# A PARKING LOT MANAGEMENT SYSTEM USING IBEACON

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**Abstract-** The existing parking systems' goal is just to park a car rapidly after checking parking space. If the parking spaces are occupied, drivers have to spend gas and times for finding empty space. So, the exiting parking systems are focused on it. To archive this, the parking lot management systems using wireless sensor networks (WSNs) and vehicle ad-hoc networks (VANETs) are proposed. To park a car safely, iBeacon which can connect external networks and measure indoor location exactly is needed in a parking lot management system. So, this paper proposes a parking lot management system using iBeacon.

**Keywords-** iBeacon, VANET, Parking lot Management System, 802.11p

## I. INTRODUCTION

National Highway Traffic Safety Administration (NHTSA) published the report, "Vehicle to Vehicle Communications: Readiness of V2V Technology for Application".

It is for V2V communication technology. In this report, the big issue of V2V communication is for preventing a traffic accident by rising safety. To achieve this, VANETs have to apply the ad-hoc communication method.

VANETs can receive data from two communication nodes: Vehicle a Road Side Unit (RSU).

The data from vehicles is vehicle's status and relay data for forwarding the other vehicles. And the data from RSU is environment and pedestrian data. These data can help vehicles monitor real-time traffic information. Thus a parking lot management system with VANETs is issued.

However, the existing parking lot management systems have the following problems. First, wireless sensor nodes and RSUs are difficult to measure exact location. That means that location distance from vehicles and RSUs is out of range error. Second, they can't connect direct to external networks because they use only own communication method. To achieve this, a parking lot management system have to use iBeacon which can support indoor navigation system and real-time management for parking spaces.

## II. RELATED WORKS

A. Irisnet

A parking lot system would be divided into three methods Irisnet, sensor based management system and SPARK.

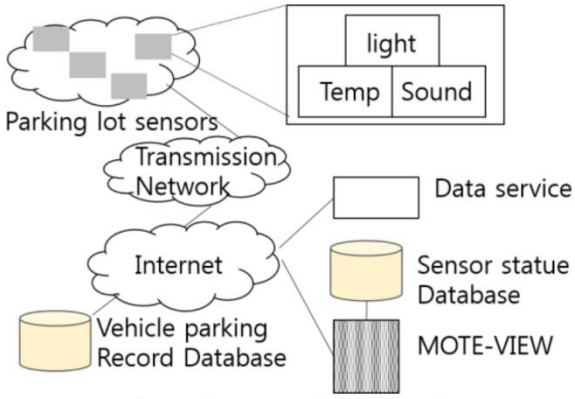


Fig1. Irisnet model architechture

First, Irisnet uses a video camera (or a webcam), microphone and motion sensor to detect a vehicle. For example, when webcam saves parking lot space, like image data, it is transmitted to Web. The transmitted data are scattered in Web and users can contact them easily to a smart-device like a smart-phone. However, it is not suitable for real-time system because video camera makes big data of image.

B. Sensor network based parking system

Second, sensor networks based intelligent parking system detects a vehicle which is in a parking space. That means that sensor can monitor a vehicle in a parking lot using by wireless sensor networks. It can know by the data of sensor which are sound, temperature, intensity of illuminations and so on. Sensor nodes transmits the data, which are occurred when vehicles are coming in a parking lot, to the management server which includes sensor status database. And, it helps vehicles register parking record. Users can know real-time data of own vehicle by Web. However, credibility of sensor nodes is lower than other mechanisms. And a large scale parking lot needs so many sensor nodes which is expensive.

Sensors are easy to flooding in water and damaged from external power. Finally, users could not receive detail data like reservation and location of own vehicle.

C. SPARK

Third, SPARK is a parking lot system which measure a vehicle's location using by 802.11p communication protocol of VANETs. SPARK detects the vehicles by searching the location of vehicles using RSU (Road Side Unit) with communication device which could transmit data to vehicles. SPARK also cannot support location service because its location data is out of error range in a parking space. It can support user vehicle information by relating navigation system of vehicles. However, the location of vehicle is not accurate because of detecting method of this system. And if vehicle's power is off, this cannot collect information of vehicles. Finally, because it do not support vehicle's data like name, status, owner and so on, it cannot extend services any more.

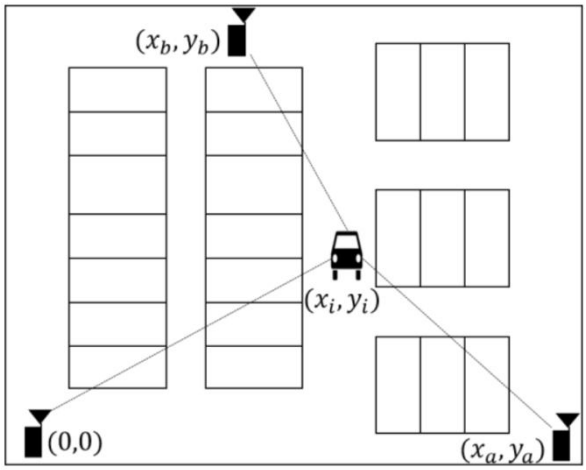


Fig. 2 SPARK model

Above three methods have the following problems. Irisnet is unfit to rapid networks like VANETs because it needs so much wireless communication bandwidth and low delay bound. The sensor based system do not guarantee the parking information of vehicles because sensor data is just raw data.

And it cannot support a service like a parking reservation service because it is just connected own networks. When you submit your final version, after your paper has been accepted, prepare it in two-column format, including figures and tables.

As said, to insert images in Word, position the cursor at the insertion point and either use Insert | Picture | From File or copy the image to the Windows clipboard and then Edit | Paste Special | Picture (with "Float over text" unchecked). The authors of the accepted manuscripts will be given a copyright form and the form should accompany your final submission.

## III. IBEACON BASED PARKING LOT SYSTEM

We propose iBeacon based parking lot system. It use for parking lot to east to find parking place.

A. iBeacon based parking lot system architecture

In Fig. 3 is iBeacon based parking lot management system architecture. In this architecture composition is parking lot management server, smart phone(able to Bluetooth low energy), and iBeacon. This architecture flow is first, receive the parking lot information (parking space) by smartphone application. Seconds, Driver do the parking lot reservations and park to drive. Third, if drivers finish the work, leave and update parking lot data to parking lot management server.

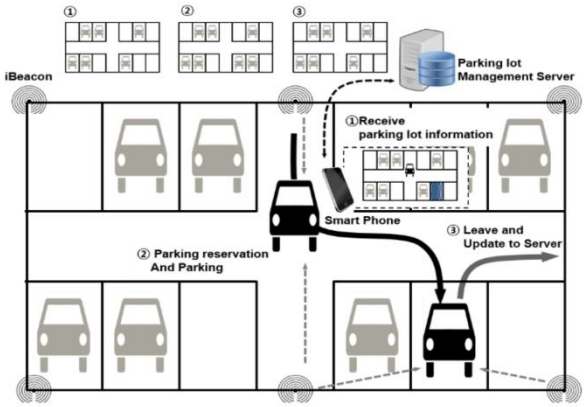


Fig. 3 parking lot model

B. *iBeacon based parking lot system algorithm*

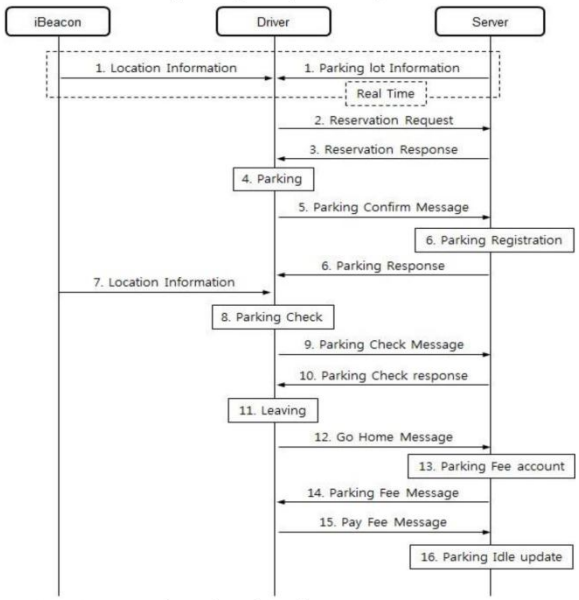


Fig. 4 iBeacon-based Parking lot Management System Algorithm

This system is divided into three process: the first process of receiving indoor location data from iBeacon, the second process of receiving a parking

space information by a smart device, and the third process of checking for leaving a vehilce in a parking lot. Through above three process, the proposed system can know a parking space when a vehicle arrives at entrance of parking lot and notify an empty parking space when a vehicle leaves. The whole process is as following. When a vehicle arrives at an entrance of parking lot, a driver or user can know an empty parking space from iBeacons which is located in an entrance using by smart device like a smartphone. After a driver check the wanted space, he can reserve the parking space by just touching a screen of parking map. And then a user drive a vehicle to the reserved space. After parking a vehicle in there, a driver transmits the parked message to a Server. A parking lot management server collects the parked message and reserved message from a driver. Using them, the server can manage the parking spaces. When a driver leave the parking space, a driver pays parking fee by smart device and checks the receipt of it. After that, the server changes the parked space into the empty space. And then other drivers can use this space and receive this information from the server.

## IV. RESULT

The proposed parking lot management system can reserve the empty space in a parking lot in realtime using by connection between iBeacons and external networks. In future works, we will solve the approace path problem of vehicles. That means that we will distinguish between difference of a vehicle and a human when they arrive at entry of parking lot using by measuring acceleration value of them.

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