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IoT based Smart Parking System using Mobile Application

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Abstract: ***In day-to-day life, the parking problem is becoming a major issue in human life. Mainly in urban and metropolitan cities, we face a parking problem, and it becomes a major task to find parking spaces mainly at malls, multiplex, market, etc. It is more time and fuel consuming. Finding a parking space, it becomes a frustrating moment for a driver. If a driver does not find any parking space and they park anywhere in a roadside or a restricted area, then the traffic can occur, and the security of the vehicle becomes a major issue. To overcome this problem, we proposed IoT based parking system using a mobile application. Using internet technology for connecting physical objects with the help of a mobile phone with Google API, the controller, sensor, Wi-Fi module, and cloud database to store user data. It helps the user to find a parking space using a mobile application. Users can book a parking space in advance and help to find the shortest way to reach a parking area. And they park a vehicle on their specific place and during exit users can pay a parking charge to depend on the time using a mobile application (e-payment). It saves human time, money, and fuel and provides security to vehicles.***

Keywords: IoT, Arduino Uno, Ultrasonic Sensor, Wi-Fi Module, Cloud Database, Mobile Application.

I. INTRODUCTION

Many times, we visit places like temples, malls, cinema halls, etc. we face one of the common issues i.e. parking problems. In urban or metropolitan cities parking problem is getting increases day by day. Finding a parking space is also one of the difficult tasks or it becomes a frustrating moment for vehicle drivers. It is more time consuming and fuel consuming. Many times happen if the driver doesn't get space they parked at any roadside or non-parking zone that can cause traffic or accident can occur. We need a smart parking system must be developed in our cities to solve the problem of parking. It helps the user/driver to park a vehicle using a mobile application technology. That is users can easily find parking slots using a mobile application that the space is empty or not. If space is available users can easily book or allotted a parking slot in advance before the parking and space allotted valid for a specific time for it. Users can easily pay parking charges online before leaving parking. With the help of the Internet of Things technology, a smart parking system can develop that can help to improve human life better and easier. An Internet of things (IoT) is a combined form of Physical or real-life object + sensor, actuator, or microcontroller + Internet = Internet of things (IoT)

The concept of a smart parking system can help to save time and fuel and make a systematic parking system that users can easily handle using smartphones. In this paper, we will step by step see how we can manage a smart parking system, find parking spaces for parking, payment methods using a mobile application and how a user can easily be booked a parking space using the mobile application in advance by monitoring online that the space is available or not and seeing working on an application for booking a parking spot with the online payment method.

The paper is structured as follows in section 2 the covers Objectives of the study. In section 3 covers a literature review. In section 4 covers a Methodology. the Section 5 Covers Experiment. In section 6 Result and finally section 7 covers Conclusion and Future Scope.

II. OBJECTIVES OF STUDY

1) *H1:* Finding a parking spaces in urban and metropolitan cities it is most difficult, and it is time consuming task for peoples and driver.
2) *H2:* Smart parking system implementation in urban or metropolitan cities is beneficial for vehicle driver to find a parking space without wasting time.
3) *H3:* With this IoT technology helps to create good environment in urban area with no more population and reduces the carbon dioxide emissions that makes the human life better and reliable.

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III. LITERATURE REVIEW

The paper highlighted Jambotkar et. al. [1], Parking space with Android app and OTP. IoT based Smart Parking System and its Specifications hardware and Software devices and components include Ultrasonic Sensor, cloud server, Arduino Uno. The paper highlighted Thorat et. al. [2] RFID (Radio frequency Identification) and IR sensors (Infrared sensor) parking becomes smart and systematic detect parking spaces and online methods. The paper highlighted Lookmaung et. al. [3], Embedded controller (Raspberry-pi), cloud API, features and interface of mobile application check parking slot, set a timer, and online payment process working of design and algorithm to solve parking problem. The paper defined Gupta et. al. [4], smart parking management system to allocate parking space involves uses of ultrasonic sensor, Arduino Uno, ESP8266-01 Wi-Fi module, cloud server and how to reserve a parking space. The paper defined Thangam et. al. [5], Smart Parking Reservation System to reserve a parking lot with mobile apps. In this optical character recognition (based on KNN algorithm) and facial recognition (based on Vector machine algorithm) to provide security and architecture, Implementation of the Smart Parking System. The paper Emphasized Bachhav et. al. [6], a Smart Parking slot to provide security in the Parking System or an IR sensor is used to detect an object. The paper proposed Dhar et. al. [7], MQTT Protocol with Intelligent Parking System and cloud computing vehicular technology. The paper emphasized Kamble et. al. [8], a Smart Parking using Android Mobile Apps to book a Parking slot in advanced with OTP (One Time Password). The Author proposed Rizwan et. al. [9], solution for Parking problems using an android application, google map API, Working of Application, Database, functions and to navigate the user/driver for finding a parking slot. The paper highlighted Desai et. al. [10], a Smart Vehicle System to book Parking slot using an Android Application, ultrasonic sensor, raspberry pi3 with a camera, QR code for managing a gate entry of vehicle systematically. The paper proposed Natarajan et. al. [11], with an IR sensor and detects a parking space is empty or not and update at the parking gate with a display board before entering the parking lot. The paper highlighted Khanna et. al. [12], a parking system using a mobile application and store and manage data using cloud computing with working and implementation in real life scenario.

The paper proposed Cynthia et. al. [13], a management of parking by android app developing, identify a free slot, parking area navigation, authenticating a vehicle etc. The paper defined Fatima et. al. [14], the Parking system using a mobile application, IR sensor, cloud, leading a new technology called a cloud of thing (CoT). The paper highlighted Al waili et. al. [15], the ultrasonic sensor, Wi-fi-module, Google maps, Android, and Arduino Mega to designed Parking slot through IoT. The paper proposed Thomas et. al. [16], an IOT based parking system using a Mobile application with cloud integration or Cloud of things, System architecture, working, and described software.

The paper highlighted Kumar et. al. [17], a smart parking system, IOT module, working of the parking system using a mobile application, requirements are specified, and algorithm of application to booked parking space. The Paper proposed Dhumal et. al [18], automatic parking system using mobile android application booking parking slot in advanced, Microcontroller and detecting parking space with the mobile and booked a parking space in advance with online payment process. The Paper highlighted Atiqur et. al. [19], smart parking system using Internet of things, communicating technology, RFID, and smart billing process. A focused point is the IOT based smart parking system.

The Paper proposed Mani et. al. [20], parking reservation, Internet, Bluetooth technology, wireless sensors, parking system management SPARK, RFIDS, speed measurement system, peripheral interface controller, integrated circuits, LCD display, etc. The Paper proposed Mitra et. al. [21], android based parking system using mobile application that user can booked parking space easily in advanced with online payment, QR code and the GPS technology. The Paper proposed Anitha et. al. [22], Intelligent parking system using Android mobile application that user can booked a parking slot in advanced for specific time with online payment process. The Paper proposed Vennila et. al. [23], smart parking system helps to reserving a parking space using wireless sensor system, GPS and creates a parking slot for a client to easier to select a best slot where you want to parked a vehicle. The Paper proposed Basavaraja SR et. al. [24], reservation-based parking system that driver can reserved a parking space using Android application RFID, parking space detection, MCU, that helps you save time and fuel during finding a parking space. The Paper proposed Singh et. al. [25], IoT smart parking system with mobile application and help of KNN algorithm, Raspberry pi OS, IR sensor to develop their system.

IV. METHODOLOGY

The methodology is a model to defined techniques or methods to develop, plan, and design a model or a project. This session explains about working of systems and applications with hardware and software that will be used for developing a system. The results should be analyzed to achieving the objective of this model or a project.

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A. Overview

The proposed system is about to detect a space for parking using mobile applications with hardware and software specifications. Users or drivers can easily find a parking spot with an application that monitors the space is free or not before parking and can do the advanced booking of parking space for a specific time. Ultrasonic and infrared sensors help to detect a vehicle parking space that the parking is available or not and sensor sense the availability or not and gives the data to the controller and stores the data the in the cloud and with the help of Wi-fi module user can access the data from cloud to know that and monitor the space in own mobile application and easily can track the parking area without more time consuming It easily can reach parking spot with the help of Google maps and can do online payment depends on the parking time they parked a vehicle.

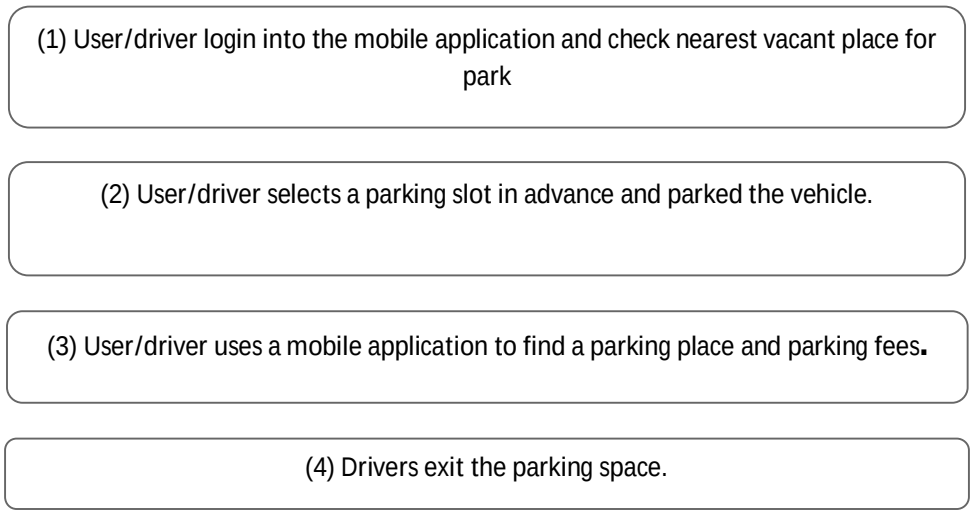


Fig. 1 Methodology Diagram

1) Process (1) user/driver register and login into the mobile application and check the nearest vacant place for parking. A mobile application that helps to monitor the parking area is a parking space available or not. If it is available or not. If shows green if not it shows red.

2) Process (2) User/driver select parking slot in advance and parked the vehicle. In real-time parking space is immediately update on a mobile application. When drivers park in the selected parking space then the notification comes in application to fill the license plate number of the driver. User-provided services like tracking, the position of vehicle timer, and online payment services application.

3) Process (3) User drives use a mobile application to find a parking space and show park a fee. After a vehicle is parked in a slot then the timer gets started before exit the parking the application automatically generates a parking fee based on timing and the user can easily pay the fee online.

4) Process (4) driver exit a parking space. After a driver paid a parking fee online then they exit a parking space, and the application is updated.

B. Data Analysis

In this paper data analysis is performed by collecting data through google forms. A data is a formal quantitative data that is collected related to the hypothesis we set and analysis of data for calculation chi-square is applied for proving the hypothesis.

C. Hardware Components and Modules

1) *Arduino Uno:* It is a microcontroller board. It uses AT mega32p. It consists of 14input/output pins and 6 analog inputs. It acts as an interface between the hardware part and the software part of the project. It can read input like detection motion, light and gives output on it. In Arduino Uno we can store the programming code it acts like a brain.

2) *Ethernet Shield:* Ethernet shield is used to connecting Arduino with the internet and it allows a data exchange worldwide through internet connections.

3) *RFID:* RFID stands for radio frequency identification tag is an electronic type of tag that exchange data from an RFID reader. We mainly use an RFID active tag. It is primarily used for tracking. This tag has chips, memory, or antenna.

4) *Ultrasonic Sensor:* It acts like input for collecting data and send it to the microcontroller.

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5) *IR Sensor:* It is an electronic device that emits to sense any object around to the surroundings. It detects the motion and measures the heat of the object.
6) *GSM Module:* It is a circuit that is used to set up communication between microcontrollers and mobile phones. It is used to send voice messages, SMS through smartphones. It allows high data transmission.
7) *Reader Module:* This device scan and collect information from RFID. It is used to track objects.
8) *Android Module:* It helps to connect users from the parking area.
9) *Mobile Application:* User or driver downloads an application in the mobile phones through which they track a parking area to check the availability is there or not and booked a space in advance before parking.
10) *Online Payment Method:* During exiting the parking user can pay the parking fee online. It depends on the duration they parked, and the payment is done in all modes such as net banking, PayPal, etc.



Fig. 2 Block Diagram

V. EXPERIMENT

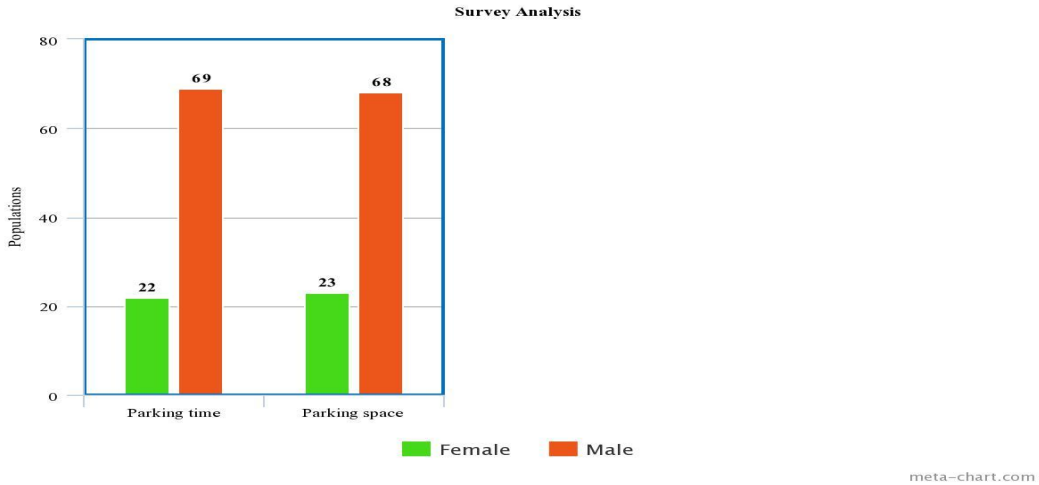


Fig. 3 Survey Chart

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We collected 90 samples out of 100 population with male and female responses. A data is collected using the google form platform we prepared a questionnaire for response and analysis. It is a quantitative-based analysis collected nominal based data. Of 90 samples 69 are males and 21 are females are responded. In each graph red represent males and green represent females. In the above graph figure 1.1, we see that 69 males and 22 females respond that finding parking space is time consumption where 68 males and 23 females responded that there is a problem for finding space in urban cities. According to the graph, we see the majority say finding a parking space is more difficult in an urban city and it is more consuming for vehicle driver/user.

We performed a chi-square test based on a hypothesis in which created an observed table than expected a table and calculated chi-square and find a degree of freedom to get a tabular chi-square value. If chi-square calculated is greater than chi-square tabular it except alternative hypothesis and rejects the null hypothesis.

A. Table of Observed Value

Table(a)

Response	Male	Female	Total
Yes	70	19	89
No	20	2	22
Total	90	21	101

Formula for finding expected value
(Observed Value-Expected value)^2 % Expected value
Table of Expected value:

Table(b)

Response	Male	Female
Yes	79.3	18.5
No	19.6	4.5

Calculation of X^2

Table(c)

Observed value (O)	Expected value (E)	(O-E)	(O-E)^2	(O-E)^2 % E
70	79.3	-9.3	86.49	1.090
19	18.5	0.5	0.25	0.013
20	19.6	0.4	0.16	0.008163
2	4.5	O.44	0.19	0.0438

Chi-square calculated= 1.154963
Degree of freedom =(column-1) (row-1)
(2-1) (2-1)
1×1=1
Chi-square tabular=1
Chi-square calculated= 1.154963
Chi-square calculated > Chi-square tabular
We accept alternative hypothesis

VI. RESULTS

We performed data analysis by collecting relevant data from the given questionnaire and performed a chi-square test related to the hypothesis we set. So according to the experiment H1 hypothesis is accepted that in a parking space is difficult and more time-consuming in an adding to the majority of respondents is proven that finding parking space in urban areas is a time-consuming task for people.

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VII. CONCLUSION AND FUTURE SCOPE

In this paper, we proposed a smart parking system using a mobile application with reservation-based control, tracking, and help to find near locations and with online payment method and the specified hardware components and software module in the paper. according to the duration you parked a vehicle. The focus of the paper is the parking problem is more time-consuming and it is difficult to find parking space in urban or metropolitan cities. In this paper, we performed survey analysis or data analysis by collecting specific responses related to the problem of parking space faced by the vehicle user/driver and performed a chi-square test. In the end, we came to the solution that the majority of users/drivers are responded that they are facing parking problems, and it's consuming more time for finding a parking space, especially in urban cities and areas. It provides the easiest way to parking a vehicle.

In the future enhancement increased in survey respondents to know the problem and analysis the data more Accurately System Requirements can extend to multiple parking areas with more secure and effective parking. It added navigation technology to guide a user to reach a destination or parking area easily. It minimizes the time and adds an application such as an accident alarm and an AI camera can be implemented.

VIII. ACKNOWLEDGMENT

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IX. GLOSSARY

1) *IoT*- Internet of Things
2) *e-payment*- electronic payment
3) *RFID*- radio-frequency Identification
4) *IR sensor*- infrared sensor
5) *GSM*- global system for mobile communications
6) *CoT*- Cloud of things
7) *OTP*- One Time password
8) *API*- Application Programming Interface
9) *KNN algorithm*- K-nearest neighbors' algorithm
10) *QR code*- Quick Response

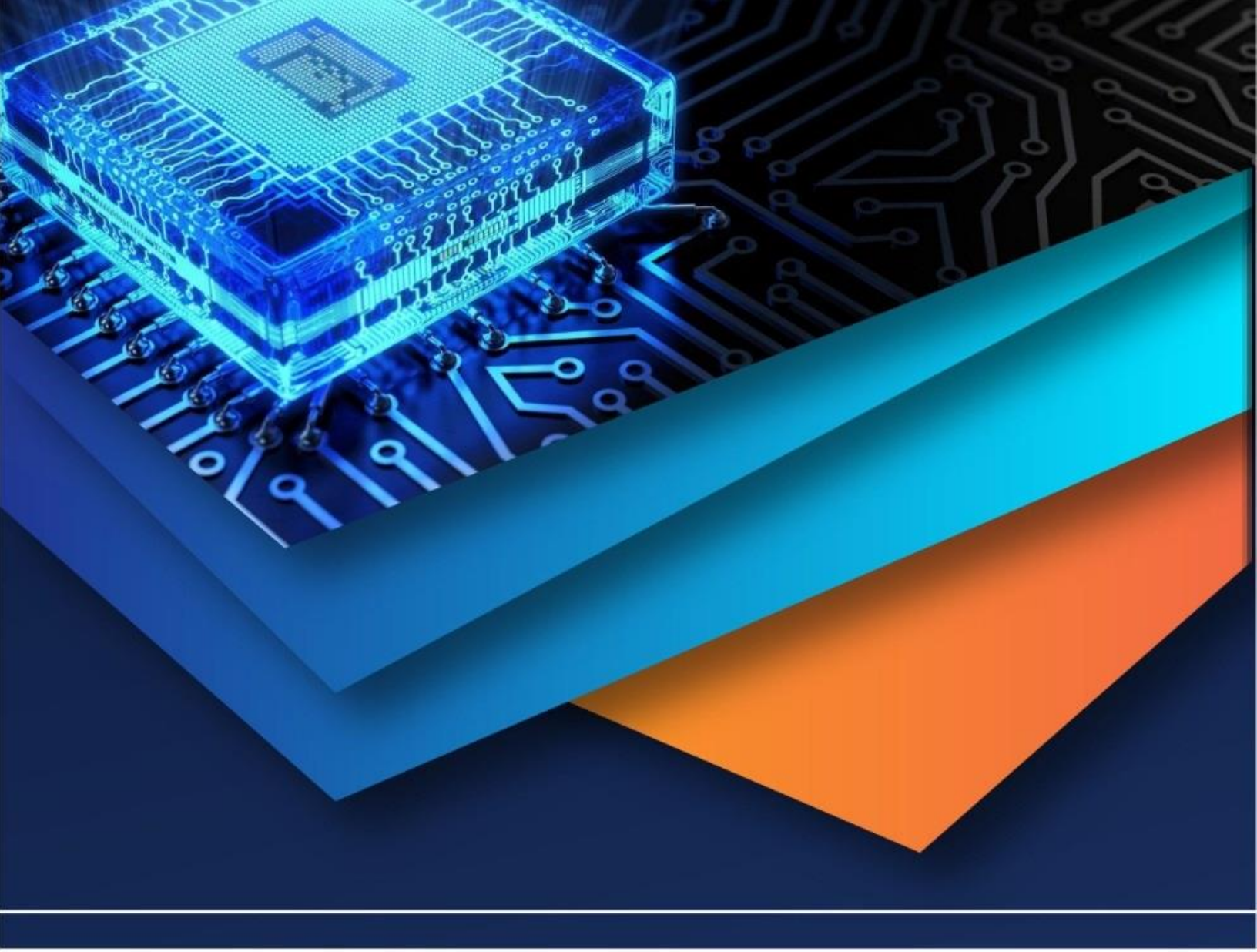
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