Designing Smart Parking Application for Car Parking Space Arrangement

E S Soegoto¹*, V Y Pamungkas² and A Herdiawan³

¹Departemen Manajemen, Universitas Komputer Indonesia, Indonesia
²Departemen Teknik dan Ilmu Komputer, Universitas Komputer Indonesia, Indonesia
³Departemen Bahasa dan Sastra Inggris, Universitas Komputer Indonesia, Indonesia

*eddysoeryantos@email.unikom.ac.id

Abstract. The objectives of this research is to provide information about the Smart Parking Application Design for Parking Arrangement detection by counting the number of parking spaces which occupy the parking car entrance, the number of cars entered, the car left the parking lot and the number of cars outside the parking entrance. The research used descriptive method to collect information about the status of existing information by action method (action research). The type of data that exist in this research is primary data and secondary data. The data collection methods were field research, research libraries and prototype methods. Smart parking application works by sorting in advance the existing parking lot row based on the parking lot number. If there is available parking space, then the parking ticket will be given the number of empty parking area in the nearest sequence and reducing the common mistakes in the parking system. The entire Smart Parking system consists of a series of senders and receivers. The receiver circuit consisting of wireless data transceiver will capture the serial data from Arduino Uno which will be converted by converter to be processed by Personal Computer.

1. Introduction
The comparison of parking capacity is very small compared to the rapidly growing population of vehicles and the need for larger parking lots. This causes problems in finding a parking space. Furthermore, almost all parking systems and parking lot management in Indonesia are ineffective because vehicle placement is still done manually. The process of finding parking spots can take time and dispose of fuel can be one of the problems that cause more pollution, especially in urban areas. In addition, the emotional level of motorists in search of parking spaces is increasing. Length of time finding a parking space can cost extra because it can spend up to 1 hour. According to Michael, a review of literature reveals that parking policy is currently influenced by a desire for environmental sustainability and improvements in urban design [1].

One of the researchers explaining the problems of the parking is Tullio et al. In their research, they focused on technically advanced solutions for parking management are concerned with the application of secured wireless network and sensor communication for parking reservation using the conceptual architecture of IPA (Intelligent Parking Assistant) which aims at overcoming current parking management solutions and thereby becoming a leading paradigm for the so called “smart cities” [2]. therefore, the need for a secure, intelligent, efficient and reliable system which can be used for searching the unoccupied parking facility, guidance towards the parking facility, negotiation of the
parking fee, along with the proper management of the parking facility create Intelligent Parking Service as a part of Intelligent Transportation Systems (ITS) [3].

Rosamaria et al later described that Parking is becoming an expensive resource in almost any major city in the world, and its limited availability is a concurrent cause of urban traffic congestion, and air pollution. (IPA) architecture aims at overcoming current public parking management solutions and creates convenient management of public parking in urban area, which could improve sustainable urban mobility [4]. A parking arrangement system that allows users to instantly get a parking slot that already listed the floor number and parking lot when getting a parking ticket will automatically reduce the time to find parking space, save fuel and reduce the car driver's emotional level. Every parking ticket will be given the number of parking slots and on what floor the parking slot number is located. Then give the numbering on every parking lot using lights (indoor) and balloon (outdoor) so as to facilitate the visitor to find the parking slot and for determining the maximum number of cars by the number of parking spaces available [5]. The goal configuration within the parking space is also planned ignoring the kinematic restrictions on the movement of the car [6] and intelligent parking services with the mobile application technology and vehicle license plate recognition system in a high-end shopping mall [7]. It can facilitate human activities by means of appropriate information and communication technologies [8].

In addition, Yanfeng and Christos described that the parking system must assigns and reserves an optimal parking space for a driver based on the user's requirements that combine proximity to destination and parking cost, while also ensuring that the overall parking capacity is efficiently utilized [9]. Moreover, Amin et al explained their concept of Smart Parking System (SPS) that is proposed to assist drivers to find vacant spaces in a car park in a shorter time. The new system uses ultrasonic (ultrasound) sensors to detect either car park occupancy or improper parking actions. Beside of that, Features of SPS include vacant parking space detection, detection of improper parking, display of available parking spaces, and directional indicators toward vacant parking spaces, payment facilities and different types of parking spaces (vacant, occupied, reserved and handicapped) through the use of specific LEDs [10].

From the various references obtained, there are some drawbacks, especially on the details of Smart Parking application formation and tickets. This paper provides information about the Smart Parking Application Design for Parking Arrangement with the number of parking spaces, which occupy the car park entrance, the number of cars entered, the car left the parking lot, the number of cars and ticket optimization as additional information for the driver.

2. Methods
The research method uses descriptive methods to collect information about existing status based on the current state of the research as well as the action method (action research) to develop new skills, new approaches, or new knowledge products to solve problems with direct application in the real world. The type of data that exists in this study is data collection consisting of field research and library research.

Source Data used is using Primary Data source through Observation Data collection techniques by conducting research and direct review of the problems taken and Interviews to obtain data by way of direct communication with parking area users. Furthermore, secondary data sources use data in the form of questionnaires about the level of satisfaction of the users of the parking lot in the search for parking area.

System development used prototype method. Ideally the prototype serves as a mechanism for identifying software requirements. This method begins with the collection of needs. Users and developers meet to define the overall objective of the software as well as identify all the needs, so that developers know the description of the system. (Figure 1)
2.1. Hardware
The hardware used in this system is Arduino Uno, Ethernet Shield, Internet Cable (UTP cable), ultrasonic sensor, and Computer. Technologies for parking gate and parking tickets using existing technology:

2.1.1. Arduino Uno. Arduino Uno is a development board because this board indeed serves as a prototyping circuit arena microcontroller based on ATMega328P chip. The Arduino UNO has 14 digital input / output pins (6 of which can be used as PWM output), 6 analog inputs, a 16 MHz Crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Arduino UNO contains everything needed to support the microcontroller and it is easy to connect it to a computer with a USB cable or supply it with an AC adapter to DC or use a battery to start it. The worst possibility is only the damage to the ATMega328 chip, which can be easily replaced and the price is relatively cheap (Figure 2).

2.1.2. Arduino Ethernet Shield. Arduino Ethernet Shield is a module that connects Arduino board to the internet network quickly by installing this arduino module on the board, then connected to the network via RJ45 cable. It is based on W5100 Wiznet Ethernet chip (datasheet). W5100 Wiznet which provides internet (IP) network both TCP and UDP and is supported by 4 simultaneous connection sockets. The Ethernet Shield has a standard RJ-45 port connection with an integrated line transformer and active power over Ethernet UTP cable.

2.1.3. Unshielded Twisted Pair. Unshielded Twisted Pair is a cable used to connect a local network or so-called Local Area Network. Derived from, then UTP cable is a cable that has no protection and has
a series of interconnected between cables. In the UTP cable, there are eight cables, four of which are useful as transmission media to send or receive between computer networks.

2.1.4. The ultrasonic sensor. The ultrasonic sensor is a digital ultrasonic system for monitoring ultrasonic sound waves. This device consists of ultrasonic sensor sockets and monitors designed alternately removable, and capable of receiving sensors from a set of sensors. The sensor socket has electrical contacts to receive electrical signals from electrical contacts on sensors mounted on the sensor socket and where the sensor is set. Sensors have different sensing properties in which each sensor contains an identification code so that a digital ultrasonic monitoring device can identify the sensor according to the identification code.

2.2. Software
The software used for connecting the entire hardware system is the programming language and library.

2.2.1. Programming Language. The programming languages used are C++ Arduino and the Arduino IDE library to build the logic of the system for sensor and Arduino hardware systems. In addition to the C++ programming language, php is also used for recording the results of each data into the database. The database used is PostgreSQL which is believed to be able to survive for longer usage.

2.2.2. Library. Library used include library of barcode readings, receipt print, Arduino data converter to php for data processing.

3. Results and Discussion

3.1. Analysis
Current parking systems contained in office buildings, malls or public parking lots using automated parking gate systems use systems that only provide information on the length of the driver's parking and the vehicle images used to obtain cost information to be paid. In the existing system there are some problems where drivers sometimes do not get parking because parking attendants do not know that the parking lot is full.

In addition, the other problem is that drivers sometimes do not know whether when he gets into the parking lot he will easily get an empty parking lot so it does not take long to park and does not make the driver exhausted to find parking. The current system still leaves the driver confused whether the parking lot is full or available. So when the driver picks up a ticket, he thought that the parking lot is available.

3.2. Planning
This planning used new technology and new system. The system will be built using hardware microcontroller and top-level programming language that will collaborate to make the parking system to be organized, reduce the stress level of the driver and reduce fuel usage when looking for parking space.

In the ticket fetching phase, the driver will get a ticket that has a barcode image generated from the date and time when the retrieval of tickets and the number of parking sequences used as barcodes. Before generating, the system will first locate the database of available parking places. If a parking space is available then the driver will get a parking ticket but if no red gates are available the red will display a "full parking" notification. The process for automatic red entrance gates is a different part of parking ticket retrieval. Here the design of the parking ticket to be used. (Figure 3)
In the parking recording phase, the driver will enter the parking lot provided according to the serial number found on the parking ticket. When the driver parked in the parking lot, ultrasonic sensors will detect the presence of vehicles under the sensor. Ultrasonic sensors will be placed in the parking lot along with LED signaling lights whether parking is available or not. If the ultrasonic sensor captures the object then the sensor will send the sensor data to the Arduino which will be recorded on the database. The data in this database will also serve as checking of the automatic gate in front of the parking lot whether the parking area is still available or not.

In the parking payment phase, the driver will leave the parking lot and the sensor will catch the absence of vehicles on the parking lot. Then, the system will do the recording on the database and change the color of the LED lights to green indicating parking space available.

The entire Smart Parking system consists of a series of senders and receivers. In the sender circuit, ultrasonic sensors or diode photographs are inputs to be processed by Arduino Uno. As a processor, Arduino Uno serves to process input data from each sensor. The input data from the sensor of High and Low logic will be processed by Arduino gas Uno that has been programmed beforehand. Data from the sensor consists of High to detect that there is a car and Low to detect no cars. Serial data from Arduino Uno used telemetry method so it does not require the use of cable.

The use of a pair of wireless data transceivers mounted on Arduino Uno and on the receiver produces data communications wirelessly. Serial data from Arduino Uno will be received by the receiver circuit without the need for cables.

Receiver circuit consisting of wireless data transceiver will capture serial data result from Arduino Uno which will then be converted by RS232 converter to be read by parking attendant. Then the data entered on the parking attendant will be processed using Smart Parking software. This software is designed as a processor as well as the viewer of parking condition information. With Smart Parking software available then the driver of the vehicle will get a parking ticket containing the location information where he can park his car.

4. Conclusions
After testing the parking space simulation system, it can be concluded that the smart parking application works by sorting the existing parking lot based on the parking lot number, if found parking space available, then the parking ticket will be given the number of empty parking area in the order the nearest one. Human error becomes one of the obstacles in the application of this application. Due to lack of discipline parking area users, the driver often parked in accordance with their wishes that are not in accordance with the number of parking areas that have been given by the system. With the existence of this system, the process of searching for parking lot becomes more effective, efficient and very helpful for the driver as parking area user in searching for parking place to park their vehicle.
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