INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
*(Volume 5, Issue 2)*
Available online at: www.ijariit.com

# Developing an advanced smart parking system using IoT

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## ABSTRACT

***Internet of Things (IoT) plays an important role in connecting the surrounding things of an environment to the network and provides easy access from the remote location. It is essential that the people should be updated along with the growing technology. In the present world, there is a numerous number of vehicles owned by the people. Due to this large number of vehicles, there will be a lot of discomfort for parking of a vehicle at public places such as shopping complexes, function halls, and cinema theatres. In such places, it is very difficult to find a vacant place to park the vehicle, even though it is a paid facility along with the security guard. In this study, we design an Advanced Smart Parking System (ASPS) which identifies the vehicle and displays an empty slot on the display at the entrance gate of the parking. So that the person will know whether there is any availability or not before entering into the parking place. This system of design also provides the shortest path from the entrance gate to the assigned parking slot by showing the directions through leds. This process of implementation does not involve human interaction except the payment collection.***

***Keywords***— *Automatic license plate recognition, Smart parking system, Available parking slots*

## 1. INTRODUCTION

The present. The difficulty in searching the available parking lot leads to time and fuel wasting and causes high frustration and stress level of drivers. The car-parking area has many lanes/slots for car parking. So to park a car one has to look for all the lanes. A lot of time is wasted in searching vacant slot for parking and many times it creates jams. , this involves a lot of manual labour and investment. So, there is a need to develop an automated parking system that indicates directly the availability of vacant parking slots in any lane right at the entrance. So the person desirous to park his vehicle is well informed about the status of availability of parking slot. The proposed intelligent parking system is a counter based indoor car parking system which able to count, display, assign the nearest parking slot. Upon arrival at the parking entrance, the system assigns the nearest parking slot and display the way to an assigned parking slot. Dijkstra's algorithm is applied to calculate each of the lots distance to the specific mall entrance as the destination. The directions for the assigned slot are given through the LED boards. Once the system passes the node, the LED automatically turn off. This result in no traffic jams in the path. The system would not only save time but the software and hardware would also manage the Check-in and check-outs of the cars under the control of Automatic License plate Recognition with additional features of Entry-exit data logging. In this system, the users are guided to the vacant slot for parking using LED Displays placed along the path of the parking slot, these displays show a visual representation of directions to reach the parking slot. The parking charges are automatically generated based on the time spent inside the parking area.

## 2. RELATED WORK AND PROPOSED SYSTEM

The system is based on first come first serve basis. Each driver will be given an amount of time to park the car which depends on the lot's distance. The lot will be locked for a certain of time and will be available for the next driver if the time allocated has ended or if no car is parked as the sensor in that particular lot will always detect whether it is occupied or empty. In order to keep updating the parking status, this system will rescan after a certain period of time, thus the monitoring system will always synchronize in real time for the parking lot. This parking system will bring multiple benefits to the driver and car park management. The proposed car parking system has the specification below:

- The system that counts and displays the number of all vacant slots.
- The system that assigns the nearest vacant lot to the mall entrance and shows the directions to the assigned slot.

 

- The system that locks the assigned slot for a certain time period and depending on the distance and locates the vacant slots.
- The system that shows the directions for the assigned parking slot through the LED boards by the used of various sensors.
- The system that stores the number of plates of a vehicle along with the entry time and exit time.
- The system that calculates the time duration and finds the amount to pay.

**Automatic number-plate recognition** (**ANPR**; see also other names below) is a technology that uses optical character recognition on images to read vehicle registration plates to create vehicle location data. Optical Character Recognition (also optical character reader, OCR) is the mechanical l or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image (for example from a television broadcast).

ALPR systems function to automatically capture an image of the vehicle's license plate, transform that image into alphanumeric characters using optical character recognition or similar software, compare the plate number acquired to one or more databases of vehicles. There are two types of ALPR: stationary, which uses infrared (IR) cameras at high fixed points, and mobile, which uses vehicle-mounted IR cameras.

Stationary cameras can be mounted on signs, street lights, highway overpasses or buildings as a cost-effective way to monitor moving and parked vehicles twenty-four hours a day. The camera software is able to identify the pixel patterns that make up a license plate and translate the letters and numbers on the plate to a digital format. The plate data is then sent to a database where it is compared in real-time to a list of plate numbers that belong to "vehicles of interest". If the system detects a match, it sends an alert to the dispatcher or other designated personnel.

Automated License Plate Recognition has many uses including:

- Recovering stolen cars.
- Identifying drivers with an open warrant for arrest.
- Catching speeders by comparing the average time it takes to get from stationary camera A to stationary camera B.
- Determining what cars do and do not belong in a parking garage.
- Expediting parking by eliminating the need for human confirmation of parking passes.

## 3. METHODOLOGY

India has many Metro cities which are highly populated and has high urban life. In this type of cities, the people face many problems with the automobiles in which parking of a vehicle at the public places. Car parking at the shopping malls and the cinema theatres is the major task for the people to find the vacant slot in the parking place. Our design provides an efficient way of finding a vacant slot and reduce the human effort in finding the vacant slot. Our proposed system of car parking system will overcome the challenges and difficulties faced in the current parking management. And it happens on a very large scale that is difficult for us to comprehend. This system reduces the time and effort in finding the empty slot, and also it reduces the wastage of fuel. This system can be helpful in reducing the difficulties in the conventional car parking system.

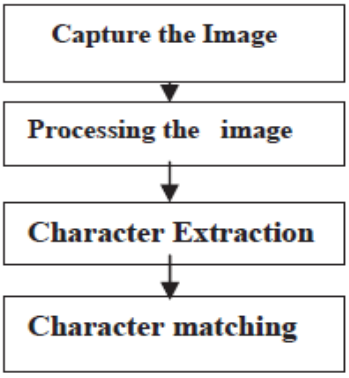


**Fig. 1: Methodology**

**(a) Capturing of Images:** In this process, a high-resolution analogue/digital camera is used to capture the image

**(b) Processing the Image:** In this process firstly grayscale conversion is used to convert the image from RGB to grayscale. After that image will be resized by the resize function. The median filter is used to remove the salt and pepper noise.

**(c) Character Extraction:** After median filtering process we used smearing process to find out the text area from the plate and get the erode image and then we applied morphological process to remove the unwanted edges of the plate as shown in Figure. It also includes the dilution process. Dilution means to fill the gap/to separate the character from the image and after that, each character is cut separately from done by finding starting and end points of the characters in the horizontal and vertical direction. Characters cut from plate areas.

**(d) Character Matching:** Before the Character Matching Normalization process is occurring in order to normalize the character means not to include any other white or extra spaces in all the four sides of the character. Then each character is to fit equal size.

**Code to store the graph:**

```
from collections import defaultdict
import pickle
class Graph:
def __init__(self):
self.graph = defaultdict(list)
 def add_edges(self, i, j):
  self.graph[i] = j
if __name__ == '__main__':
 n = int(input("Enter the number of vertices: ").strip())
 g = Graph()
 for i in range(n):
  edges = list(map(int, input("Enter the edges from vertex {}: ".format(i)).strip().split()))
  g.add_edges(i, edges)
file_name = input("Enter the filename: ").strip()
 with open(file_name + '.p', 'wb') as fp: pickle.dump(g.graph,fp,protocol=pickle.HIGHEST_PROTOCOL)
```

**Code to find the paths:**

```
from collections import defaultdict
import pickle
class Graph:
 def __init__(self):
  self.graph = defaultdict(list)
  self.paths = defaultdict(list)
 def print_all_paths_util(self, u, d, visited, path):
```

 

```
 visited[u] = True
  path.append(u)
  if u == d:
   self.paths[d].append(path.copy())
  else:
   for i in self.graph[u]:
    if not visited[i]:
     self.print_all_paths_util(i, d, visited, path)
  path.pop()
  visited[u] = False
 def find_all_paths(self, s, dest):
 for d in dest:
   visited = [False] * len(self.graph)
   self.print_all_paths_util(s, d, visited, [])
if __name__ == '__main__':
 file_name = input("Enter the filename: ").strip()
 g = Graph()
 with open(file_name + '.p', 'rb') as fp:
  g.graph = pickle.load(fp)
dests = list(map(int, input("Enter the indices of parking slots: ").strip().split()))
 src = int(input("Enter the vertex of entry: ").strip())
 g.find_all_paths(src, dests)
 for slot in g.paths:
  print(slot)
  g.paths[slot] = sorted(g.paths[slot], key=lambda x: len(x))
  print(*g.paths[slot], sep="\n")
 paths_file_name = input("Enter the filename to store paths: ").strip()
 with open(paths_file_name + '.p', 'wb') as fp:
  pickle.dump(g.paths, fp,
protocol=pickle.HIGHEST_PROTOCOL)
```

## 4. SYSTEM ARCHITECTURE

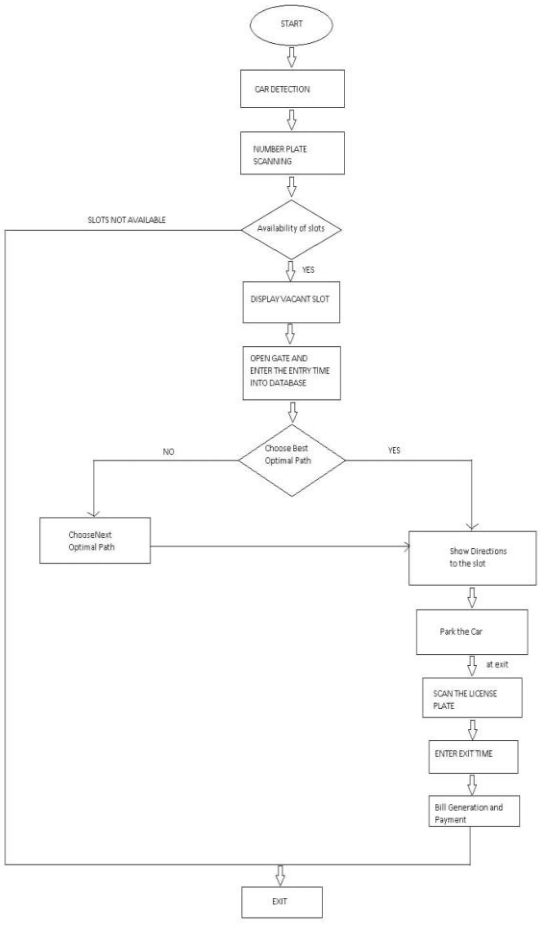


**Fig. 2: System architecturte**

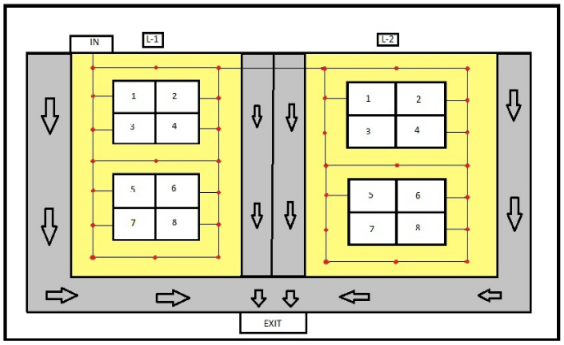


**Fig. 3: Parking system model**

## 5. CONCLUSION

Finally, at the end of the design, it is concluded that the fundamentals and the objectives of this project are achieved. The difficulty in finding an available parking slot has been completely reduced. This final design is utilised everywhere due to its accessibility and ease of usage. It also provides an effective way of finding an empty parking slot. It reduces the problems occurred in the parking management. The IOT integrates the hardware and software of the system to the network that provides access from the remote location. This type of integration allows the admin to monitor the available and unavailable parking slots that make an effective way and economic benefit.

## 6. FUTURE WORK

The development of advanced smart parking has many applications in the future. It has a wide area of applications in advanced parking management. This design can be applied to another type of transport such as ships and aeroplanes. Due to an increase in the growth of the Internet of Things, our design concepts can be interfaced with the network systems. This design can be used not only for the commercial purpose but also it can be used for residential and domestic purpose. For a residential parking system, our system can be interfaced with the home automation system which controls the various activities done in house. This system identifies whether there is a presence of a man i.e., the arriving and departing from the parking place. For example, if the user has arrived at the parking place, the system will automatically sense the information and sends the same to the home automation system which can control the next forwarding steps such as ventilation and air-conditioning and also turn on Wi-Fi-routers etc. If the person departs the parking place, the system will automatically close the gate and automatically locks the gate.

For the commercial purpose of parking system, the system can be interfaced with a network which can sense the arrival time of an employee and turn on his personal computer and ventilation, air-conditioning and turn on the Wi-Fi routers. Similarly when the employee departs the place, then it automatically switches off the computers and turns off the lights and shut down all the activities in the system. The system can also be used as an accurate attendance system that observes the arrival time and departing time of an employee.

Thus the proposed system can reduce the use of resources like electricity, the manpower and usage of data management. Thus it makes a flawless system.

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