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An App for Parking with Indoor Navigation Facility

Atiqur Rahman[a*] & Musabe Jean Bosco[b]

[a]*Computer Science and Engineering Department, Faculty of Engineering, University of Chittagong, Chattogram-4331, Bangladesh*

[b]*Senior Lecturer and Dean of the School of Science and Technology, Kigali Independent University, ULK in Rwanda*

[*]*Corresponding author: atiqcse09@cu.ac.bd*

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ABSTRACT

There are numerous parking supervision and random booking procedures that regulate parking operations. Travel time to the parking slot and walking time inside the terminus can still be dropped if the parker can book a precise parking spot instead of an arbitrary one. This is achieved by our proposal, called sPark which is an app-based parking method that includes indoor navigation facility i.e., an app for parking with indoor navigation facility. sPark's sharing system will rapidly book the optimal parking slots for parkers and advise them on the best feasible entrances for practice. Also, parkers will find the briefest path to their target using our proposed app's navigation technique, saving them a lot of time roaming to the building. Different parking methods like sPark (our proposed), non-directed and directed methods (existing) are designed and assessed. The designed and assessed simulation outcomes of sPark indicate an important decrease in the overall driving time by 30% to 60% as compared to the non-directed method which is an existing method. Additionally, the resource sharing module in our scheme i.e., an app for parking with indoor navigation facility called sPark has revealed a 9.99% decrease in driving time in comparison to directed methods (existing) that feature interior cruising and direction only.

Keywords: Smart driving; parking lot; sPark; radio frequency identification; MySQL database

INTRODUCTION

The parking process can become redundant due to lost payment or time and effort. Traveling for parking is clearly the primary inconvenience produced by the rise of vehicle owners in public. To resolve the parking drawback, numerous forms of PGI schemes have been advanced (Ji et al. 2014; Asakura et al. 1994; Rajabioun et al. 2015; Guan et al. 2003; Sakai et al. 1995; Yoo et al. 2008; Caicedo 2010). PGI schemes offer parkers with info about vacant parking places in a specific range via Virtual Memo Signatures (VMS) on the street or via the Net (Griffith 2000; Liu et al. 2016). Even if PGI systems offer drivers with info about available parking slots and can also provide them directions, it nevertheless does not fix parking difficulties. This is due to the fact that "numerous vehicles want to use the same parking space" (Geng et al. 2013). Indeed, this situation is not limited to heavy transport, and transport jamming, gas loss, environmental destruction, and parker nuisance growth. Improvement of parking booking method (PBM) is a different concept for intelligent transportation system to provide specific booking of parking spots to parkers such that there is no parker entrance collision over the parking spot (Shoup 2016). Benefits of PBM even beyond solving transportation jamming problems, PBM systems are likely optimized to maximize the utilization of parking resources and parking profits, reduce the price role of parkers, or both. Parking guidance and info, and random booking oriented smart parking schemes (PBM) are both related to direction-based approaches. Generally, they are a massive advancement over chaotic parking, yet, they cannot provide a complete answer. To alleviate the existing problem our proposal is a highly digitized and experimentally connected indoor navigation oriented smart parking system that relies on smart navigational structural design. The smart parking indoor navigation system model is considered as the new concept for the parking revolution. The proposed system provides real-time info about a smart car's parking spot and can be compatible with iOS cellphone apps, thereby allowing operators to book a precise parking slot that is located at a far-off location. RFID schemes consist of RFID-enabled gadgets carried by parkers and RFID chips incorporated into buildings and parking lots to facilitate direction and navigation. One such demand is the sPark that may be in a large mall where it is aided by a large number of parking places divided into several narrow vehicle parks. Parkers will be able to find and select a precise slot inside a shopping mall, using the sPark app in advance or upon arrival at the mall.

In fact, the sharing system will rapidly book the optimal parking slot for parkers and advise them on the best feasible entrance to the spot. Also, parkers will find the briefest path to their target using the applications' navigation, saving them a lot of time roaming to the building. Park users will be able to navigate using the apps as well as know how to pay for their vehicles, eliminating the risk of not remembering where the vehicle is parked.

LITERATURE REVIEW

Stochastic and deterministic parking booking method mainly accepts deterministic entrances - the parker entry time to the parking spot has to be informed in advance, also there are enough parking resources to assist total inward cars incoming in one period (Mouskos 2017). In (Mouskos et al. 2010), Mouskos et al. showed this booking method like that a resource-sharing dilemma. Theirs design is dependent on MILP with the goal of reducing parker prices. The price is a sign of the parkers' mobbing length from the parking spot to the end plus the cost of lodging the parking spot. All parties state the deterministic entry and exit times. Using the entire parking spot service, short time periods are calculated. Due to this, a binary integer linear programming conundrum is created, which is resolved by software for LP. The effort suggested by Mouskos et al. (Mouskos 2017) is to examine a complete parking booking method (Mouskos 2010). Yet, Geng et al. (Geng et al. 2013, Geng et al. 2012) had prolonged their research by emerging a dynamic resource sharing MILP diagram that permits the parkers to have re-allocated constantly an improved parking resource just before they are in the proximity of their target. Further, numerous equality restrictions were added, like fixing the significance of booking parking spots for parkers on the ground of their vicinity to their targets. In (Mouskos 2017), a parker has no power on stating his or her concern in deciding the price. However, in (Geng et al 2013), a parker fixes a weight in between zero and one, a parker fixes a weight to indicate his or her desire to cut costs or roaming space. The design is then extensively simulated in order to show a significant improvement over advanced parking management schemes using a physical world use case. The universal architecture of the methods suggested in (Shoup. 1997) and (Geng et al 2012). The parking mart can be governed by utilizing costing methods. The usage of the inadequate parking size in high-need regions might be enhanced by employing a more effective dealing of the parking demand over the application of costing methods (Cats et al. 2016). Parking methods do not simply disturb the parking resource usage, it likewise precisely disturbs the overall transportation flow. For example, low-cost parking guides to a rise in transportation jamming, since it makes a financial inducement for parkers to travel for the finite available parking resources (Mouskos 2010). A mathematical examination given by Zhou (Zhou 2014), exposed that raising the on-roadway parking charges that are low-cost to an optimum line will decrease the number of hunters, also disheartening people from parking their vehicles on the road.

Costing-oriented PBM methods consider diverse parking costing strategies, e.g., in the form of compromise (Chou et al. 2018, Li et al. 2014, Longfei et al. 2019, Yang et al. 2019, Hashimoto et al. 2019), costing variation (Yang et al. 2018), or dynamic costing (Mackowski et al. 2015). Costing conciliation is generally achieved by using a smart agent scheme (DeLoach 2010), wherein agents act as deputies for the parkers, and the vehicle stops. The parties interact through conciliation by way of a dialogue, interchange bids, assess other agents' bids, and then revise their plans up to all agents reach a suitable promise (Ndumu et al. 2017). Conciliation approaches are typically formed on game theory or subjective by natural humanoid activities.

PROPOSED SYSTEM AND METHODOLOGY

Figure 1 graphically shows our proposed system. From the figure, we see that our proposed sPark: Smart Parking Indoor Navigation System has five main components like sPark apps', RFID tags, Immediate booking method with indoor/outdoor navigation, Central MySQL database, Users, and Parking lot.

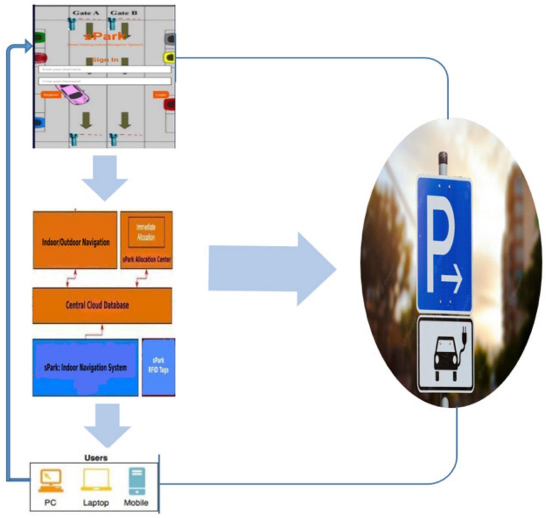

FIGURE 1. Proposed Parking System

Different segments of our proposal are discussed here one by one:

SPARK APP

This segment is used by the user and admin to properly utilize the parking lot. With the help of this developed app, a user can book a precise slot immediately and access his booked slot within the specified span of time. Navigational assistance is available to users. Using this app, the user has the ability to track their reserved slot. The proposed system would cut down on driving and interior parking lot roaming time while also increasing resource utilization and rate of service, as shown in the results section.

RFID TAGS, INSIDE/OUTSIDE NAVIGATION

Smart Parking Indoor Navigation System, or sPark, is a "smart drive and park" scheme that is based on resource sharing, radio frequency identification (RFID), and routing. The various theories of RFID schemes include devices that support RFID that are worn by park visitors and RFID chips installed in the vehicle park and buildings to assist direction and navigation. The data about inside is used by this system, along with digital diagrams of the parking lots' to assign and book the best slot for parking that is close to the terminals for users. Furthermore, RFID integrates origin-oriented inside routing for mobile devices to permit routes taken by drivers going in reverse from the parking spot to their destination. The optimum parking slots, doors for entrance and exit (for a parking spot and internal architecture) have the outcomes of every MILP and get by using Dijkstra's algorithm. An internal navigation s/w platform with an Apple app with RFID technology, our s/w for digital drawings, as well as a server program. The execution of the inside routing sub-module of sPark is this s/w platform, which is incorporated in sPark apps.

CENTRAL MYSQL DATABASE SERVER

There is a principal ethernet-linked server installed with storing and computational control. Particularly, it is for scheme parkers to demand the facilities of parking info and parking immediate booking. As soon as, parkers' booking is approved, the server will be up-to-date with the status through the Net.

USERS

With the help of developed apps, the user can access parking lot information from the MySQL database using his/her cellphone, laptop or desktop computer, and made an immediate booking in his/her desired parking lot. Parkers will be capable of utilizing the sPark app in advance or at incoming in the area of the mall to look for and pick a precise slot inner that mall. Quite the reverse, the sharing method will rapidly book the finest parking spot for the parkers and inform them of the best feasible entrances they would practice. Also, the parkers will be capable of yielding the least path to their terminus using the apps' navigation, redeeming them a considerable roaming period in the building. Utilizing the apps' navigation, the parkers will as well know how to yield to their vehicles, removing the risks of disremembering where the vehicle is parked.

SIMULATION RESULTS OF OUR PROPOSAL

SIMULATION SETUP FOR SPARK

In this segment, our proposed sPark scheme is described as smart-driving (SD) and the existing directed system as (D), non-directed as (ND1) and (ND2), respectively. D is designed as an intelligent driving scheme without the existing parking resource sharing factor in SD, i.e., a D operator will aimlessly find a blank parking spot but have indoor directional signs to drive to fully enclosed houses. Away, ND operators will frantically search for available parking spots and recklessly trace their terminuses inside enclosed houses with no support. ND designs differ from each other in terms of path planning or walking charge indoor simulation and measurement, so that for ND1, indoor parkers are intended to provide a route to their destination at an avg cost. Overall briefest route which is promising. Unlike ND2, operators are going to provide a route to their terminus that is random considering the value between the longest route and the briefest feasible route. Parking nature is identical for D, ND1 and ND2, i.e., operators will check the parking range in consecutive commands before getting an available spot. Then they would reach the house from the side entrance. In the last part of the procedure, the operators will get the adjacent exit.

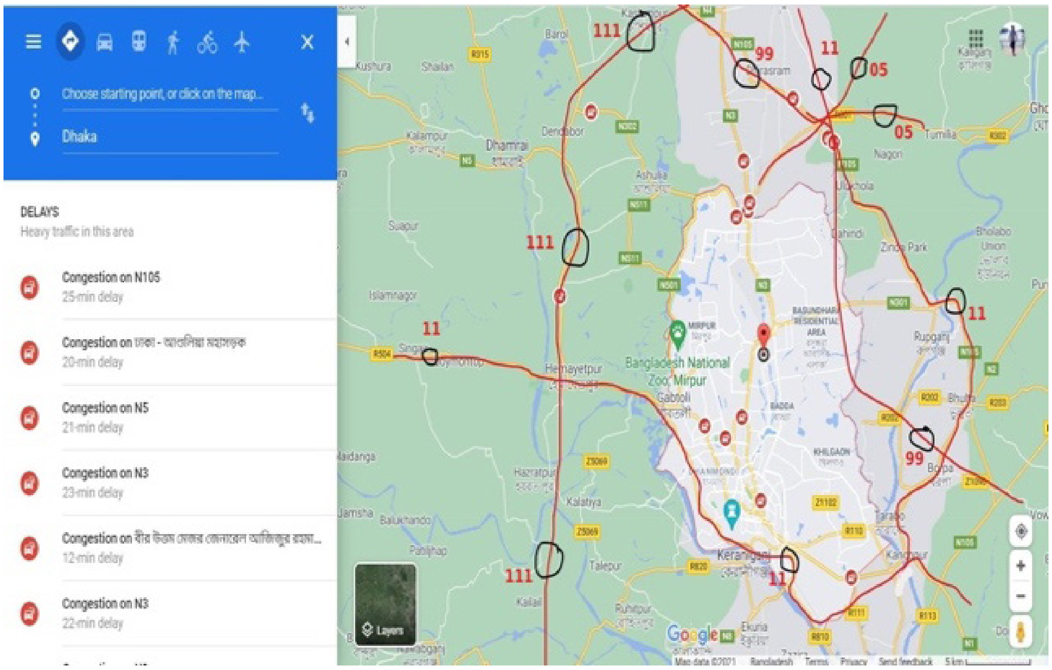

FIGURE 2. Map of Dhaka city/Simulation Case Study Environment

The same case was used throughout the simulations (here). Figure. 2) depicts the study environment in use, and the operator entrances to Poisson distributions with rate are expected to be used for the sharing method.

TABLE 1. System performance during regular and heavy traffic

	Regular Traffic				Heavy Traffic			
	SD	D	ND1	ND2	SD	D	ND1	ND2
Use	0.22	0.24	0.27	0.32	0.88	0.93	0.95	0.96
P	0.10	0.23	0.41	0.67	0.12	0.24	0.44	0.70
Entry-Spot (m)	72	74	80	88	84	393	502	540
Spot-Gate (m)	95	212	202	191	149	155	155	155
Gate-Dest. (m)	281	696	1535	2683	318	692	1535	2665
Spot-Exit (m)	95	111	111	111	83	85	84	84
Entry-Spot (min)	0.43	0.45	0.48	0.53	0.51	2.36	3.01	3.24

continue ...

... cont.

Spot-Gate (min)	1.14	2.54	2.43	2.29	1.78	1.86	1.87	1.86
Gate-Dest. (min)	3.37	8.36	18.42	32.19	3.82	8.31	18.42	31.98
Spot-Exit (min)	0.57	0.67	0.67	0.67	0.50	0.51	0.50	0.50
Commuting (m)	167	186	192	199	167	478	586	624
Walking (m)	376	908	1737	2874	467	847	1690	2820
Commuting (min)	1.00	1.12	1.15	1.19	1.00	2.87	3.51	3.74
Walking (min)	5	11	21	34	6	10	20	34
Length (m)	543	1094	1929	3072	634	1325	2276	3444
DTime(min)	6	12	22	36	7	13	24	38
Assisted (#)	4451	4451	4451	4451	17766	17282	15590	13578
Not Assisted (#)	0	0	0	0	29	513	2205	42 17
Parkers_Overall (#)	4451	4451	4451	4451	17795	17795	17795	17795
Traveling (#)	0	0	0	0	0	2614	3564	3473
Service Rate	1.00	1.00	1.00	1.00	1.00	0.97	0.88	0.76
Traveling Rate	0.00	0.00	0.00	0.00	0.00	0.15	0.20	0.20

There is a wide range of entrance scores, from small entrance score (λ=2) to big entrance score (λ=11) to evaluate the performance of sPark covering non-directed and directed schemes. Times consumed by operators in their terminus are exponentially distributed with the ratio of 31mins. The terminuses picked by parker are arbitrary and distributed equally. A persistent determination interim is assumed for effortlessness. It is assumed that T (Z) = 1200 mins, Z = 1, 2,. Aforesaid design is coded in IBM ILOG CPLEX Optimization Studio which is a shared financial MILP solver optimization s/w package. The entire logic is coded in java language and lastly, the outcomes are preserved in a MySQL database.

SIMULATION RESULTS FOR SPARK

We can prove the theorems behind our scheme by considering the results in Table 1. From parker's perspective, SD helped parker pay the smallest probable price. In both, regular and heavy transport, the price P or otherwise the entire time for travel is reduced by about 69.99%, 79.99%, and 49.99% compared to ND1, ND2, and D respectively. This result shows the benefits of both modules of the sPark scheme – interior aspect and parking booking. Only the SD's internal direction module cuts the price significantly, separating it from the ND1 and ND2 by about 49.99% and 19.99%, correspondingly. Measured based on the case that D, without telling the parking booking module that it is parallel to SD, identifies a price variation of 9.99%. Parking booking functionality not only cuts driving time to the car park lot, but also cuts the distance required to walk indoors, as the booking system reserves parking spaces adjacent to the home entrance to parkers. Also adjacent to the concluding terminus. This consequence can be observed by correlating the walk lengths of SD and D, such that SD is about 6 mins shorter than D's.

It is empirical that parkers' prices depict insignificant differences between regular and heavy transport. This is because, in all scenarios, indoor driving time actually accounts for at least 91% of the total park value, and in fact, the total of people inner a house usually has little influence on their walking. Nevertheless, in heavy road traffic, the driving times for D, ND1 and ND2 increase by 151%, 206% and 211% compared to their driving times during regular road traffic. These surges are likely because parking spots become unavailable in heavy traffic much faster than in regular traffic, so detours are much more likely. For example, the rates of roaming parkers in heavy road traffic in D, ND1 and ND2 are 14%, 19% and 19% correspondingly. However, the rate is zero percent for all schemes for regular vehicles on the road.

Driving times are now equal when SD is considered for all traffic conditions because parkers do not move around as the total driving time generally decreases which assumes that parking spots will become available relatively quickly to different parkers. D and ND methods. It is important to note that previous results did not consider parkers who were not assisted i.e., parkers who had no available space at all. Correspondingly the non-assistive parkers are 2.99%, 11.99%, and 23.99% of the complete parkers for D, ND1, and ND2. In contrast, 99.99% of parkers were assisted to SD.

In different scenarios, from the perspective of house and parking administrators, SD provides 99.99% of service rate compared to 96.99%, 87.99%, and 75.99% for D, ND1, and ND2 in heavy road traffic, correspondingly. This assumes that typically in SD, larger parkers will be continuously assisted.

It will absorb profit substantially in the case of twisting especially in shopping malls, institutions etc. The principal downside seen is the poorer parking resource utilization in SD compared to others especially less gridlock -2.0%, 5.0%, and 9.99% less than D, ND1 and ND2 correspondingly. Presumably this could happen as parkers drive down in SD. However, this will not be a drawback for the situation when parking is provided for opening and the typical example of this case is malls.

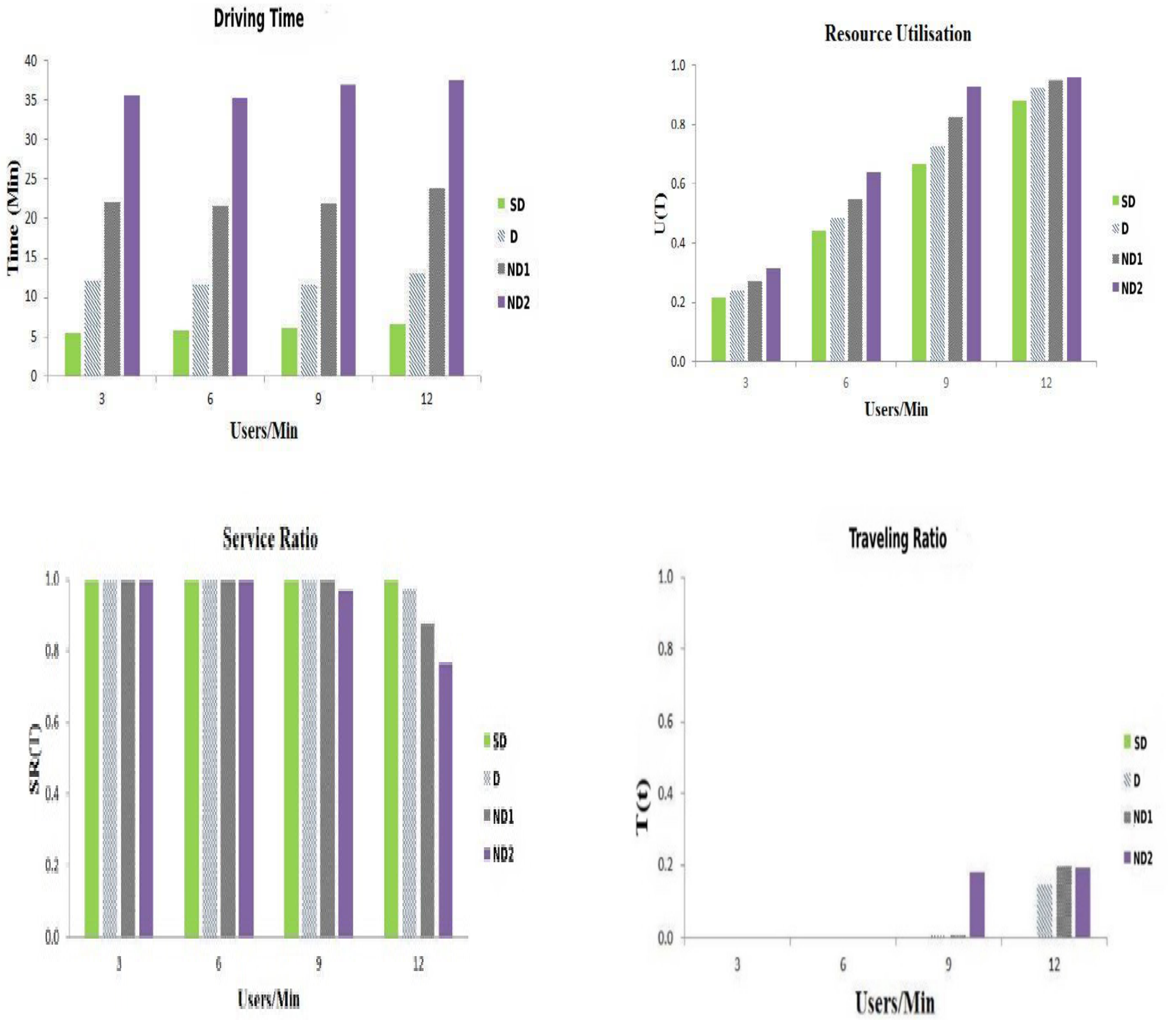

FIGURE 3. Performance metrics under dissimilar entrance ratios.

By simulating all 4 models considering diverse inlet ratios, further simulation outcomes are gotten and shown in figure 3 and figure 4 where they approve the previous analysis.

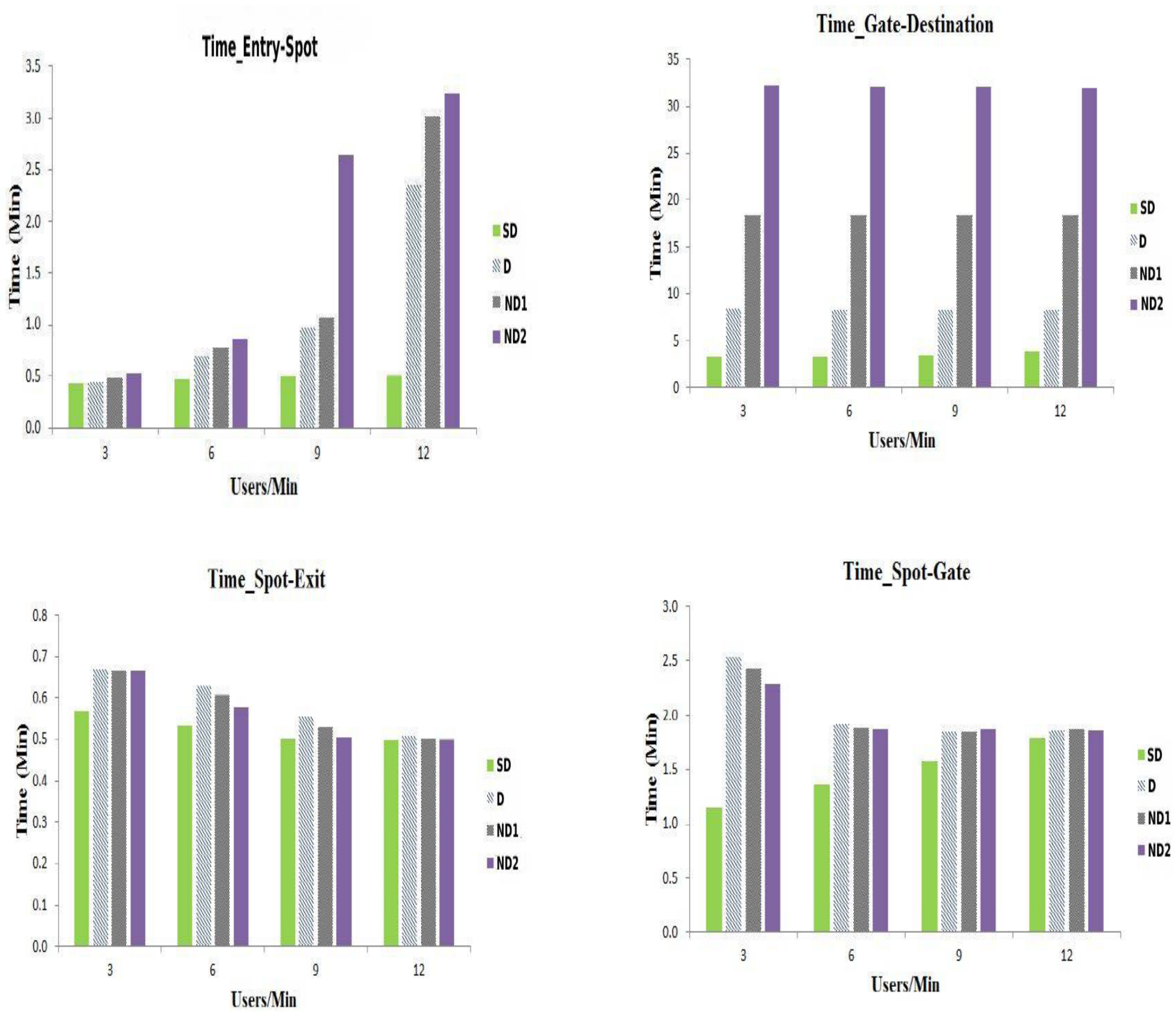

FIGURE 4. Continuous performance metrics under dissimilar entrance ratios.

CONCLUSION

In this paper, we have implemented a new smarter parking direction, navigation, checking, and booking-oriented smart parking solution' with the help of our proposed scheme sPark: an app for parking with indoor navigation facility. Our research emphasizes the emergency of vehicle parking across a remote urban area and comes out with an IoT-oriented subordinate cell apps' scheme. The proposed research result provides real-time information of a smart vehicle parking spot and can adjust with the iOS cellphone apps', consequently, giving operators the chances of reserving a precise parking slot residing at a far-off detachment and navigate to find his/her booked slot. From the simulation results, we observed that our systems' performance are best at all aspect compared to the random booking methods. Further improve the scheme by employing profits building functions, for example, ad and advertising operations through the sPark app. By incorporating the information found from the motion sensors in cellphones to the scheme, improve the locating module. Investigate and advance innovative approaches for car parks booking assurance in abandoned regions.

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DECLARATION OF COMPETING INTEREST

None

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