exit validation of vehicle.



**Figure 3.** HBPs barcode design with unique code in online mode.



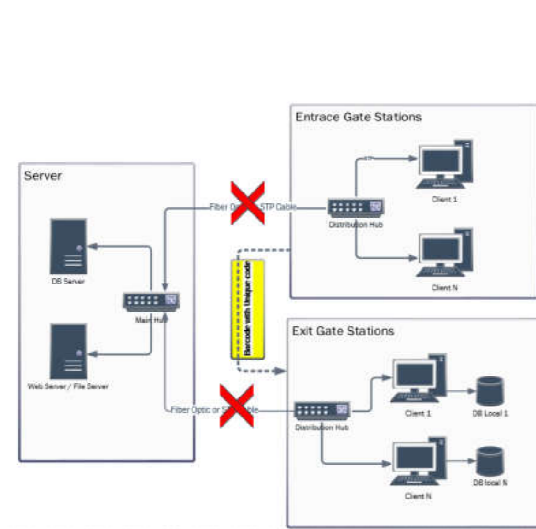
**Figure 4.** HBPs barcode design with unique code in offline mode.



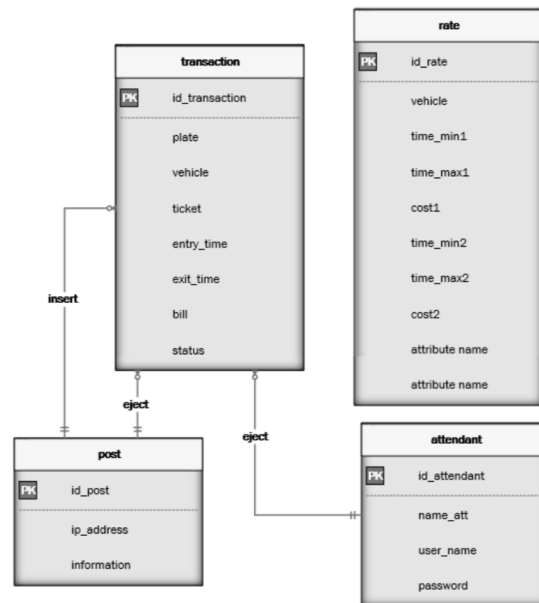
**Figure 5.** Architecture design for Hybrid Billing Parking System (HBPs) in online mode.

Figure 6 is a designed applied in HBPs. In general, architecture is designed into several local networks, namely entrance gate stations, exit gate stations, and server node. If the distance between the server and the entrance gate is remote, it is recommended to use fiber optic or Spanning Tree Protocol (STP).

In the online condition, entrance gate stations and exit gate stations directly get connected to the server. Billing and transaction data transfer are stored to the server (figure 5). Digital unique barcode is sent directly to server. Meanwhile, offline condition (figure 6) is assumed that communication of entrance gate stations and exit gate station are disconnected with the server. In offline condition, barcode with unique physical code are transferred to entrance gate station to the exit gate station through the consumer.



**Figure 6.** Architecture design for Hybrid Billing Parking System (HBPs) in offline mode.



**Figure 7.** ERD Hybrid Billing Parking System (HBPs).

Figure 7 is Entity Relation Diagram from HBPs. ERD consists of transaction cable, attendant cable, rate table, post table. Transaction cable serves to store activities log system along the running system. The table is responsible for delivering incoming and outgoing transaction from parking or consumer vehicles. The attendants table is a table to keep the ideas of officers guarding the exit only. This table is responsible for providing the identity of the officer. Table rate is a table that provides the applicable rate which also shows prevailing price to be used as the basis for calculating the parking bill. Table post is a table that provide idea post at the entrance or exit.

This project provides an in-depth description in providing solution by keeping payment transaction data or parking billing is safely stored without being disturbed by machine communication status.

#### 4. Conclusions

The proposed Hybrid Billing Parking System is a solution to improve parking service especially in the billing and parking payment. HBPs contributes to the concept of thinking that the operational system of an online based parking service does not guarantee that the service could work properly consistently, therefore, it backup system is required as a support system of the main system in offline condition.

The offered HBPs has the strength in the management process, for evaluation and financial report, also for continuously parking service system. From energy perspective, HBPs consumes less energy, because it could work without huge backup power system. As long as the database in the gate station could work, the report of transaction could be saved.

HBPs can be designed by using the same architecture in general system parking but the unique code that exist in the barcode of each customer makes it different. This case becomes crucial because the problem would occur if the customer loses the parking ticket, therefore, a strategy is required to save the parking ticket. Surely, this is the future work that can be done for further research.

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