# An Approach to IoT based Car Parking and Reservation system on Cloud


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***Abstract*— This paper introduces the concept of using IoT and Cloud based technology in car parking services in cities. A high-level view of the proposed system is outlined. Our solution makes the ancient parking system smarter by leveraging the power of IoT and embedding it with the latest innovation of electronic sensors & computers. An IoT-based intelligent car parking system is described. A number of software solutions, including Python, PHP web gateway with MySQL database, Cloud based storage and mobile applications, are proposed to provide pleasant parking experience to mobile users. Also, Data generated by the sensors, Image detection cameras and mobile application will be used to gain insights by storing it in cloud foundry and applying Big Data analytics using Hadoop.**



***Keywords—Internet of Things(IoT); Cloud Computing; smart cities; Car Parking; Hadoop; Big Data; Cloud Foundry***


## I. INTRODUCTION

Since the inception of global computer networks, there has been a vision of smart and communication objects. The essence of connecting everything-to-everything gave birth to terms like Machine-to-Machine (M2M), Radio Frequency Identification (RFID), Wearables and Web of Things. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure [1].

A major problem that people face today is to park their vehicles in multi-level parking lots. Whether its a shopping mall, Airport or a multi national company, facilitating parking is a major part of any infrastructure. The survey of drivers found that 81 per cent say it often takes them 20 minutes or more to find a parking slot, with 45 per cent describing parking as their biggest motoring headache [2]. We plan to create a system which makes this facility hassle free, time saving and convenient for the customers. Today in the era of technology when everything is turning smart, public parking lots are still far away from being smart. Creating an efficient and proficient parking system in real time is still a big challenge for any multi level pubic parking facilities.

## II. PROBLEM STATEMENT

The following statement has been divided into two modules for simplicity. The first module focuses on the current demands of the customers and the second module describes the Organizational level challenge.

### *A. Customer Level*

In order to make the entire system easily adaptable and generic for all types of people, There are a lot of parking facilities which people visit on daily basis (e.g.- Offices). Keeping that in mind we have created an addition express entry and express exit for such valuable customers. Standing in queues for entry, searching for a parking slot and then standing in queues again for payment are a big challenge. Also, often people forget the pillar number where they parked their vehicle and end up searching for their vehicle on the entire floor.

### *B. Organizational Level*

With the current progress in the field of analytics and cloud computing, it's a challenge for any organization to gain business insights and enhance customer experience. In order to attain such business advantage it's necessary for any organization to possess humungous amounts of data that can be used by analytical tools to gain insights.

## III. OVERVIEW

Before we begin to explain the technical and business components of our solution, lets define our objectives clearly. These objectives are as follows:

### *A. Objectives*

- Allocating the nearest parking slot at the entry point.
- Payment can be done through payment wallet. No need to wait in queues to pay.
- Locate your vehicle through your mobile app.
- Special reservation system for senior citizen/physically handicapped visitors near the lift.
- Image Processing will be used to recognize the number plate.


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### B. Components

- Cloud Foundry is used for storage. Cloud Foundry is an open source cloud-computing platform as a service. (PaaS) [3]
- The express entry check point has a passive infrared sensor (PIR) and a processing board (Arduino UNO, Intel Edison etc.) connected to it.
- Each parking slot has a proximity sensor and LED lights to indicate if a parking slot is available or not.
- Server Side scripts run to allocate the nearest parking slot, calculate the duration for which the vehicle was parked and the total billing amount.
- Mobile application for android and iOS are developed which require the customers to register one time. Also, payment wallets are linked for faster payment.

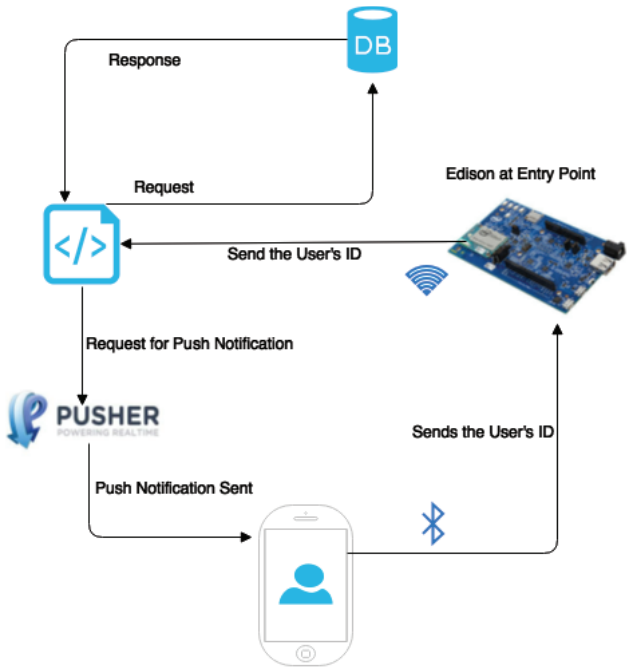


Figure-1. The main components of the IoT-based car parking system

## IV. Ease of Use

### A. Mobile Application for customers

A mobile application is developed for the customers. By downloading and registering on this mobile application, users can benefit from a wide range of facilities provided to them. They can reserve parking slots (e.g.: near the elevators) before arriving to the facility itself by easily paying through payment wallets. This can be beneficial for a large group of people including senior citizens and physically handicapped citizen. Also, they will get electronically generated parking slip on their app which will have all the details of their vehicle including the slot number where they placed their vehicle.

### B. Express Entry and Exit

Customer loyalty and satisfaction is a major priority for any organization. In order to give our registered customers ease of entry and exit, an express entry and exit is available. These entry and exit points will recognize your car by the power of Digital Image processing and allocate you the nearest parking slot available. You don't have to wait in queues anymore to get a parking slip. Your parking details along with the allotted slot will be pushed to your Mobile Application.

Upon express exit, you don't have to stand in queues for payment anymore. As soon as you leave your parking slot, total bill amount will be deducted from your payment wallet and you will get your receipt on your mobile application.

## V. Proposed Work

The solution will describe the design and explain the implementation along with a flow chart showing different the interaction of different components.

### A. Mobile Application Development

Mobile Application developed for android and iOS will have a one time sign up during which the user is asked to enter his name, phone number, email id, card details and car number. The user can add multiple cars to his account. After successfully signing up he'll be assigned a user id. All his details will be updated in the database and stored in cloud foundry.

### B. Sensors

PIR sensor will be used to detect the vehicle at the entry checkpoint. As soon as the vehicle arrives at the entry, the PIR sensor will trigger an event which in our case is the camera at the entry point. This camera will capture the image of the number plate and using digital image processing at the server side identifies the user id of the car owner. Parking slip with the nearest parking slot or the pre-reserved slot will be displayed on the owner's mobile application upon verification. Also, the LED on the allotted slot will turn red indicating that the slot has been booked/allotted.

Once the vehicle is parked on the allotted slot, the proximity sensor installed will trigger and update the database that the car has been parked. Upon completion of this event, the parking time of the customer will start.

### C. Payment and exit

As soon as the vehicle leaves the parking slot, proximity sensor will trigger and the timer will stop. The total billing amount will be calculated according to the parking time and will be withdrawn from the linked payment wallet of the

customer. The acknowledgment receipt will be sent on the mobile app and the user's linked email id.

Upon the express exit, as he approaches the barricade, the PIR sensor will trigger thereby capturing the image of the number plate and verifying whether the payment has been done or not. After verification the barricade will open and the customer can drive away.

### D. Cloud Tier

The cloud provides data storage and computing resources for the car parking service. It stores the 'big data' of available car parking lots, car parking area, car's location, user's location and profiles, etc. The most recent data is usually stored in the Hadoop's HBase [4] database to support real-time queries, whereas the historical data is serialized to Hive [5] (a warehousing in Hadoop). For computing, a number of Map/Reduce algorithms [6] are used, such as a recommendation algorithm for suggesting the 'best' car parking lots to users, a profile-updating algorithm based on user's parking history, etc. To build an efficient and scalable system, a rule engine Drools [7] is used to make decisions, based on facts, quickly and reliably.

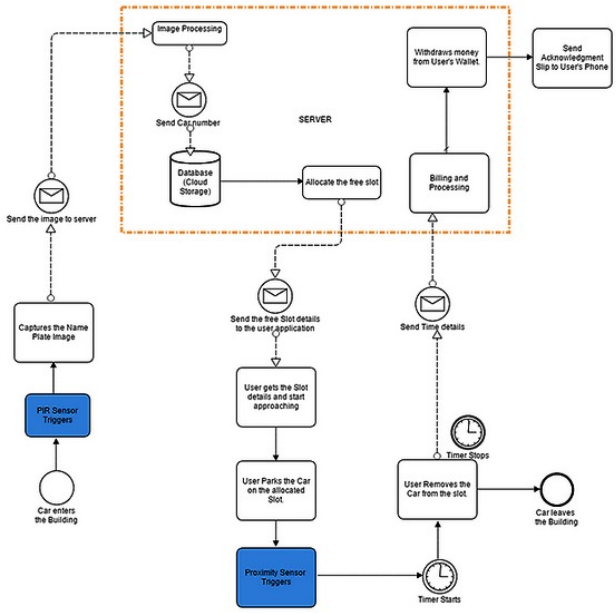


Figure-2. Flow chart of the system.

### E. Business Value

- Eco Friendly Solution. Looking for a parking space leads to carbon emission that has major impact on environment.
- Saves Paper. In 2011, Chicago alone recorded 33.1 million meter receipts and about 54.5 tons of waste. [8]
- Since the parking tickets will be digital, Need for human supervisor will be eliminated
- Valuable data generated by the sensors, camera and customer interaction can be used to gain business advantage and insights.
- Providing offers with promotions through mail or mobile app can attract customers.

## VII. Conclusion

We have proposed an approach to IoT based car parking and reservation system on cloud. The future scope of the work is to design the algorithm, test the solution and implement it in simulated environment.

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