# An Interactive Approach for Smart Parking System Using Machine Learning

Anagha R1, Arpitha S2, Sanjay B S3, Swasthi B S4, Harshitha K5

*Department of Computer Science and Engineering Vidyavardhaka College Of Engineering, Mysuru, Karnataka, India*

**Abstract** — *Parking vehicles has been a very challenging task these days.Lack of availability of parking spaces, lack of proper information about vacant spaces,search for those vacant spaces, all add up to the challenge of parking. Finding a place for our vehicle, not only causes wastage of time,money and effort,but also causes a lot of inconvenience to the drivers.The problem further escalates to traffic jams, air pollution and environmental damage.Hence,there is an urgent requirement for a proper parking system to be in place,inorder to minimize the parking problems.This paper is basically a survey of a few of the proposed parking systems,that have been put forward,so as to overcome the problems of parking.In this survey paper,various methods and implementations proposed by the authors are discussed, comparethembasedon their efficiency,optimization,cost and a few other parameters.*

**Keywords** – *Convolution Neural Network(CNN),Internet of Things (IoT),Radio Frequency Identification(RFID), arduino.*

## I. INTRODUCTION

As the number of vehicles is increasing day by day, looking for vacant slots for those vehicles keeps getting more and more challenging.Drivers have to wait for a long time, in a queue in order to park their vehicles in parking lots, which again takes up a lot of time,fuel and effort.Mismanagement and lack of discipline while parking also adds up to the predicaments of parking. People tend to park their cars just anywhere on a road,thereby leading to huge traffic jams on the roads or may take up more space to park than their vehicle actually needs for parking,hence ,they are not only taking up more space,but also denying space for another vehicle. The remaining part of the paper is structured as follows: the section 2 discusses about the various techniques used for Smart Parking Systems around the world. Section 3 summarizes aboutdifferent methodologies used.Section 4 briefs about method used in the proposed system and Section 5 concludes the paper.



**Fig 1: A Parking Lot**

## II. RELATEDWORK

This Section deals with the literature survey of the techniques related to our work.

Sepehr Valipour, Mennatullah Siam, Eleni Stroulia, Martin Jagers and proposed a framework, consisting of three sections. First isvisual hubs, specifically cameras, that are associated with the server through either neighborhood remote system or on the other hand through the Internet. The server is the subsequent segment. It incorporates a database, identification module, web administration and occasion handler.

The server gathers pictures from visual hubs, bolsters them to identification module and gathers and stores its yield in the database and gives web administration to front-end applications to get data from the database. The third component is the front-end that presents parking garages opening to clients.

Visual hubs

Customary shading camera pictures are utilized in this venture while there exist different decisions, for example, microwave radar.As per the author,camera is a reasonable decision for stopping the executives framework, because of its low support, minimal effort per slow down and simplicity of adaptability. Nonetheless, a downside is that camera crude yield pictures are profoundly delicate to natural parameters. The paper investigates the camera perspective which is subject to the stopping's structure and temporary workers who introduce the cameras. In this manner, the main imperatives that the paper puts on our visual hubs are:Stalls of intrigue ought not be outwardly blocked and cameras picture yield ought to be conveyed upon server's demand.

Server and location module

The server alongside the gathering of pictures serves web administration that front-end applications use to get to database.The principle use upheld is recovering status of all slows down in each parking area. At last,it sustains the pictures from visual hubs to the discovery module alongside bouncing boxes of slows down and gets the recognition module expectation.[1]

VijayPaidi and Hasan Fleyeh exhibited a paper which tends to the initial phase in distinguishing stopping inhabitance data and the following stage is train the locator with extra preparing pictures and get the positional data of the empty parking spot which can be nourished to a stopping direction system. In this paper, a warm camera is utilized for acquire stopping inhabitance discovery in an open parking area. An open parking area is exposed to different weather,environment and light conditions and a warm camera is equipped for distinguishing objects during such conditions,which is a bit of leeway. Pretrained locators, prepared identifiers utilizing total channel highlights, histogram of situated angle and profound learning system are executed for stopping inhabitance discovery. The warm camera ,as indicated by the paper, records recordings dependent on movement recognition which leadto accumulation of a few little interim recordings. The recordingswere gathered in splendid, dull and frigid climateconditions,and one picture from every video is gathered. Thefundamental downside and bit of leeway of utilizing a warm camera isthat the vehicles can be perceived dependent on radiated heat. Avehicle can be perceived during whenever or anyecological conditions if there is adequatemeasure of warmth transmitted by the vehicle. Be that as it may, if a vehicleis stationary for a while, the warmth in the vehiclereduces bit by bit and the vehicles can't be perceivedeffectively which is weakness in utilizing warm camera.So, itwould be a test to identify a vehicle with no warmth incolder environments.The paper shows the locationtechnique in the accompanying manner: A Pre-prepared FasterRegionalConvolutionalNeuralNetwork (Faster RCNN)indicator is a pre-prepared profound learning convolutional neural system prepared utilizing unoccluded pictures of vehicles. Itcomprises of altered adaptation of CIFAR-10architecture.Then, A Faster RCNN from Resnet50 ismade utilizing a 50 layer profound learning system (resnet50,2018). Resnet is a prepared profound learning system which canarrange 1000 articles. The system is re-prepared with preparing dataset. This identifier is fit for creating betterresults with less number of preparing pictures.[2]

Julien Nyambal displayed a paper for a real time stopping space characterization dependent on Convolutional Neural Systems (CNN) utilizing Caffe and NvidiaDiGIT Ssystem. The paper shows the accompanying procedures for the issue:

Image Acquisition: The pictures are taken from a video ofa parking area put away on a nearby workstation. Utilizing OpenCVlibraries, the video is perused and creates casings to performthe forecasts.

Definition of Parking Spots and storage: The first edge ofthe recording (or a casing that contains generally involvedparking spaces) is utilized to characterize what a parking space is in thatcurrent edge, when the program begins. The client characterizes thespot by tapping on two corners of the parking space (theupper corner left and the lower corner right). After that setof snaps, the parking space is characterized and grouped on thego. A JSON record is made by the framework to hold thedirections of the diverse parking spaces characterized by theclient.

Prediction and classification:First,the json organizedpictures are edited to get just parking spotimages.Then, after the training stage. The framework takes as contentions the model made at the preparation stage, theorganize design and the edited picture of thestopping (one at the time). Those contentions are preparedthrough an acquired capacity composed by Nvidia, classify,which is a piece of DiGITS.

This handling permits to outwardly decide if a spotis either empty (green square shape) or involved (redsquare shape), in light of the score or certainty level (consequence ofthe likelihood model registered) delivered by theorder technique. Those outcomes are then gushed to theprimary framework to create the necessary yield [3].

Marzia Alam proposed a paper where system functions as seeks after:Driver will put is vehicle before garage door and there will be a screen open where quantity of available halting spaces will be appeared. The customer should give his wireless number and vehicle's selection number and manager will offer heading to open the door, a vehicle leaving plate will come and will leave the vehicle in the parking space. The customer will get a SMS which will contain a code. After the vehicle is left a period counter will count proportion of money to be deducted till vehicle is halted out. While halting out the driver should give the code to the overseer at leave entryway. The customer will get a SMS communicating the aggregate to be paid. In the wake of paying the entirety the vehicle forgetting about plate will stop, vehicle using a comparative method ,was halted out. Automated Car Parking System as proposed in this paper, is made up with 3 noteworthy portions: Arduino Uno R3, GSM Module and RF Module. Focal point of this system is the microcontroller in Arduino R3. Coding of this system has been done using Arduino

IDE programming language. LCD will show the amount of available openings and price.It will have a RF(radio repeat) Beneficiary Module to get invigorates about halting space. Right when a vehicle comes, manager will send direction through arduino to open the door using RF Transmitter Module. A DC motor urges the door to open up when it gets signal from arduino, arduino will simply get the sign to DC motor using RF Receiver Module. Manager will send a SMS containing a code to the customer's phone using arduino& GSM Module. The stopwatch will be started as in a little while as the entryway opened. This code will be saved in the system against an opening which will be sent to the vehicle leaving plate using RF Transmitter Module. The vehicle leaving plate will in like manner be called by using RF Receiver Module &arduino. The vehicle leaving plate will leave the vehicle and will end up leaving the accompanying vehicle. The wheels of the vehicle leaving plate will be compelled by arduino with objective that it lands at the particular space. For halting out the customer should give the offered code to overseer at the leave entryway. The customer will get a SMS communicating entirety to pay for halting again by usingarduino& GSM Module. After customer makes portion, the chairman will offer heading to stop out the vehicle. The director will invigorate the space information to the LCD appear at the path using RF Transmitter Module. The vehicle will be halted out a comparative way it was halted in. Regardless, one noteworthy piece of elbowroom of the structure is with cost.The RF module is truly exorbitant and is difficult to actualize.[4]

Aniket Gupta, Sujata Kulkarni, Vaibhavi Jathar, VedSharma, Naman proposed an IOT based Smart stoppingsystem,that empowers vehicle inhabitance, observing andoverseeing of accessible parking spot progressively andincludes the utilization of Ultrasonic sensor, Arduino Uno,ESP8266-01 Wi-Fi Module, Cloud server. The creator putsforward the accompanying engineering, chiefly comprising of:
 End –Node:
Beginning from the front end, the end-hub is the main hub ofany IoT framework, without this hub the 'T' some portion of IoT for exampleThings isn't accomplished. These end hubs are now and again moreovercalled as articles and ordinarily they fill in as detectinghubs. Proposed framework has utilized Ultrasound Sensors as endhub.
Handling Node:
Handling hub is the focal significant square. It is utilized togive a computerized reasoning to the entire hardware. Itforms the information and data got from end-hubsfurthermore, moves it to further connection for next activity which in thiscase is a cloud stage. In

this framework Arduino Uno hasbeen utilized as the handling hub.Here is the manner by which the paper portrays the progression of the framework:The end hub of the system,is chose to be ultrasonicsensors,that sense whether a parking area is accessible ornot.This sensor sends the information as (0 – engaged, 1-accessible) , to the arduino processor. In the wake of preparing theinformation references to a specific stopping space area, it is sentto the Cloud server by means of an Ethernet Shield.Data on the cloudserver is synchronized at regular intervals for stopping opening at a sensor separation of 50cm.This information from the cloud can at that pointbe gotten to by end clients through a web application or portable application. [5]

Apeksha P. Bari1, Manali A. Parab, Amey U.Kokate,NidaParkar proposed a versatile applicationwhich is likewise given that enables an end client to check the availability of parking spot and book a stopping space.Issues identified with stopping and traffic clog can be solved if the drivers can be informedin advance about the profitcapacity of parking spots before coming to their expected destination.The essential on-screen characters that establish the stopping system are: Parking Sensors: For our stopping framework we have man-made utilization of sensors like Infrared, Passive Infrared(PIR) and Ultrasonic Sensors.The complete procedure ofbooking a stoppingopening, leaving a vehicle in that space and leaving the leaving region isclarified with the assistance of Flow Diagram. The checking the accessibility ofparking space to really stop a car in an empty parking slotby actualizing the brilliant stoppingframework inparking area.The above technique of booking a slot and leaving a vehicle in that space is clarified with the assistance ofpaper given.Shrewd stopping frameworks offers ascend to new arrangements with thehelp of Internet of things . The framework have consistently been atthe center of building shrewd urban communities. In this paper, weaddress the issue of stopping. It introduces an IoT based Cloudincorporated shrewd stopping framework. The framework gives genuinetime data with respect to accessibility of stopping spaces in aspecific stopping region. With the assistance of this portableapplication client can book a stopping space for them fromremote area. The endeavors made in this paper are indentedto improve the stopping offices of a city and in this manner pointingto improve the quality This planned programmed keenstopping framework which is straightforward, financial and gives powerful answer for lessen carbon impressions in theclimate. It is all around coordinated to access and guide status of stopping spaces from remote area throughinternet browser. In this way it decreases emergency of vehicle leaving overa remote city and furthermore it takes out

superfluous going ofvehicles over the filled leaving spaces in a city,thisdecreases time.[6]

J Cynthia,CBharathiPriya,C A Gopinathproposed a paper,which helps  to lessen time to locate the stopping territories, consequently to it lessens fuel consumptin.Sensors would be conveyed in the stopping zone and through the versatile application, client books or the stopping space and permits online installment choice also.Customary stopping the board frameworks use sensors andother correspondence module, yet doesn't address arrangementfor both open and shut parking spot.Strike Based Smart Car Parking System Android based application the acquire data about accessible void stopping slot.India's capital New Delhi from 2015 beginning intending to collect every single significant datum about parking garage and stopping territories multilease infra-structure of stopping place possession.Design of Online reserving for stopping space For each standardlord district, InfraRed sensors are sent and IR sensorswould distinguish the quantity of stopping spaces, Number of free and booked spaces are graphically shown in LCD screen, WIFI module is utilized for correspondence between portable application.Order stopping space Navigating to stopping Slot Visualization in Server for Owner to Analyze To empower a client to utilize thebrilliant stopping framework, client need to enlist with client ID.Page is made utilizing PHP and stopping datainput, Parking ID,Vehicle number, leaving period, charge sum, and graphicalportrayal of the stopping.Mobile application enables the client to find and save a parking space in on the web, route from passage entryway to accessible parking opening is likewise the proposed framework lessens the driver's exertion and time to look through parking spot. [7]
.

NazishFatima,PratikshaJagtap,AkshayaNatkar,Snehal Choudhary presented a paper,which demonstrateswith ancient rarities that the model dependent on savvy stopping framework utilizing IoT finds an answer for the traffic blockage andease best approach to get a parking slot.According to the most recent report made by The International Parking Institute , we found that numerous imaginative parking thoughts have been developed. Introduction of finding a parking opening to leave their vehicle has wound up being adisillusioning issue to the drivers constantly. Keen Parking System utilizing RFID :
 Smart Parking System utilizing optic Wireless SensorSystem : This framework utilizes RFID to coordinate the vehicle's unique RFIDtag with the incentive in the database when it is understood by the RFID peruser in the parking garage entrance.When his vehicle arrives at the parking area, his vehicle's insensible plate is checkedwith the number plate

entered while booking a stopping opening.When the vehicle is effectively left in the space leaving time starts.Smart Parking System utilizing IR sensors : This geniuspresented framework utilizes criticism instrument to discover the availability of stopping spaces.Availability ofthe space could be discovered simplyafter  vehicle enters the parking part, so if parking spot isn't accessible it needs to turn away fromthere and it may causetraffic blockage. Once the vehicle is left and afterward taken off from the parking space, stoppingcharges are deducted from your E-wallet.The primary significance is that they can hold their stopping spaces before entering the parking space [8].

Basavaraju presented a paper wherein following was stated.Generally people are standing up to issues on halting vehicles in halting openings in a city.More frequently than not people put their precise vitality in looking through parking structures to leave their vehicles.The most traffic happens essentially in light of vehicle obstruct in  urban districts along these lines individuals are lounging around in glancing through halting area anomalous accomplice to leave their vehicles.The leaving system is organized in such a manner, that it is proper for verified parks, open stops additionally, street side halting. Cloud master association which gives appropriated capacity to store information about status of halting spaces in a halting zone and so on presents the structure of splendid halting system and it contains some control centers around each halting spaces which will be used Navigation structure: banner openness of parking spots to as reference point for the camera. The central server displays  customers and investigates to unequivocal region of closest halting information about various openings in a single standard master an area and zone from current area. The director is fit for making new halting regions by giving  depiction or information about the halting zone and moreover figures out how to remember number of stopping spaces for a specific halting territory and a lot further clear the present halting openings in a stopping zone. Making Car Park Steps related with setting the Parking System: Appropriately mount  camera to such an extent that the picture got by it is clearly shows halting opening [9].

Debaditya Acharya,Weilin Yan and Kourosh Khoshelham Camerabased proposed frameworks that give the accurate area of  vacant parking spots which is a necessity for route ofvehicles to  empty leaving spaces. Counter based frame works can just give data on the absolute number of empty spaces instead of managing the drivers to precise area ofthe parking spots, and such frameworks can't be enforced toroad stopping straights and private stopping spaces.24300

portioned parking spot pictures were set upby characterizing inclusion of each stopping space. Ariation of exactness crosswise over various parking spots which permitsus to recognize stopping spacethat

the stopping spaces, it is apparent that the characterization accuracy for parking spots 5, 25, and 27,30 is poor, when contrasted withdifferent spaces, particularly parking spot 25 with an overall precision of just 58%.Firstly the division of stoppingspaces isn't clear for the parking spots 25 - 30.Besides, the perceivability of the vehicles in the parking spots25, 27,30 is incomplete because of impediment of the parking spots by structure wall.Fourthly, the inclusion of stopping expert 25 in the camera view is fractional and under half. Lastly, on a more intensive take a gander at the characterization aftereffects of inhabitancein the parking spot 5, it is seen that theaccuracy drop can be described to solid sun powered reflections from vehicle parked in that space.The parking spots can effectively be distinguished by coordinating a structure that can recognize the stopping. [10] E Cassin Thangam,M Mohan, J Ganesh,C V Sukhesh proposed an IOT Based Smart Parking System The proposed Smart Parking structure contains an on area arrangement of an IoT module that is used to screen and signalize state of openness of each single halting space.A compact application is in like manner given that allows an end customer to check the availability of parking space and book a halting space accordingly.An progressing audit performed by the International Parking Institute reflects a development in number of creative musings related to halting frameworks.At present there are certain halting systems that assurance to residents of passing on continuous information about, open standard master spaces.Problem Statement Parking the administrators impacts drivers journey time and cost for halting spaces. [11]

## 3. COMPARISION OF DIFFERENT METHODS ADOPTED FOR SMART PARKING SYSTEM

Below Table 1 gives idea about different methodologies forimplementing Smart Parking System. It also gives recommendation which can be implemented in future.

are arranged less preciselyFurthermore, shadow of the structure cast on the parking spotsdiminishes the perceivability and difference of the picture portions of

Table 1 : Comparison of some IoT and CNN techniques

| Reference no. | Technique | Mechanism | Complexity | Overhead | Accuracy |
|---|---|---|---|---|---|
| 1. | RCNN | Images of the parking space captured by a colour camera are fed to a pretrained RCNN detector with a CIFAR-10 architecture. Parking information(live images) to the users,through mobile app | High | Medium | The AUC-ROC predictions for training data was found to be 0.994. |
| 2. | RCNN | Images of parking space captured by a thermal camera and fed to FRCNN detector. Parking information through web app | High | Medium | The detection rate was around 88% for the modified RCNN network. |
| 3. | CNN | Video of the parking space(later processed as frames) is given to a CNN using Caffe and Nvidia. Classification of spots as empty and occupied (area defined in green and red colour) | High | Medium | The accuracy was 0.95 by using AlexNet and 0.92 for LeNet. |
| 4. | IoT | Radio frequency module sends data to arduino LCD display displays the slots available after getting signal from RF receiver module | Medium | High | This model saved a great deal of time and money spent on parking. |
| 5. | IoT | Ultrasound sensor sends information as empty(1) and filled (0) to arduino processor. A mobile/web app which helps users to search for a freeslot. | High | High | This model led to optimum usage of parking lots. |
| 6. | IoT | Real time images of parking slots sent by sensors to processing Parking information through web app | Medium | Medium | Recorded an accuracy rate of 81% on public dataset. |

| | | | | | |
|---|---|---|---|---|---|
| 7 | IoT | IR sensor detected information will be transferred arduino. LED display shows slot number N (empty), D (occupied). | High | High | The detection rate for this system is given as 86%. |
| 8 | IoT | Sensor data from The IR sensor used to detect the car in parking. On LED it will show the indication of booked slot. | Medium | High | This model proposes that it would reduce the search time drastically for drivers. |
| 9 | IoT | Images from pi-camera are sent to module. The output of parking slots were sent to user through web browser. | Medium | High | Detection rate of parking slot status was around 82.44% for the test data. |
| 10 | SVM classifiers | Training and testing of four binary SVM classifiers were done using parking lot data set. | Medium | Medium | Output accuracy of 99.7% with training dataset and accuracy of 96.6% with test dataset. |
| 11 | IoT | Sensor data from IR sensors is sent to the OCR to identify license plate | High | High | This system proposes that the model ensures proper management of parking slots and in a small budget. |

## IV. METHODOLOGY

Convolution Neural Network(CNN) is one of the most popular classification technologies right now. It is widely used in the domain of Image classification and is very effective. It has many hidden layers, which are responsible for the accurate output. CNN's are of the type Multilayer Perceptrons, which means it is a fully connected network.

CNN has the hierarchial pattern and hence processes complex patterns using smaller and simpler patterns, which makes it an ideal model for Image Classification.

All the existing Smart Parking technologies are mainly IoT based.The problem with IoT is that it involves a lot of hardware, which results in increased overhead and less secure system. The proposed system considers the above drawbacks of using IoT and hence CNN is being used.The model obtains real-time visuals of the parking slots and is sent to the Image Classifier which is built on CNN.To enhance the output of Image Classifier, Transfer Learning Technique would be applied.Pre-trained model used for Transfer Learning would be either of AlexNet, VGG, ResNet etc.
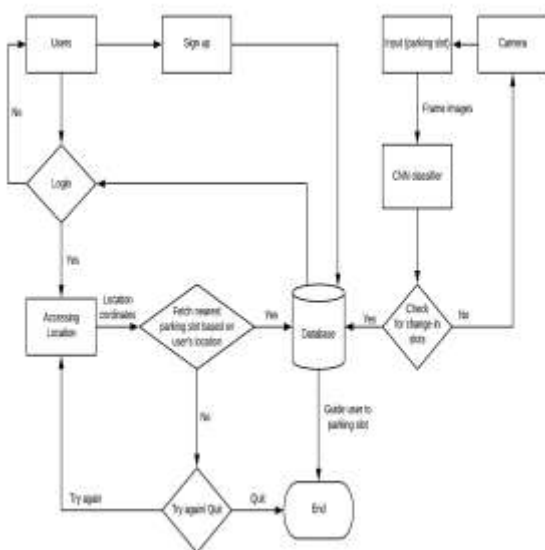


**Fig 2: System design**

## V. CONCLUSION

As finding parking space has been a cumbersome task in urban areas, people spend a lot of time and effort in searching for an empty parking slot. CNN and IoT take a step forward in resolving this issue. This paper discusses various approaches to overcome the problems of parking through a literature survey and also gives an outline of different techniques used for Smart Parking Systems and their short comings. Later, these approaches are compared based on a few parameters and has been put in table.

## REFERENCES

[1] Valipour, Mennatullah Siam, EleniStroulia, Martin JagersandSepehr, "Parking Stall Vacancy Indicator System Based on Deep Convolutional Neural Networks", UniversityofAlberta,2016.

[2] Vijay Paidi and HasanFleyeh Dalarna ,"Parking Occupancy Detection using Thermal Camera",DalarnaUniversity,School of technology and Business Studies,Borlange,Sweden.

[3] Julien Nyambal,Richard Klein, "Automated Parking Space Detection Using Convolutional Neural Networks" School of Computer Science and Applied Mathematics,Universityof the Witwatersrand Johannesburg.

[4] Ms. Marzia Alam, "Automated Car Parking System", B.S Thesis ,BRAC University, DhakaBangladesh.

[5] Aniket Gupta, SujataKulkarni, Vaibhav Jathar, Ved Sharma and Naman Jain, "Smart Car Parking management system using IoT",American Journal of Science,Engineering and Technology,vol 2,2017.

[6] Apeksha P Bari,Manali A Parab,Amey U Kokate and NidaParkar, "IOT based smart parking system",IOSRJounal of Engineering,vol 15,pp 28-31,2018.

[7] J Cynthia,CBharathiPriya,C A Gopinath, "IoT based smart parking management system", International Journal of Recent Technology and Engineering,vol 7,2018

[8] NazishFatima,PratikshaJagtap,AkshayaNatkar,Snehal Choudhary, "IoT based smart parking system for smart cities",International Journal of Advanced Research,Ideas and Innovations in Technology

[9] Mr. Basavaraju S R, "Automatic Smart Parking System using Internet of Things (IOT)", RV College of engineering,vol 5,2015

[10] DebadityaAcharya, Weilin Yan and KouroshKhoshellam , "Real-time image based parking Occupancy detection using deep learning",InfrastructureEngineering,University of Melbourne.

[11] E Cassin Thangam,M Mohan, J Ganesh,C V Sukhesh, "Internet of Things(IoT) based Smart parking reservation system using Raspberry-pi", International Journal of Applied Engineering Research vol 13, pp. 5759-5765