Booking smart parking system using microcontroller

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Abstract. Recently there are many vehicle users have difficulty to find a parking area because no information full or empty parking slot so that it can cause congestion, pollution, and fuel inefficiency, because of these conditions can cause difficulty in controlling the parking management. By using microcontroller smart parking system (based on IoT) parking problems can be resolved. Smart Parking System is designed to make easier for parking users to get information on the availability of empty and filled parking slots, in addition to that parking users can also book for parking slots using web based applications. There are many phases to implement microcontroller based Smart Parking System i.e requirements systems, prototyping development, prototyping evaluation, coding system, testing and evaluation system. This system uses hardware such as Arduino Mega, Arduino Uno, Ethernet Shield, PN532, LDR, and NFC. The programming language used is C to configure Arduino and PHP which are used for the web interface while MySQL for database server. By Smart Parking Application, it is expected to help parking service users to get information and find empty parking slots through booking in the application so that it will be more efficient in time and parking management will be more controlled.

1. Introduction
At present the conditions in urban areas with dense population and high economic levels make it difficult to limit the level of ownership the four-wheeled vehicles, resulting in increasing volume number of four vehicles. This condition can make a parking system are difficult to control. Currently there are still many parking lots that use conventional parking systems that only have parking lots and parking attendants who control vehicles coming and out of the parking lots, it can cause trouble for the vehicle owner because they have to find an empty parking slot, they do not have information where the location of the available parking slots even sometimes of the vehicles parked carelessly that can cause the situation congestion. According to survey [1] shows that during peak hours, forty percent of traffic jams are caused by searching for parking spaces. Finding a parking space during rush hour make it difficult for the driver. Nowadays with increasing Technological advances, there are several parking information systems [2] that can automate the management of parking locations, such as recording vehicle license plates, recording time in entry, recording time out, until recording the number of cars entering and the remaining parking capacity, but this still does not help the vehicle owner for example in searching for parking slots and there is no verification whether the driver who wants to park may park in that place or not, besides the system has not helped the management in controlling the parking location and often conflicts between drivers because fighting over a parking slot.
With these problems, a smart parking system [3] is needed to overcome them, the system can provide information [4] about available parking slots, so drivers do not have to search for available parking slots. The system makes it easy for parking users to book parking slots through the application, parking users must register first as a member through the application, after register the member will get an RFID card as user parking for verification data user when parking so that users can’t carelessly park in that place. Booking Smart Parking system using the concept of the Internet of Things (IoT) that is when the data can be accessed by everyone anywhere and anytime via an internet connection [3][5].

In this research smartparking is to design a prototype parking slot booking system [6] and develop a parking system with reference to a pre-existing system [7]. In this system, we use the arduino ATMega 2560 microcontroller, Arduino Uno, and Near-Field Communication (NFC). The application is created using the PHP programming language and My-Sql database.

With this system it is expected that the use of time and fuel is more efficient in addition to more controlled parking management besides vehicle owners will feel the security to park their vehicles in the correct parking slot because there is verification using an RFID card [8]. Zheng Y et.al [9] created utilizing sensor circuit, RFID and IOT. This framework encourages client to discover parking spot accessibility with help of IOT. RFID is utilized for burglary administration. Less human association, adaptability, security. Aishwarya et.al [10] built up an appropriate most brief way calculation is utilized to locate the base separation amongst client and every auto stop in the framework. Uses RFID innovation which is utilized as a part of robbery administration purposes. all user data and parking slots are stored in the database so it helps the parking management to manage the parking slots and it is safer for the vehicle owner to park.

2. Methods
The project of this smart parking system was built by some system such as hardware architecture, software architecture and system.

2.1. Hardware architecture
The main of the hardware architecture in this project was built by many component, as followed:

2.1.1 Arduino Mega. Arduino Mega is generally made using a type of microcontroller ATMega 2560. As the name implies, this Arduino uses an ATMega2560 processor which has 54 digital I/O pins (of which 15 pins can be used as PWM outputs), 16 analog input pins, 4 UART pins, 2x3 pins ICSP (to program Arduino with other software ), and a computer USB cable that is also used as a voltage source.

![Arduino Mega](image)

**Figure 1.** Arduino Mega.

2.1.2 Ethernet Shield. Ethernet Shield is a module used to connect Arduino with internet using cable (Wired). Arduino Ethernet Shield is based on the Wiznet W5100 ethernet chip.
2.1.3 Near-Field Communication (NFC). NFC is one of the latest communication Technologies between gadgets that uses RFID (Radio Frequency Identification) systems to exchange data over short distances, about four inches. NFC Technology works with short range radio signal transmission systems. PN532 module is one module that can read and write NFC tags. This PN532 module has three alternative communication ports, namely SPI (Serial Perpheral Interface), I2C (Inter Integrated Circuit) and HSU (High Speed UART).

2.1.4 Light Dependent Resistor (LDR). LDR is one component of the resistor whose resistance value will vary according to intensity light that hits this sensor. LDR can also be used as a light sensor.

2.2. Software architecture
Software architecture is built by several systems, which is programmed by Arduino and sent into the cloud and then the app synchronizes with the real-time database.

2.2.1 Arduino IDE, The Arduino Integrated Development Environment (IDE) is a software for write and upload the program for communicating between microcontroller and database or a system.

2.2.2 Hypertext Preprocessing (PHP), (PHP) is a programming language that is usually used to create HTML pages. The .php file that is created will be processed on the server, while the page that will be sent to the visitor's browser is only the appearance. With PHP, website pages that are created will be dynamic, i.e. it can always change without having to edit the script. Database Server is a computer program that provides database management services and serves a computer or database application program that uses a client / server model.
2.2.3 **Database server.** MySql is a database management system software multi-user (SQL DBMS). Database Storage Engine is widely used by web developer programmers. His ability is reliable.

2.3 **System Architecture**

The following is the architecture of the prototype smart parking system. The architecture of prototype smart parking system as shown in figure 5 has depicted many components, i.e. PN532, LDR, Arduino Uno, Arduino Mega, Ethernet Shield, LED, Buzzer and Database server (MYSQL).

![Prototype smart parking system architecture.](image)

**Figure 5.** Prototype smart parking system architecture.

3. **Results and discussion**

The result of this project, one of which is creating a smart parking that is connected to the prototype that has been created. This application consists of several screens such as depicted in figure 6, 7, 8, 9 and 10. The first screen in figure 6 is for the registered user login after registration as member, the second screen in figure 7 for the menu for information slot parking (Booking, Empty and full), the third screen in figure 8 for the menu user to booking using application and the next screen in figure 9 and 10 is to display the prototype smart parking.

Prototype is one of the most widely used software development methods. By using this prototyping method, development and customers can interact with each other during the process of making the system so that good communication is established. Development can work well in determining customer needs, saving more time in system development and Implementation is easier because the user knows what is needed.
Figure 6. User interface for management user.

Figure 7. User interface for information slot parking.

Figure 8. User interface for booking slot parking.

Figure 9. Prototype smart parking system.

Figure 10. Prototype smart parking system.
4. Conclusions
Smart Parking System on this project has been successfully made in accordance with the purpose of the smart parking system. One of the purposes is smart parking system that has been built can solve the problem of congestion caused by vehicle drivers not having information parking slot and location. With the smartparking application it is expected that vehicle owners can book a parking space without having to search for a parking space again according to the availability of parking slots (empty, booking or full) whenever and wherever using applications based on Internet of Things (IoT).

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