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Smart parking for smart cities: a novel approach to reducing frivolous parking zone determination

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ABSTRACT

Internet of things (IoT) infrastructures are rapidly expanding, which will lead to an unanticipated rise in demand for smart cities. The concept of a "smart city" has recently gained traction in urban planning circles. An IoT-based smart parking system is the focus of this article, and it allows a motorist to locate a car park and an available parking space in an indoor metropolis, all from the comfort of their own vehicle. Additional efforts are made to reduce the time spent defining parking zones. Reduced fuel use helps to cut down on pollution, as well as avoid needless travel through congested parking lots, which can help to reduce unlawful parking and alleviate traffic congestion in the city we all live in. These innovations include automobile particular identification via radio frequency identification (RFID) tags, unoccupied slot detection through the use of ultrasonic sensors, and cost calculating based largely on parking duration. The technology we've used is unique in that it runs on separate parts of the system for the hardware and the software.

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1. INTRODUCTION

In the previous two years, the concept of smart capitals has grown fast. Nonetheless, one of the obvious issues that residents in smart cities encounter is a shortage of car parking facilities as well as traffic management [1]. In recent years, research has cast-off car-to-car as well as car-to-infrastructure interaction using a range of Wi-Fi web technologies such as radio frequency identification (RFID), Zigbee, Wi-Fi mesh net, and the internet. This work aimed to provide data for practically nearby car park places as well as to indicate a booking in advance utilizing adopted devices such as mobile phones or tablet computers. Similarly, while booking a parking space, the facilities utilize the identity of each automobile. The cutting-edge smart parking system, on the other hand, no longer provides a standard best response in identifying a convenient parking spot, does not fix the pain of load balancing, does not offer financial advantage, and does not sketch for vehicle-refusal provision [2].

To address the aforementioned challenges and capitalize on the significant increase in ICT infrastructures, internet of things (IoT) knowledge has erupted in a variety of age-related sectors, including automatic car parking system (ACPS) technology. The current study suggests and develops a high-quality cloud-focused smart car parking system (SCPS) based mostly on IoT technology [3]. Every car blockage is created as an IoT network by our system, and the data, which includes the vehicle's GPS position, the separation between vehicle parking zones, and the number of permissible spaces in-vehicle parking zones, is

sent to the cloud data edge. We employed a geolocation service to determine the cost of a parking request based on distance and time, and this price is often up to date and accessible at all times via the autos in the configuration [4]. The system is built on a number of ground-breaking innovations and is capable of displaying and controlling vehicle zones via screen design. A typical automotive zone may be defined in the system by labeling any green as such [5].

This research also includes a system model with Wi-Fi entry in an absolute somatic calculating policy focused on Raspberry Pi4 and consuming a smartphone that provides communication and the user interface for each device and the vehicles to validate the possibility of the proposed system. There are various advantages to using automated parking with a booking policy for both the parking user and the parking management (i.e. owners). Operators may reserve their parking places ahead of time using our iphone operating system (iOS) application, which was built for this purpose. In contrast to the conventional parking direction and info (PDI) approach, a parking reservation system offers significant advantages [6].

Availability of parking spaces is constantly displayed in the iOS app. Parking vendors benefit from the most efficient use of infrastructure as a result. A revolutionary smart parking booking structure design based on the misuse of interval setting up codes is recommended in this study. The scheduler (park regulating design) agrees whether it is able to accept a project and deliver it to particular ways or dispose of it after a list of parking requests has been agreed upon as a collection of desired time spans (expressed as beginning and ending times).

2. METHOD

Above the many years, our republic has been technologically advanced radically; today we are in this republic that we have a lot of well-furnished highways, industrial buildings, and a growing quantity of vehicles [7]. When parking these vehicles in parking areas we practice the guided system of parking (Figure 1). Utmost of the instances are unforeseen and absence restraint due to this, humans able to park their vehicles somewhere they prefer to, which forms a disorder, as humans fix no longer observe the precise nod peak of the spell. Because of this, massive traffic congestion in that location. While parking in and rescuing automobiles due to malpractice automobiles can catch depression via jerking with every difference as there is a short of enough space. This clues to advice, competitions amongst individuals that sometimes creates massive traffic jams. This is additionally financial damage, as we need to restore our broken automobile besides additionally; automobiles devour more fuel whilst parking now and then. Traffic congestion is a difficulty at this time as it destroys our valuable spell. Due to this anarchy in parking, our precious spell is lost. It troubles the undergraduates, workers, and accidental patients to a notable level [8].

Figure 1. Present car parking system

It additionally reasons financial harm to industrial areas like malls, amusement grids, as humans stay extra probably not to go to these locations due to this parking threat [9]. As we are proceeding with time, the guided automobile parking scheme in industrial areas is growing a difficulty that is initiating consumption of time and some financial damages as well. Hence, we want an answer that is able to overwhelm these difficulties. At this point, we are presenting novel smart parking system (Figure 2) as an answer to these difficulties as properly as an alternative to the guide auto parking structures in industrial areas [10]. The method not only keeps time and currency, but also it can also additionally get cash by using costing for parking places.

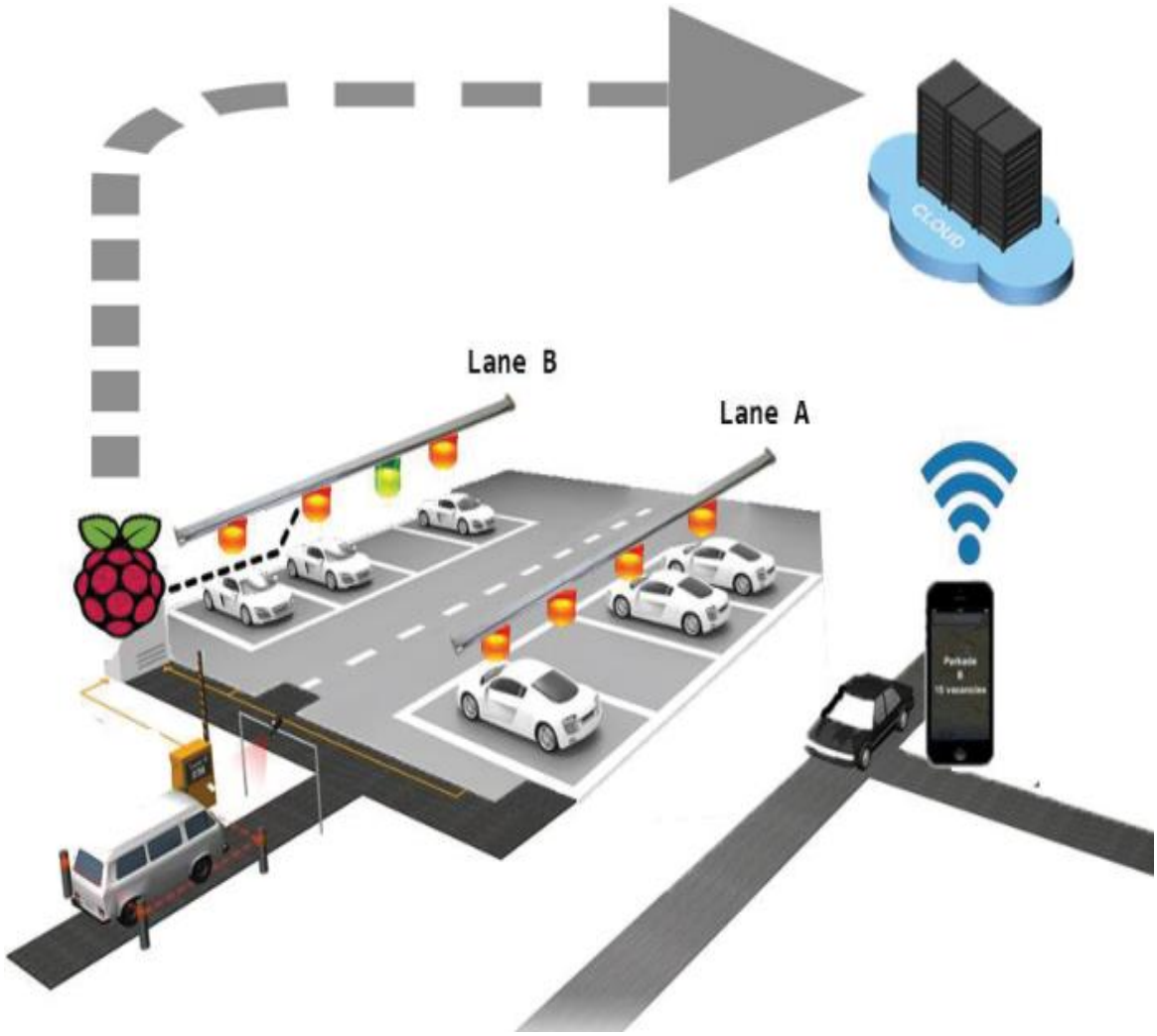

Figure 2. Novel smart parking system

The ordinary or guided car parking method is in all places in our republic however, this method is full of difficulties [11]–[14]. The difficulties are as follows:

- We can realize that in lots of malls, clinics large road traffic jams before the parking. The, parking shield breaks the whole car then offers a charge slice, this forms a traffic bottleneck.
- It is hard as well as time ingesting to discover the parking place, which charges greater gasoline, and loss time.
- Safety hassle is unique to some other trouble in guided automobile parking, humans can come into a parking spot as well as their grabbing, and theft can take place.
- In the guided parking method, some shield wants to be employed for the entire business, it is expensive too.

In this paper, an iOS based smart parking system algorithm below are proposed.

```
Inputs: Distance, Time, Parking Spot, Operational Code,
Outputs: Upon satisfying the condition, entry to a parking spot.
1.  System Starts {
2.  ArrayList<LatLng> smart_car_parking_loc;
3.  smart_car_parking_loc = new ArrayList();
4.  smart_car_parking_loc_n = new ArrayList();
5.  smart_car_parking_loc.add (new LatLng(lat, long));
6.  smart_car_parking_loc_n.add (new LatLng (......, ……));
7.  ShowUserCurrentLocation () {
    a. googleMap.SetLocationEnabled = 1;
    b. LocationManager loc = (LocationManager) getSystemService (Loc_Service);
    c. String Service_Provider = LocationManager.GetBestProvider (services, 1);
    d. Location loc=LocationManager.GetLastKnownLocation(Service_Provider);
    e. if (loc != null)
       i.  long double lat = loc.getLatitude();
       ii. long double long = loc.getLongitude();
       iii. MarkerOptions opt=new MarkerOptions ().setTitle( "My Present
            Position").setMarker(lat,long)
       iv. googleMap.addMarker (opt);
       v.  return lat, long;
    f. end if
    g. Void ButtonPress ()
          ShowUserCurrentLocation (lat, long);
8.  SearchForSmartCarParkingLot (){
9.  If (D = = minimumOfD (smart_car_parking_loc1, smart_car_parking_loc_n)) {ArrayList
    smart_car_parking_loc = SetLocation (lat, long)
10. if ( P != 0){
    Print "adjacent smart parking found"
11. end if
12. else {
    Print "Effective parking spots not found. Examining for a second-best location"
13. Repeat;
14. end else
15. void AdvancedBookParking(){
    a. if (P != 0){
    b. show_Route (lat, long){
       Print "Parking reserved for fifteen minutes"
    c. T- -;
    d. P--;
    e. D = UserCurrentLocation (lat, long) – Smart_Car_Parking_Loc (lat, long);
    f. end if
16. D- -;
17. POPUP Msg: This is your 4-digit code "yyyy", satisfy the drive to your terminus before
    time goes off;
18. if (D != zero && T == zero){
     cancel_Route ();
19. While (D = = 0){
    Print"please press your 4-digit code"
    a. if (app code == h/w generated code) {
    b. Gate.Open ();
    c. end if
    d. else{
    e. Gate.Access_Denied ();
    f. end else
20. end while
21. Remove_Keycode (code){
     code = null;
22. Exit
```

3. RESULTS AND DISCUSSION

3.1. The equation for data examination

In this examination, we have thought about the analysis of gasoline redeemable, time securing, and greenhouse gas (GHG) outflow decrease. This examination has been finished thinking about the data from our proposed model.

3.1.1. Gasoline redeemable

The gasoline redeemable each day for a computerized vehicle parking system determined utilizing the accompanying condition:

$$FR = PQDTrs \quad (1)$$

where,
FR = fuel rate;
P = Complete number of a vehicle parked and rescued in one day;
Q = Quickness of vehicle parking plate;
DT = Regular distance covered;
r = Gasoline utilized per unit detachment;
s = Regular time to park and rescue a car (in seconds).

Putting every value in (1), we can calculate the fuel cost for our designed prototype.

3.1.2. Time securing

Time devoured into a park and recover a vehicle is determine by the following (2) and (3):

$$QS = QM - Q \quad (2)$$

$$Q = (DE * r) + (DL * r) + rl \quad (3)$$

where,
QS = Time kept by automated smart car parking method;
Q = time paid for automated smart car parking method;
QM = Time paid for guided car parking;
DE = Detachment of slot from the entry;
DL = Detachment of slot from leaving;
r = time to move per unit detachment;
rl = Regular time passed at leaving door.

By collecting every value and putting it (1) and (2) we can easily calculate the timesaving value for our proposed prototype.

3.1.3. GHG radiation

The saving of GHG radiation rate is determine by the succeeding mathematics:

$$GRQ = TQ * TR \quad (3)$$

where,
GRQ = Low radiation of GHG;
TQ = Time secured;
TR = Degree of GHG radiation per unit time.

By collecting every value and putting it into (1), we can easily calculate the GHG radiation value for our proposed prototype.

3.2. Data examination

Having the mathematics' it is not difficult to compute savings and gas redeemable. Here just the model has been thought of it is an estimated figuring. Table 1 summarize all the data, which was found considering our proposed prototype results.

Table 1. Data analysis of our simulation results

Element	Existing parking method	Smart parking method
Rate per square feet (taka)	1500	1800
Place required per slot (in feet)	16/9	16/9
Repairs cost per month (tk)	90000	30000
Worker required at the car parks	9	3
Gasoline paid-out per 60 minutes per 100 km (in ltr)	3	2
Regular distance covered by a vehicle to park in or park out (in kilometer)	49.08	44.12
Gasoline redeemable per vehicle to park in or park out (in ltr)	0.277	0.027
Total gasoline redeemable per day		
Regular time required to park in or park out a vehicle (in min)	9	1.2
Regular time to delay in a line (in min)	2.4	4.8
Time secured (in min)	1	4
Over-all GHG radiation per km (in ppm)	140	55
Over-all GHG radiation per 60 minutes (in ppm)	50	30

Now from the tabular value, it is plainly shows that our system will be progressively more effective like need less gasoline redeemable per day, less greenhouse gas radiation, and less distance travelled to find a desired spot. Then the other existing system where the existing system was manual based or some other online systems. Figure 3 graphycally shows the comparative analysis based on the tabular value of Table 1.

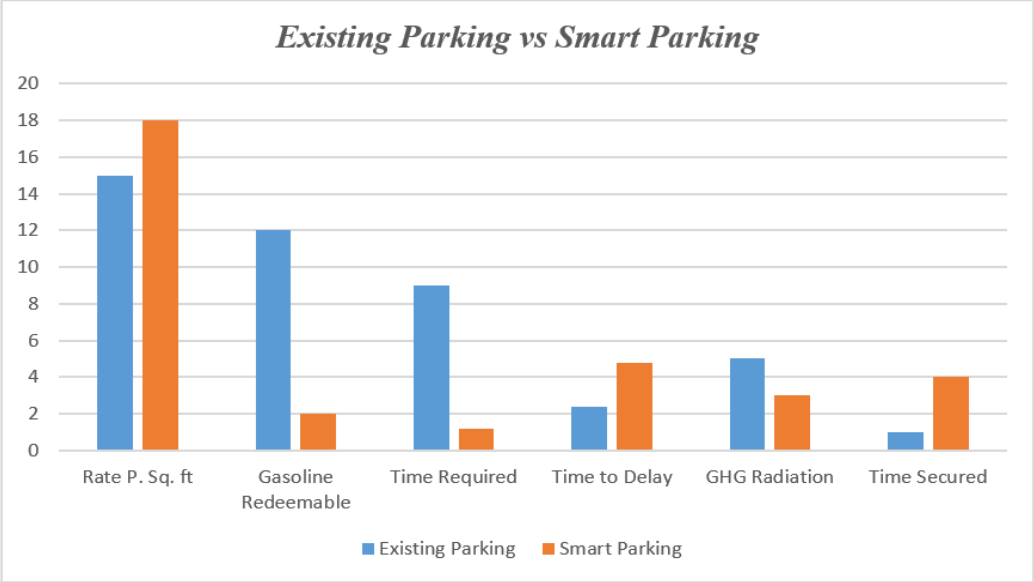

Figure 3. Performance comparison with existing system

4. CONCLUSION

The simplicity of use of smart parking methods is now a challenge. Since the beginning of technologically modern cities, the number of automobiles has grown, and people are suffering more and more as they try to deal with their cars in a parking IoT. This scenario of parking crises gives birth to creative outcomes using IoT to handle car-parking systems. This research focuses on the issue of automobile parking throughout an isolated city and proposes an IoT-based secondary cellular application system. The proposed study result gives real-time information on a smart vehicle parking lot and is compatible with the iOS mobile application, allowing users to reserve a parking space from a distance. Based on the simulation findings, we can infer that this research reduces the outcomes in all sectors, such as gasoline redeem-ability, time security, and GHG outflow reduction, when compared to other current systems.

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