Smart Parking System

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Abstract— **Due to population explosion, especially in India and China as population is increasing simultaneously number of vehicles on road also increasing. Therefore congestion is the main problem nowadays, during parking the vehicles finding available parking slots is tedious job it is better to identify the available parking slot before living the current location. By identifying and reserving the parking slot in destination place or nearby it is the good job. This study is aimed at analyzing available parking slots. This system allocates available parking space to a needed driver to park their vehicles. Renews the availability of the parking space when vehicles leaves and computes the charges, due to implementing this system will increase parking utilization. The system does this by providing more efficient and effective parking enforcement. In this system keypad, cloud, sensors, servo-motors are used. Sensors are used to detect space is available or occupied, Cloud is used to store data of parking details, keypad is provided for the manual entry of OTP number by users. LED Lights like Red, Green and Blue are used to indicate slot status.**

*Index Terms—***Arduino, Cloud, Keypad, Sensor, Smart Parking.**

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I. INTRODUCTION

There are two types of parking management system first is a normal parking system and another one is an automatic parking system. What we are using nowadays to park the vehicle is normal parking system. . In normal parking system, problem faced by people due to lack to car parking management is shown in Fig.1. An automatic parking system is used to make the whole process of car parking more efficient and less complex for both drivers and supervisor. This can be done through sensors, microcontroller, LEDs as indicator, LCD display, keypad, and servo-motor. By storing the data related to parking area in cloud can be accessed from anywhere. To access the data from cloud internet is required.

Project objective
- To develop an intelligent, user friendly automated car parking system which reduce the human intervention and also traffic congestion.
- To offer safe and secure parking slots within limited area.

Problems
- It is tedious job to find the vacant spaces during weekends or public holidays.
- Finding space during weekends or public holidays can take more than 10 minutes for about 66% of visitors. Stadiums or shopping malls are crowded at peak periods, and difficulty in finding vacant slots at these places is a major problem for customers. Insufficient car park space leads to traffic congestion and driver frustration.

Figure 1 Improper Parking

II. RELATED WORKS

When we saw how people park these days, we came up with this idea that we certainly need a better parking system that exist today as there is no authorization and anyone can park their vehicle where they want.

At entrance it reads RFID Tag and checks it is authorized user or not. If authorized user than gate opens for entry to parking slot and park the vehicle, if slot is available and counter get updated. IR sensors are used to sense the car present in slot or not [1]. User need to get registered by entering their credentials. Those details are get updated to cloud. When user arrives at parking area captures car number plate and processed parking slip will be displayed on the owner's application upon verification. Also LED allotted to slot turn to Red indicating that slot allocated. As soon as user leaves parking area billing amount will be calculated according to the parking time and will be withdrawn from the linked payment wallet customer .cloud provide data storage and computing resource for the car parking service [2][5].

Admin application is used to define new parking area, specify number of parking lots, the parking cost per hour and other details. Parking application used to send vehicle plate number and reservation password to central server for verification when user checks in and issue bill to user on checkout. Application for user to register for service, find parking area from the list of area, and reserve an available parking slot and specify duration of reservation [3].

In some of the proposed system, using image processing concept number of slots available or not is predicted and updated to cloud [6][7]. And also to check arrived user at parking entrance is authorized user or not using OCR algorithm [8] [9].

III. PROPOSED SYSTEM

We are designing a less complex system, thus the components required is also less. There will less man power involved for installation operation and maintenance. Hence system requires small space for installation and less power consumption. It allows pre-booking. System allows user to give individual parking preference. It automatically deducts amount from user's wallet. De-allocates the parking slot once the car leaves and making payment. System notifies user of allocated slot through SMS during booking, deducted charges during exit. The smart parking system encompasses numerous sensor nodes, micro-controller, cloud, barrier gate, LCD display and keypad as illustrated in Fig.2.

Active IR sensor installed on every slot in parking area in order to collect information from them [12] [4]. Data collected from sensor is transferred to cloud through Wi-Fi module [10]. The cloud stores these data and presents them as useful information for drivers on the screen. The sensor stay in sleep condition most of the time to preserve the battery's power and starts it's reading from the active IR sensor at the appropriate time interval and then updated to cloud. The cloud manages the availability or occupancy states of all the parking slots and also offer the status of parking slot information to driver through android application and also at
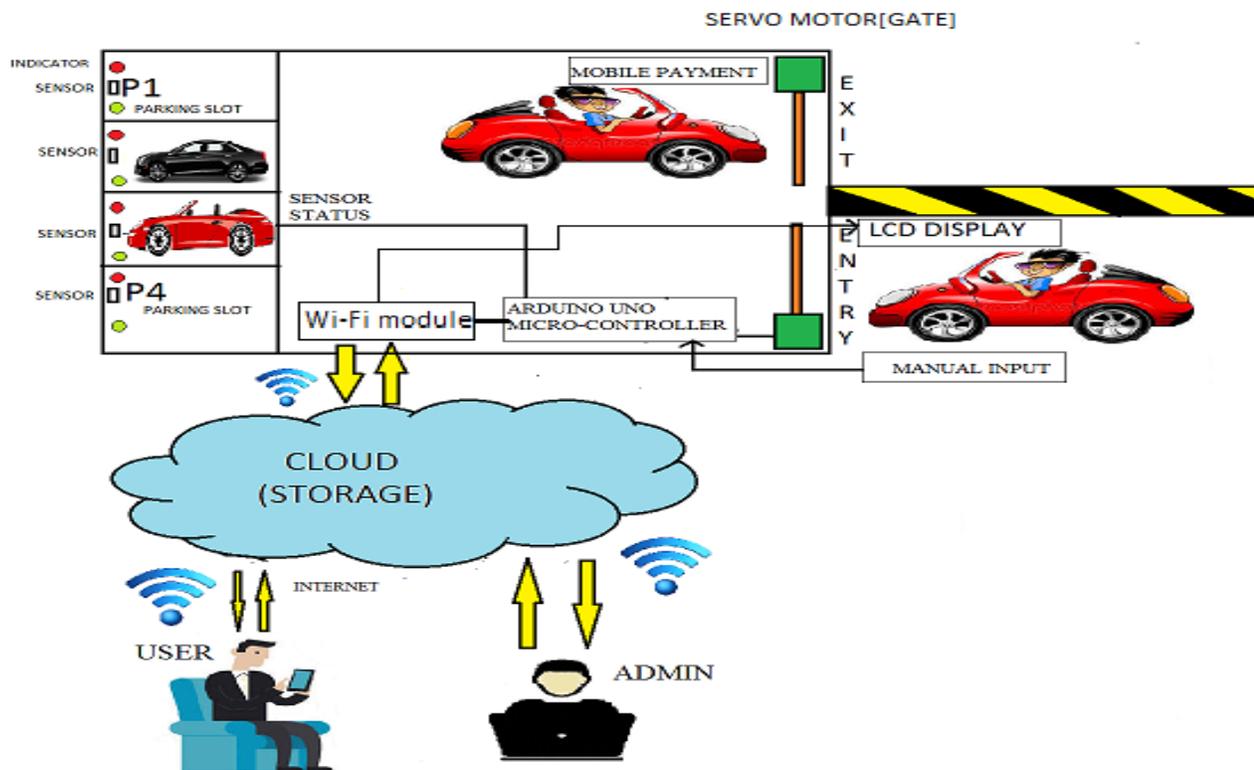

Figure 2 Architecture of Smart Parking System

the entrance of the parking area in LCD display. Smart parking system has different functionalities that are managing user, parking slots, payment and messages. User can check the status of parking slot through browser or Android Application and reserve specified parking slot if available.

After successful reservation, confirmation message is send to the user with OTP .User as to enter received OTP at entrance of parking area .If those numbers are matched the barrier gate opens. User will park the vehicle in reserved slot. During exit time user needs to make payment by cash or e-wallet (like Paytm). To make payment smart phone is required [11]. After successful payment it allows user to exit from that point.

IV. METHODS AND MATERIAL

A. Hardware description

The required hardware component are Arduino UNO microcontroller, Wi-Fi module, LCD, Active IR sensor, servo-motor, power supply, Key pad and LEDs.

1) Arduino Uno: The Arduino Uno is a microcontroller board based on the ATmega328 (data sheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, and a reset button. This contains all the required support needed for microcontroller.

2) Sensor: Sensor is placed in each slot to know the status of each parking slots. It sends signal to microcontroller, here active IR sensor are used.

3) Indicators (LEDs): Neopixels are used and placed in each parking slot. Advantage of it is these are addressable LEDs and it require only 3 wires to connect 'n' number of LEDs. Each slot separate color can be assigned and Red indicates slot occupied, Blue indicates slot has been booked and Green indicates available.

4) Servo motor: Servo motor is a rotary actuator or motor that allows for a precise control in terms of angular position, acceleration and velocity, capabilities that a regular motor does not have special type of motor which is automatically operated up to certain limit for a given command with help of error-sensing feedback to correct the performance. It is used to open the barrier gate when user arrives at entry point and departure at exit point.

5) LCD Display: Display is placed in outside of parking area at entrance. It contains parking slots status like number of slots occupied and number of slots available.

6) Wi-Fi module: The ESP8266 Wi-Fi module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network… the ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.
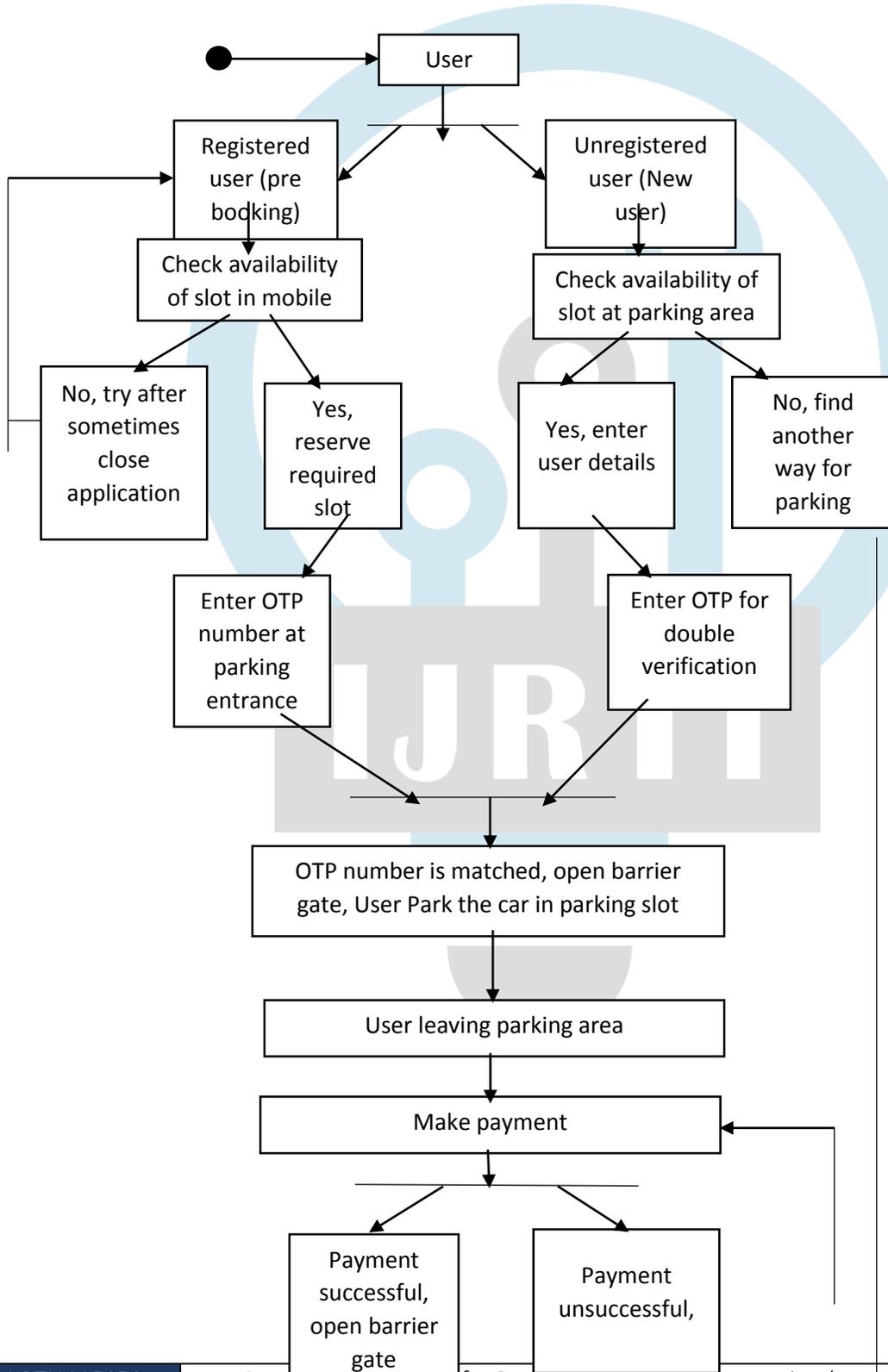
B. Software Requirements

1) Development platform: Windows 10 is a major version of the Microsoft windows OS.it is user friendly. It support application like Arduino IDE, Android studio, Mongo DB.

2) Programming language: JS is used for interface between hardware and software. HTML and Php is used for developing front end.

3)Embedded programming: Arduino consist of both a physical programmable circuit board (often referred to as a Microcontroller) and a piece of software, or IDE (integrated development environment) that runs on your computer, used to write and upload computer code to the physical board.

Entire system is divided into three Modules:-
   Module 1: Slot reservation
   Module 2: Authentication
   Module 3: Check Out

1)Slot Reservation: Initially user needs to register his details using smart phone in android application. After registration, logging to his profile user can check parking slot status. All information related to parking area will be stored in cloud. Data stored in cloud will be displayed to user in on android application. Based on the data displayed on android application user reserve the required slot. After selecting the slot an OTP will be sent to the user as a confirmation message.

Complete working flow of smart car-parking system is shown in activity diagram Fig.3.
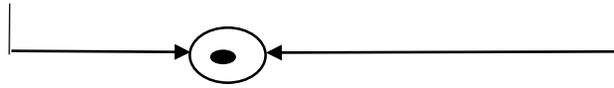
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                              ┌──────────┐
        ●──────────────────→  │   User   │
                              └──────────┘
    ┌─────────────┐                 │
    │  Registered │          ┌─────────────┐
    │ user (pre   │←─────────│ Unregistered│
    │  booking)   │          │ user (New   │
    └─────────────┘          │   user)     │
         │                   └─────────────┘
    ┌──────────────┐              │
    │ Check        │         ┌──────────────┐
    │ availability │         │ Check        │
    │ of slot in   │         │ availability │
    │ mobile       │         │ of slot at   │
    └──────────────┘         │ parking area │
      │        │             └──────────────┘
┌──────────┐ ┌─────────┐    │          │
│No, try   │ │ Yes,    │ ┌──────────┐ ┌──────────┐
│after     │ │ reserve │ │Yes, enter│ │No, find  │
│sometimes │ │ required│ │user      │ │another   │
│close     │ │ slot    │ │details   │ │way for   │
│application│└─────────┘ └──────────┘ │parking   │
└──────────┘                          └──────────┘
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- User
  - Registered user (pre booking)
    - Check availability of slot in mobile
      - No, try after sometimes close application
      - Yes, reserve required slot
        - Enter OTP number at parking entrance
  - Unregistered user (New user)
    - Check availability of slot at parking area
      - Yes, enter user details
        - Enter OTP for double verification
      - No, find another way for parking

OTP number is matched, open barrier gate, User Park the car in parking slot

User leaving parking area

Make payment

- Payment successful, open barrier gate
- Payment unsuccessful,

Figure 3 Activity diagram for smart parking system

2) Authentication

- *Registered user***:** In case of registered user**,** the registered user arrives at the parking slot and the OTP number is entered with the help of keypad which user received during reservation as a confirmation message. After verification of the entered OTP number microcontroller send the signal to open the barrier gate. Then user is allowed   park the vehicle in reserved slot.

- *Un-Registered user:* In case of Un-Registered user, the unregistered user at the entrance of parking area LCD displays the status of parking area that is total number of occupied and free slots. If the Parking space are available then user need to enter some minimum details like vehicle number and phone number. Next user will get confirmation message with OTP, user needs to enter received OTP then barrier gate will open user is allowed to enter into parking area and park's the vehicle in allocated slot.

*3) Check Out***:** User leaves parking slot and arrive at exit point. User has to make payment by cash or e-wallet (like paytm). After successful payment only barrier gate will open for user to exit. Allocated space is de-allocated and make available to another user to make use of it. All details (timings, payment, and user information) get updated in the cloud. Those details are accessible to the admin.

Complete working flow of smart car-parking system is shown in activity diagram Fig.3.

V. SNAPSHOTS

In embedded system LED lights are used to indicate the status of slots where green light indicates the availability of slots shown in Fig 4.

User need to register (Sign Up) them self through android application or web browser. Then sign in, and can checks slot status and reserve the slot and also can cancel the reserved slot. User need give their credentials during registration (sign up) like user name, mobile number and password. After registration successful user need to login by giving user name and password shown in Fig 5.

After slot reservation the status is updated as awaiting in user application as well as status updated as unavailable for other users. In embeded system LED is updated from green to blue. If user wish to cancel the booked slot they can cancel by selecting action 'cancel' as shown in Fig 6 and Fig 7.

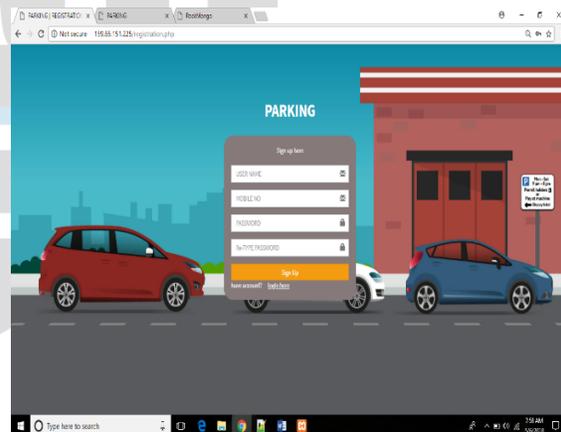**Figure 4** All slots are available
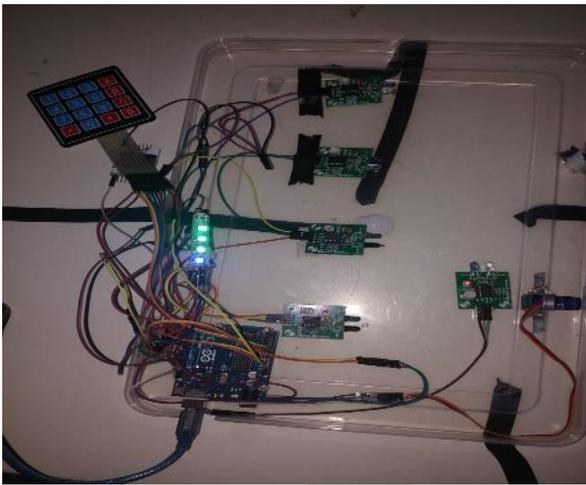

Figure 5 User Sign up page
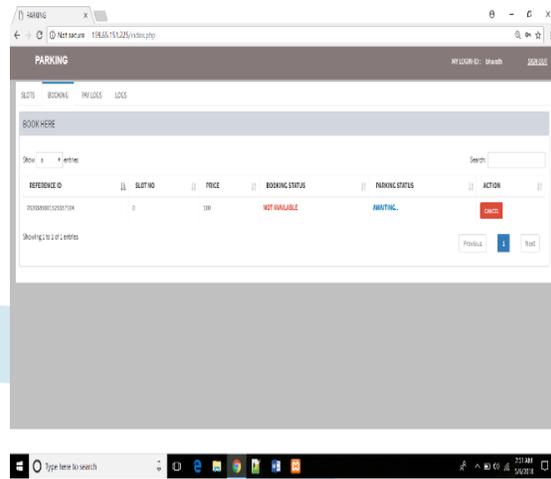
Figure 6 After Slot Reservation

Figure 7 After user reserving the parking slot

After user parked there car in reserved slot status is updated as parked for user and they cannot perform any action. In embeded system LED changes from blue to red where red indicates car parked successfully in the reserved slot shown in Fig 8 and 9.

During exit the payment slip is generated to the user where it contains details of user reference ID, slot number, price per slot in hours, duration, amount, payment mode. User has to select the mode and payment need to be done. User can also view pay logs in there android application shown in Fig 10.
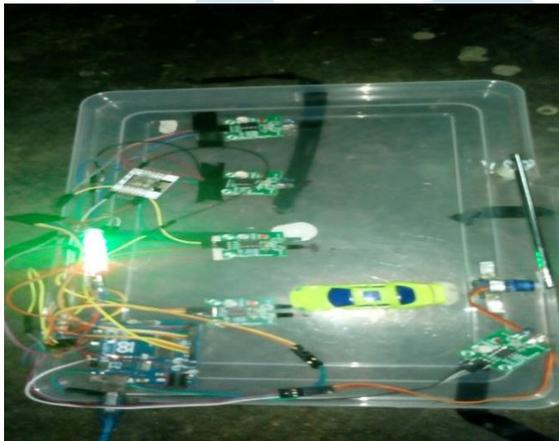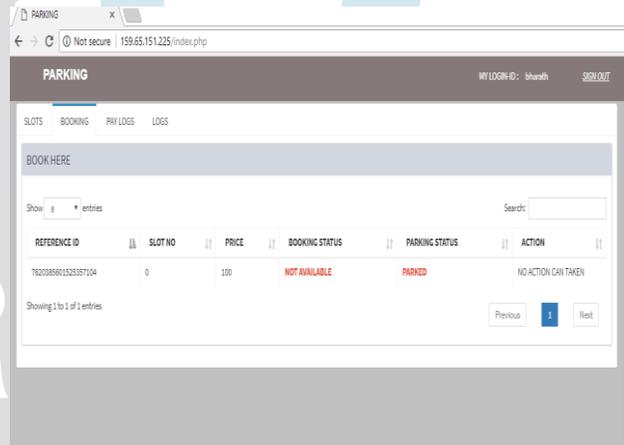

Figure 8 After Slot occupied
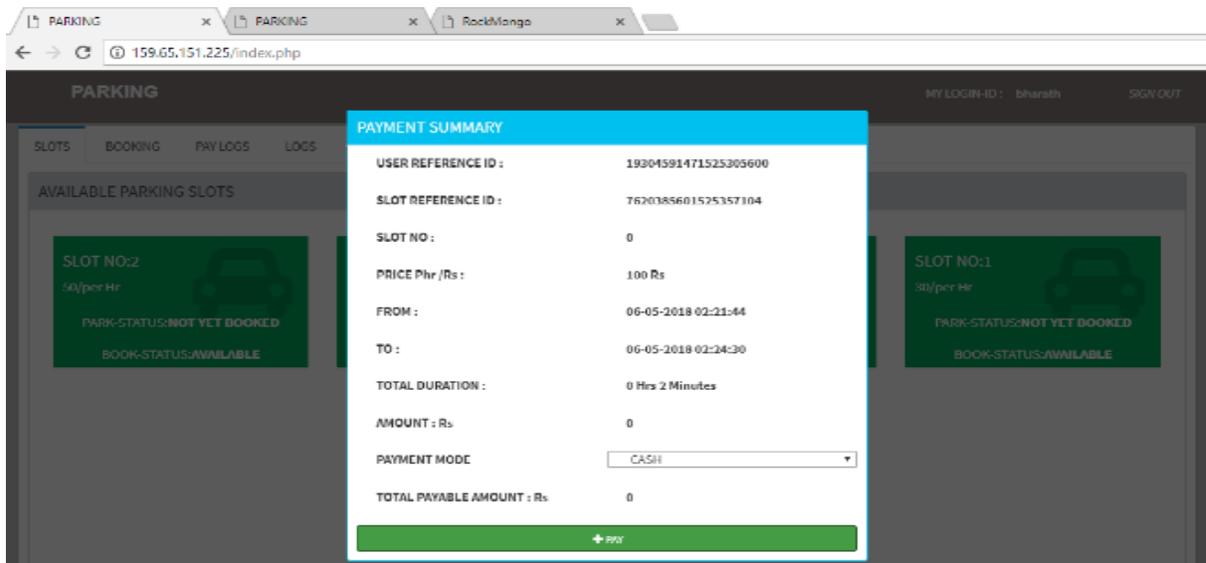

Figure 9 After user parking the car in the reserved slot

Figure 10 Payment Slip

ACKNOWLEDGEMENT

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