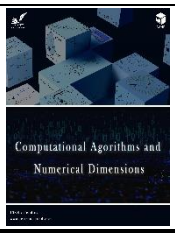
Computational Algorithms and Numerical Dimensions

www.journal-cand.com

Com. Alg. Num. Dim Vol. 1, No. 1 (2022) 46–51.



Paper Type: Original Article

A Study on Deep Learning Based Parking Lot Allotment to the Vehicles

Aziza Algarni

Department of Preparatory Year – Basic Sceinces, Umm Al-Qura University, Makkah, Saudi Arabia; algarni.a@gmail.com

Citation:

Algarni, A. (2022). A study on deep learning based parking lot allotment to the vehicles. *Computational algorithms and numerical dimensions, 1* (1), 46-51.

Received: 16/11/2021 Reviewed: 23/12/2021 Revised: 19/01/2022 Accept: 02/02/2022

Abstract

Parking a vehicle in dense traffic environments often leads to excessive driving time in search of free space, which leads to congestion and environmental pollution. Lack of guidance information about vacant parking spaces is one reason for inefficient parking behavior. Smart parking sensors and technologies facilitate the guidance of drivers to free parking spaces, thereby improving parking efficiency. Currently, no such sensors or technologies are used for the open parking lot. This study reviews the literature on the usage of smart parking sensors, technologies, and applications and evaluates their applicability to open parking lots. To develop smart parking applications for open parking lots, further research is needed in deep learning and multi-agent systems.

Keywords: Smart parking, Deep learning, Sensor network.

1 | Introduction

In order to reduce parking-related congestion and air pollution, public transportation, such as buses, metro, etc., can be utilized. However, private vehicles are still used for convenience. One way to address the carbon emission issue is to replace all fuel-consumption vehicles with electric ones. Since the average car age in Europe or the United States is approximately 11 years (U.S), it can be expected to take quite a long time before electric vehicles replace all fuel-consumption vehicles. Despite using electric cars, cruising a vehicle to find a vacant parking space would still be time-consuming, leading to congestion. A solution to that problem might be driverless cars. The driverless vehicle is one of the upcoming technologies currently being developed. Few companies like Google have developed prototype vehicles supporting driverless mode in specific conditions. With the current state of automation and proven technologies, new vehicles are providing a park assist feature, which helps park a car automatically.

Corresponding Author: algarni.a@gmail.com

https://doi.org/10.22105/cand.2022.159983

2 | Literature Review

Innovative parking tools include sensors, technologies, and applications to identify parking occupancy information and improve parking efficiency [1]. In this context, literature [2] reviews various types of smart parking sensors, technologies, and their uses while [3] identifies research gaps in designing smart parking systems for stakeholders. Furthermore, it reviews intelligent parking technologies and their economic analysis and the advantages and drawbacks of sensors and technologies [4]. Sensors like ultrasonic and magnetometers are widely studied, tested, and used in various intelligent parking applications [5]. Vehicular Ad hoc networks and fuzzy logic were not reviewed before 2013.

A detailed description of each sensor and technology can be found in this section, emphasizing expenditure [6].

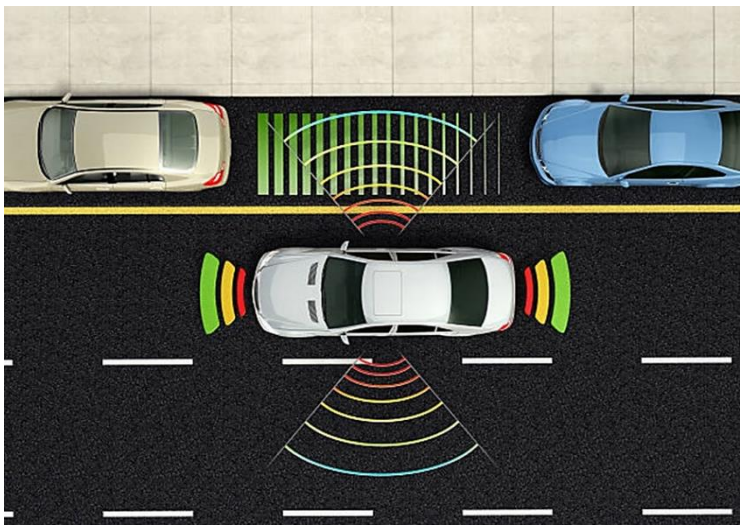


Fig. 1. Sensor detection.

3 | Proposed Study

3.1 | Smart Parking Applications

Previously, parking space reservations were made by calling the service provider. Now, with the current usage of the internet and smartphones, these services are provided online using mobile and web applications [7]. These applications serve as decision support systems for the driver occupying a vacant parking space [8]. For instance, if the application shows a parking lot of choice to be completed, the driver can search for nearby parking lots with available parking spaces or choose another destination [9]. In this way, intelligent parking applications serve as decision support systems in occupying open parking spaces. Smart parking tools improve efficiency based on the following categories [10].

I. Guide the driver to the parking lot using display boards.
II. Reserve and authorize the driver to a parking lot.

3.1.1 | Method

This paper used a literature search to identify articles related to smart parking sensors and technologies. Smart or intelligent parking has been focused on since the early 1980s, and several papers discuss implementing sensors or technologies to improve parking efficiency [11]. This paper will not review parking requirements and income generated due to parking. Similarly, this paper does not review frameworks or architecture of smart parking systems [12]. This paper focuses on sensors, technologies, and interfaces to collect and display real-time parking occupancy information [13]. The suitability of sensors

and technologies is made in terms of compatibility and expenditure. Since most open parking lots are outdoors, compatibility is measured in terms of varying environments and lighting conditions.

In contrast, expenditure is measured in purchase cost, installation, and maintenance activities [14]. Parking meters used for payments are placed either at a parking lot or beside parking spaces and are not referred to in this paper [15]. However, it should be mentioned that these reviews do not emphasize parking issues related to open parking lots [16].

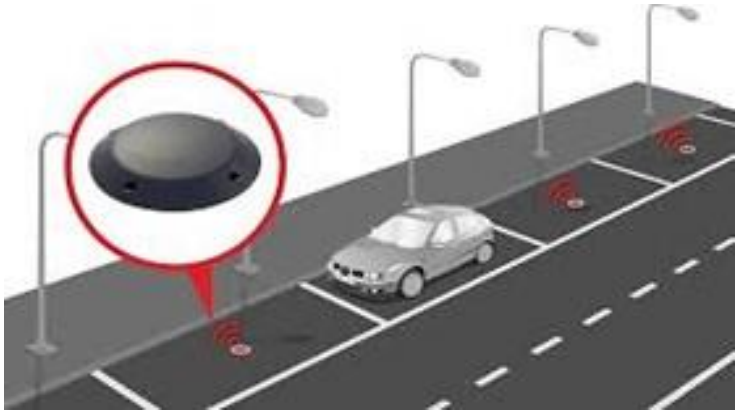


Fig. 2. Smart parking technical guide.

3.2 | Smart Parking Sensors

Various sensors detect parking occupancy information, which is mentioned in the following sections. Sensors are one of the standard tools widely tested in several previous pieces of literature. Descriptions of these sensors are mentioned in the following [17].

3.3 | Ultrasonic Sensor

These sensors emit sound waves between 25 to 50 kHz and detect objects based on reflected energy. They are usually mounted on the ceiling and are sensitive to environmental changes such as rain and snow [18]. Therefore, they are suitable for indoor parking lots rather than open parking lots. The distance at which waves are reflected can distinguish between a vehicle and a person. These sensors should be placed on top of every parking space to get parking occupancy status [19]. These sensors would be available for low cost, but installing and maintaining multiple sensors and connecting them to a grid would be expensive in the long run. Wireless ultrasonic sensors are also used to gather parking occupancy information [20]. They are connected using wireless sensor networks such as ZigBee protocol or similar networks. However, a wireless sensor involves recurring maintenance costs [21]. In another study, ultrasonic sensors are used on a drive-by vehicle, and parking occupancy information is collected regularly. The real-time parking occupancy information cannot be attained using drive-by cars [22].

3.3.1 | Pros and cons of smart parking systems

The most conventional technical definition is that a smart parking system is a system that collects and disseminates real-time parking space availability data. Of course, such systems may incorporate different business logic and value-added services that sometimes may have technical implications, but we will start with getting the tech basics right [23].

Today's choice of technological tools to collect real-time parking availability data boils down to three categories of systems: 1) cameras, 2) overhead radars, and 3) ground sensors.

Each has its advantages and disadvantages, and the choice of a particular intelligent car parking system depends on specific project requirements.

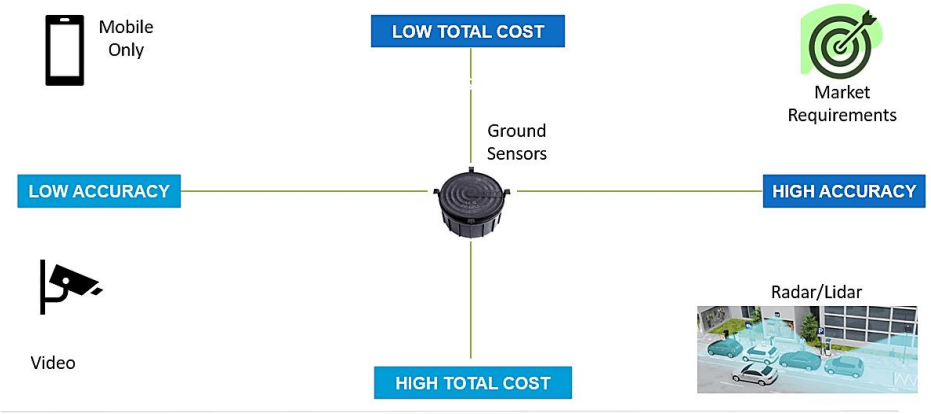


Fig.3. Periphery of smart parking.

3.4 | Smart Parking Technologies

Sensor technologies are tools that facilitate the driver in occupying a vacant parking space; descriptions of these technologies can be found in the following sections below.

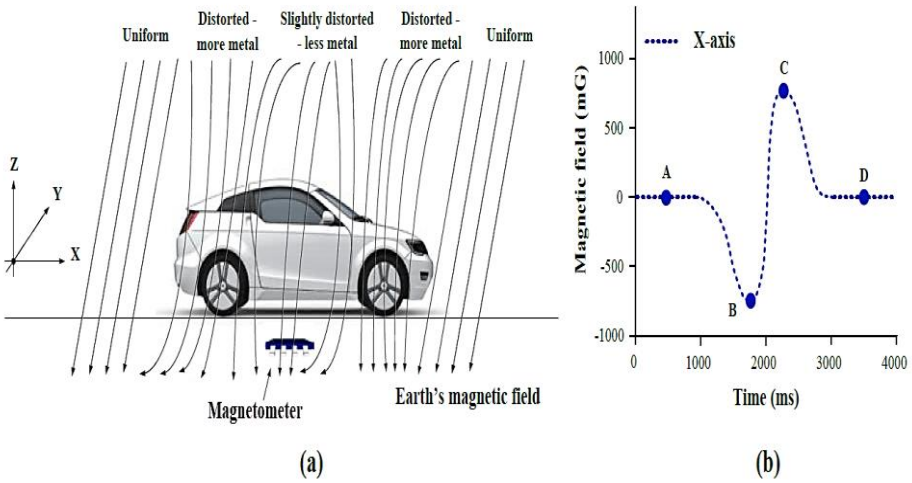


Fig.4. Principles of magnetic sensor vehicle detection.

Fig. 5. Parking of vehicles.

4 | Discussions

The review of existing innovative parking applications shows that most of these applications use sensors for parking occupancy detection in closed parking lots, which would require considerable expenditure for installation and maintenance activities. However, parking occupancy information for the open parking lot is not provided. Few applications, such as; EasyPark Group and Parkopedia, use predictive analytics or crowdsourcing, which can also be used on open parking lots. The applications that used predictive analytics were operational in more cities and countries than those that used sensors for parking occupancy detection. The difference might be due to less expenditure in using predictive analytics than deploying sensors in all parking spaces.

5 | Conclusion

This paper identifies a research gap in utilizing smart parking sensors, technologies, and applications for open parking lots. All the existing smart parking technologies and applications are unsuitable for open parking lots due to varying environmental conditions and high expenditure. As there are no immediate economic gains from providing smart parking services in an available parking lot, payment plays an essential role in choosing smart parking technologies. A parking guidance system, one of the existing smart parking technologies, can be used to get the count of available parking spaces in open parking lots. Machine vision is another technology that uses the visual camera to acquire real-time parking occupancy information on open parking lots due to its minimal expenditure. The usage of the visual camera depends on regulations supported by the country, which needs to be considered prior. However, there is no single ideal technology suitable for parking occupancy detection. Different innovative parking technologies and sensors can be used for efficient and financially viable parking occupancy detection based on the parking lot type and size. Navigational directions should be provided to a vacant parking space to improve parking efficiency further.

References

[1] Mohapatra, H., & Rath, A. K. (2020). Fault-tolerant mechanism for wireless sensor network. *IET wireless sensor systems*, *10*(1), 23-30. https://doi.org/10.1049/iet-wss.2019.0106

[2] Mohapatra, H., & Rath, A. K. (2019). Fault tolerance in WSN through PE-LEACH protocol. *IET wireless sensor systems*, *9*(6), 358-365. https://doi.org/10.1049/iet-wss.2018.5229

[3] Mohapatra, H., & Rath, A. K. (2019). Detection and avoidance of water loss through municipality taps in India by using smart taps and ICT. *IET wireless sensor systems*, *9*(6), 447-457. https://doi.org/10.1049/iet-wss.2019.0081

[4] Mohapatra, H., & Rath, A. K. (2020). Survey on fault tolerance-based clustering evolution in WSN. *IET networks*, *9*(4), 145-155. https://doi.org/10.1049/iet-net.2019.0155

[5] Mohapatra, H., & Rath, A. K. (2021). Fault tolerance in WSN through uniform load distribution function. *International journal of sensors wireless communications and control*, *11*(4), 385-394. https://doi.org/10.2174/2210327910999200525164954

[6] Mohapatra, H., & Rath, A. K. (2020). Nub less sensor based smart water tap for preventing water loss at public stand posts. *2020 IEEE microwave theory and techniques in wireless communications (MTTW)* (Vol. 1, pp. 145-150). IEEE. DOI: 10.1109/MTTW51045.2020.9244926

[7] Mohapatra, H., & Rath, A. K. (2021). IoE based framework for smart agriculture. J Ambient Intell Human Comput, 13, 407–424. https://doi.org/10.1007/s12652-021-02908-4

[8] Mohapatra, H., & Rath, A. K. (2021). A fault tolerant routing scheme for advanced metering infrastructure: an approach towards smart grid. *Cluster computing*, *24*(3), 2193-2211. https://doi.org/10.1007/s10586-021-03255-x

[9] Mohapatra, H., & Rath, A. K. (2021). An IoT based efficient multi-objective real-time smart parking system. *International journal of sensor networks*, *37*(4), 219-232.

[10] Mohapatra, H., & Rath, A. K. (2019). Fault tolerance through energy balanced cluster formation (EBCF) in WSN. In *Smart innovations in communication and computational sciences* (pp. 313-321). Springer, Singapore. https://doi.org/10.1007/978-981-13-2414-7_29

[11] Panda, H., Mohapatra, H., & Rath, A. K. (2020). WSN-based water channelization: an approach of smart water. In *Smart cities—opportunities and challenges* (pp. 157-166). Springer, Singapore. https://doi.org/10.1007/978-981-15-2545-2_15

[12] Mohapatra, Hitesh; Rath, Amiya Kumar: 'IoT-based smart water' [Control, Robotics & Sensors, 2020], 'IoT Technologies in Smart Cities: From sensors to big data, security and trust', Chap. 3, pp. 63-82, DOI: 0.1049/PBCE128E_ch3, IET Digital Library. https://www.amazon.com/IoT-Technologies-Smart-Cities-security-Robotics/dp/1785618695

[13] Mohapatra, H. (2021, September). Socio-technical challenges in the implementation of smart city. *2021 international conference on innovation and intelligence for informatics, computing, and technologies (3ICT)* (pp. 57-62). IEEE. DOI: 10.1109/3ICT53449.2021.9581905

[14] Mohapatra, H. (2020). Offline drone instrumentalized ambulance for emergency situations. *IAES international journal of robotics and automation*, *9*(4), 251-255. DOI: 10.11591/ijra.v9i4.pp251-255

[15] Mohapatra, H., & Rath, A. K. (2020). *Fundamentals of software engineering: designed to provide an insight into the software engineering concepts*. BPB Publications.

[16] Mohapatra, H. (2021). *Designing of fault tolerant models for wireless sensor network* (Ph. D Dissertation Veer Surendra Sai University of Technology). Retrieved from http://hdl.handle.net/10603/333160

[17] Mohapatra, H., & Rath, A. K. (2020). Social distancing alarming through proximity sensors for COVID-19. *Easy Chair*, *18*. file:///C:/Users/browse/Downloads/EasyChair-Preprint-3636.pdf

[18] Hitesh Mohapatra, Smart City with Wireless Sensor Network, ISBN-13: 979-8791261380, KDP, 2021.

[19] Mohapatra, H. (2018). *C programming: practice*. Independently Publication.

[20] Mohapatra, Hitesh; Rath, Amiya Kumar,' Smart Bike Wheel Lock for Public Parking', Application Number: 336834-001.

[21] Mohapatra, H., & Rath, A. (2020). Advancing generation Z employability through new forms of learning: quality assurance and recognition of alternative credentials. Retrieved from https://www.researchgate.net/publication/338680786_Advancing_Generation_Z_Employability_through_New_Forms_of_Learning_quality_assurance_and_recognition_of_alternative_credentials

[22] Mohapatra, H. (2009). *HCR using neural network* (PhD's Desertion, Biju Patnaik University of Technology). Retrieved from https://www.academia.edu/29846341/HCR_English_using_Neural_Network

[23] Mohapatra, H. (2019). *Ground level survey on sambalpur in the perspective of smart water* (No. 1918). EasyChair. https://mail.easychair.org/publications/preprint/CWpb