Survey of smart parking application deployment

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Abstract. Number of vehicles continues to increase in the urban place parallel with the infrastructure advancement. The increase of vehicles on road causes various problems and obstacles to find an empty parking slot. This problem often causes congestion, waste more effort and time-consuming process especially during rush hours when many people are driving for various reasons. In this paper, we explore the concept of smart parking based on the application of their categories and explain the classification from various parking support technologies. Present developed parking system supported by various technologies and the category. Classified the application function of this survey. The application of this smart parking application might assist in reducing congestion and other issue by manage the parking process. Achieve the key objective of this research as stated by various scientist and researcher to deliver an advanced parking system. Conducted by developing an application interface base on a mobile, desktop and web. It is an excellent determination for the parking management to deliver a real-time information update on the parking area, which is the point of interest as an improvement to the existing system and research.

1. Introduction
Population growth in urban areas that affect land reduction. At the same time, it increases the use of private vehicles for various purposes such as going to work [1], shopping centers [2] and others. This affects the increase in parking space to overcome parking problems with the number of vehicles on the streets. By increasing the number of parking lots, whether only to help the driver or vice versa will limit the availability of public land for residents in the city [3]. Finding an empty parking spot in a metropolitan region turn into a troublesome task for drivers particularly in rush hours [4]. During rush hours in most big cities, cars that are searching for parking spaces often takes 40% of the total traffic. This causes waste in effort and fuel, increases congestion [5], and results the discharge of CO2, and influences the economical-impact [6].

As shown in Figure 1 below, the process for users to find available parking space on average takes 3.5 to 14 minutes [7–9]. This situation cause more than 30-40% of traffic on the road. Thus, the parking management plays a vital role in reducing the bottleneck traffic [3]. Moreover, implementing smart parking in the urban city it could bring such a significant number of advantages for parking management along with the city arrangement due to meet the purpose of the research development. One of the methods that possible to implement is a reserve for a parking space and show the direction as a guide to the selected parking spot by systematically. In a purpose to facilitate the drivers in finding the expected parking lot.
Further, introducing smart parking in various public facilities like airport [10], railway stations, malls, hotels, hospitals and so on is an important asset to note. Smart parking technology will help their visitor and customer, to get an effective solution in finding the parking space base on parking applications which provide reliable information on the parking area in these public facilities [11]. At the same time, it will improve their service and user satisfaction [12]. Based on the results of the evaluation and research the current advancement of smart parking applications by its compatibility to run across the operation of systems and devices.

Smart parking is implemented with a myriad of technologies facilitate the drivers in finding available parking lots within minimum waiting period. This paper aims to define advancements of technology based on the smart parking framework that discussed related work around the deployment of smart parking application, which categorized based on implemented software framework, service, application deployment and others that show in table 2. Utilized a correlation of advances as a part of each framework and employs the use of the correlation in various technologies of smart parking. Demonstrated a hypothetical correlation as part of the discussion.

2. Smart parking
The headline of the smart parking system is a reservation system that provides information on the destination parking lot and provides direction for the driver to find a parking space. Intended the users to get desired parking lot. Components of a smart parking system are. The user, parking management and parking lot and its facilities as illustrated in figure 2.
As explained in the introduction above, the growing number of vehicles is increasing as a result the need of people for vehicles to transport them from one location to another. Parking lots are the first place they are looking for when they arrive at their destination. of the accumulated data, the cause of congestion in the parking area as result of a parking process [14]. Against this background, it spurred researchers and scientists in various fields to solve this problem and develop smart parking systems. Proposed scheme from surveyed paper mostly figure as figure 3 below.

![Figure 3. Integrated smart parking management system](image)

Smart parking is claimed by the expertise as a solution and clever approach to tackle the parking issue [15]. Smart parking technology aims to bring the ease for any driver in order to face the parking problem as efficiently as possible. Goals of this system can be achieved by utilizing an integrated information from parking framework advancement system that has been developed in various innovation [16]. Some aspect to consider in developing a smart parking system is should to reduce the time for seeking empty parking space [17] and shorten the tasks of parking frameworks for the driver [13] which is an extraordinary improvement for urban city development.

**Evaluation approach of smart parking system**

In preparation to this smart parking survey, it is consisting of two case situations such as parking determination based on reference case and proposed case. The reference case is a situation where the parking location can be determined without an application assistance. In opposite way, the purposed case the determine the parking location based on the application [18]. Both are the result of parking decisions based on the decisions and actions of the users. The difference between these two situations by the influence of the smart parking system on the decisions and actions taken by the driver. The proposed case model and the intelligent parking effect are two subjects that need to be evaluated in a smart parking application especially in this survey paper. In short, the statement above can be figured by the component flow and the evaluated approach as shown in Figure 4.

![Figure 4. Component and approach evaluation](image)
Determination of the parking decision process taken from the results of several investigated papers. This investigation based on user behavior when they will park their vehicles in urban areas. An essential smart parking includes information flow and traffic flow as shown in figure 5 below.

Flow of information and traffic is an important data in smart parking systems that connect to each other, to produce effective solutions to find an available parking space. Decisions to the parking area could be taken before the vehicle arrives at destination lot or pre-trip process decision.

Parking behaviors are variety dependent on the driver's information as well as the distance and time to parking destiny [19]. Integrated parking network is involved to steering the rider to the parking space in an on-trip process decision. When the vehicle leaves parking space, information on parking space will be updated and space will provide to another vehicle.

Next section will explain numerous innovation of empirical study improvement from smart parking system by various science field. Here authors purposed to do a survey on the related study due to clarify all implemented systems on surveyed paper. Overview of the surveyed paper discusses smart parking area will be describing in section 3 below.

3. Literature survey of smart parking

This section is shown selected papers to be surveyed from smart parking base on their application. As a reference to this survey author has collecting paper from Science Direct, IEEE, and google scholar. Here the author takes 17 papers from 70 paper that collected from those 3 databases. Selected papers on this survey, contains papers merely discussing of smart parking application. To show the variety of paper in this area here author has summarized 9 paper as a sample. Rest of 17 surveyed paper will present on discussion section that will describe and compare it in detail each of their project.

Outline of gathered information and examine performance on pertinent information is taken on this section. In introducing the outcomes of each papers, with a specific goal to assess and decipher their result. Table 1 below, shown as an empirical study of this research area.
Table 1. Overview surveyed smart parking application.

| Author and Year | Purpose | Summary |
|-----------------|---------|---------|
| [20] 2017       | Design a multiplatform mobile application concept. | This work is presenting a mobile application to solve the parking problem in the Virginia Tech area. As the result participant is not certain application effectiveness to find parking spaces. UI of ParkinVT was still in progress, relative lower satisfaction for understandable and need a corrected in the final design. |
| [4] 2017        | A smart parking multiagent approach to providing decision a real-timely. | Optimizing the compromise from the set of efficient solutions, which is determined by means of a multi-criteria ranking method ELECTRE III. Simulation results is widely applicable to the approach in real cases of parking solution. |
| [21] 2016       | An Intelligent parking assistance as future smart cities component. | A prototype parking system based on MEAN. API getRegionData is fetching parking information from google places near-by-search AJAX and the API (createMarker) as a marker on maps. Information flow acquired from a pattern recognition subsystem and stored parking information in MongoDB. |
| [22] 2016       | An adaptive mechanism for smart parking by using smart-phones and the Internet of Things. | A centralized system to forecast available indoor parking spaces. To produce a low-cost mobile application to obtained data from parking occupancy. Conducting computer simulations and real experimentation with a preliminary implementation have reduced the time and energy costs to find available parking spaces. |
| [23] 2016       | A smart parking system that provides occupancy estimation, payment method, permit management, and parking analytics. | Validating limited parking hypotheses in Helsinki area and recruitment of participants to the pilot of the project. A smart parking system based on LoRa (Long-Range communication technologies) to support the IoT systems. The challenges have been resolved by validating an associate parking spot in a city, allow drivers to check for available parking spaces, able to pay for the parking fee, get electronic parking permits, and the city authority gets parking analytics for the city planning. |
| [24] 2015       | Introducing a mobile-based parking reservation system. | Here author develop a mobile smartphone reservation framework, by utilizing SDK Xcode combine with SQLite and debugging real-timely with Firefox Web program. An application model has presented by considering nearby parking service providers, to satisfy customers requirements and will reserve the best parking for the use. |
| [25] 2014       | A computer program for processing a parking lot image and produce a vacant parking spaces information. | In this works, using a camera as a sensor to take photos and use the information to steer the driver into a vacant car park. The developed system in both software Matlab and camera as a software and hardware platform. An automatic parking system make the whole process of parking cars more efficient and less complex for both drivers in parking his car. |
| [10] 2013       | Provide an online car parking reservation desktop application service using XAMPP. | This Application provides a vacant parking lot, the payment method, the booking period, expire date, and other alternatives before their arrival at the airport. Connecting the user to the webpage through an interface generated by PHP and JavaScript. MySQL and DBMS applied to store related data of the car park. To connect the DBMS and PHP, APACHE is used as a bridging linker that supported by XAMPP. |
| [26] 2011       | A Mobile Applications system to help the drivers find available parking spots quickly. | The vehicle mostly trips and parked in car parks. Then this author develops a smartphone application with PhoneGap and web technologies to achieve scalability on the back end of Google App Engine. The result of deploying this application shows that the system works and can indeed provide real-time information about the availability of the parking area. |

Summarization of above surveyed studies, implemented system from each study base on smart parking application is different to each other in some aspect. In every single surveyed paper has had a different purpose, method, platform, framework and strategy in order to against the parking problem. Reach the goal to save time to get the expected parking lot and make it easier for the consumer without wasting any valuable resources.

3.1. Advantages and disadvantages

In every survey on the smart parking application, not always be perfect mostly paper it will always leave a gap for future improvement by them self or to another researcher. From surveyed discussion and project, it has advantages and disadvantages of their projects to make their method better than another.

Here I have figured nine sample of papers from 17 papers that have surveyed. In this section, we draw conclusions from the advantages and disadvantages of the parking system in the study sample that we survey. Table 2 below will show in detail of each surveyed paper of smart parking advantages and disadvantages.
Smart parking also called intelligent parking it consists of three components: an intelligent user/device, an intelligent environment, and intelligent vehicle & environment. An intelligent device is the application base on a device to get information about the car parks. An intelligent environment is an application in the parking environment; a user gets to get the information about the vacant park when

Table 2. Advantages and disadvantages from surveyed papers.

| Author | Advantages | Disadvantages |
|--------|------------|---------------|
| [11]   | Predicting accurately and sense spot/vehicle occupancy real-time. | Device and Environment should integrate which support the system. |
|        | Decreasing number of on-street parking. | The parking should be cleared vision. |
|        | Suitable for the money during utilization. | While in progress project and upgrading UI process. |
|        | Real-time sensor detection. | Demands to installing an additional equipment on campus parking lots. |
|        | Already implemented and tested in the real world. | Consuming time in the process of installing this app. |
|        | A user interface that is the focus to be a user-friendly application, improve the parking experiences and efficiency. | |
| [20]   | Routing information is shown using GPS to save travel time. | Inconvenience application, because it is just a simulation instead of data from the real world. |
|        | Implement MEAN stack, which faster and real-time compare to traditional web. | Not embedding intelligent component. |
|        | Figured details of available parking. | Priority has not provided to an emergency. |
|        | | |
| [21]   | Lifting car park management into a computational service. | The sensor at a key location divides a car park into smaller zones. |
|        | Provide bidirectional communication service to get accurate data simultaneously. | Requires a smartphone that supports the technology is applied. |
|        | Economical resources for parking space owner. | Still, a concept has not come out with the entire application to show the entire system. |
|        | | |
| [22]   | QR codes and NFC tags are cheap technologies to implement. | The WinNode needs to full charge when spend less time in the car. |
|        | QR codes, NFC tags, and BLE Physical Web Beacons to determine actual occupancy of parking space accurately. | Need intuitive and flawless designs in this system. |
|        | A lightweight client program on a smartphone allows accessing the service through the Internet. | Requires certain type of smartphone to use this app (IPhone). |
|        | | |
| [23]   | REST approach through HTTP level appliances it provide security, caching, and proxy capabilities. | The weather conditions affect the visibility of the park lots. |
|        | Convenience in finding a parking space and paying the parking fees | The camera should be placed in a perfect place where can clearly see all the car parks. |
|        | | |
| [24]   | License plate recognition via the smartphone camera and register a new car automatically. | Only one type of user abstraction in the system. |
|        | The system could feature a long-term parking such as weekly or monthly reservations. | Integration Google maps API or GPS is unavailable to visualizing parking spaces. |
|        | | |
| [25]   | The camera is moveable to detect every space in parking area. | The weather conditions affect the visibility of the park lots. |
|        | Using data from the image to guide a driver to an available car park. | The camera should be placed in a perfect place where can clearly see all the car parks. |
|        | Using camera is efficient and low-cost technology. | |
|        | | |
| [26]   | Using android application allow a user to scan a QR code and pay for their parking space | | |
| [27]   | Minimum cost is involved because the internet is used. | Physical hardware or parking map to figure vacant parking space. |
|        | The online desktop application is easy to deploy in across device and operating system. | Secure socket layer was not set up to encrypt data on credit card during for payment process. |
|        | | |

Above article exposures, has to compare and analyze every pros and con in every work. Even though they have put everything into the research they are working on, applying the latest methods and the best technology to solve the existing parking problems. However, from the surveyed paper, leaves gaps for further development that has not addressed by the researchers. In addition, those researches remain gaps to improve the works that they have not achieved in some sectors. This provides an opportunity for other researchers to conduct research in the same field to fill the gaps that still exist in this research and make advancements on this research area.

4. Discussion

4.1. Smart parking classification

Smart parking also called intelligent parking it consists of three components: an intelligent user/device, an intelligent environment, and intelligent vehicle & environment. An intelligent device is the application base on a device to get information about the car parks. An intelligent environment is an application in the parking environment; a user gets to get the information about the vacant park when
they arrive at the parking area. Last is an intelligent device and environment is a combination of both component before, a user can get information about vacant park accurately base on communication machine to machine or M2M [29]. Table 3 below is the classification category of surveyed smart parking application paper by its integration. Artificial neural networks are a reliable and sustainable method, as in a number of emerging field technology fields such as the Deep learning machine, cloud computing and information security [30].

Table 3. Classification of smart parking papers.

| ref | Deployment | Service |
|-----|------------|---------|
|     | NetU | NetS | ID | IE | IDE |
| [20] | WiFi, NFC | | √ | - | - |
| [11] | WiFi, CN | | √ | - | - |
| [21] | WiFi, CN | WSN | √ | √ | - |
| [27] | WiFi | NFC, BT | √ | √ | - |
| [22] | LoRaWAN Network, WinNode-WinSpot | | √ | × | × |
| [9] | WiFi, CN | | √ | √ | - |
| [7] | WSN | CN | - | - | - |
| [31] | WiFi, through MQTT protocol | | √ | √ | - |
| [24] | Wire & WiFi | CN | - | - | - |
| [25] | WiFi | - | - | - | - |
| [32] | WiFi, NC | | √ | √ | - |
| [28] | - | - | - | - | - |
| [10] | - | - | - | - | - |
| [33] | WiFi, CN | | √ | √ | - |
| [5] | WiFi, CN | | √ | √ | - |
| [26] | WiFi, CN | | √ | - | - |

Deployment: NetS (Network of Sensor), NetU (Network of user). CN (Cellular Network) BT (Bluetooth ) and WSN (Wireless Sensor Network) Service: ID (Intelligent Device), IE (Intelligent Environment), and IDN (Intelligent Device and Environment).

From the collection of 17 papers that have been surveyed, have been getting 3 clusters of smart parking system. A total of 8 papers apply Intelligent Device, 2 papers using intelligent environment, and the remaining 7 papers combine intelligent device and environment. From the sample data that has been obtained, then some of the paper will be described in the following section.

4.1.1. Intelligent vehicles/device are the vehicle. The application detects parking information automatically, without any integration between the environment and the vehicles/user. Here some sample paper which adopts a system intelligent vehicle/device as shown in table 3.

Intelligent device application has implemented in “ParkinVT” by Liang [20]. Purpose of this paper is to improve the parking experiences and efficiency in Virginia Tech campus. The most important feature of “ParkinVT” is the notification function. Once the users set their favorite on-campus parking lots, and the remaining parking spaces in these parking lots reach a critical amount. Such as less than five spaces remain in a parking area, “ParkinVT” will automatically send a reminder to the users based on the traffic flow and distance between users’ departures and destinations. Due to user satisfaction as a key objective of this research, Liang has divided the difficulty levels to find the parking lot into easy, medium and hard. For a guest and staff will be given the difficulty in level easy, for the faculty will be given the difficulty in level medium and to the student will be given the difficulty in level hard. The level is determined by the user interests on the Virginia Tech campus. As a future improvement Liang has conduct a survey to evaluate the inefficient component on her application.

A mobile application which develops by Bernspång [26] which is an intelligent device application that been implemented in his system. Deployment of this work is to make an interconnection between JSON (JavaScript Object Notation)-encoded that it is an application Engine to the Smartphone application which means this work is based on the intelligent device of the smart parking system but in this case, for the device is using a smartphone. Connect sensors and user connections through application engine of JSON is by transmitting the sensor that collect the data. Then, sending an actual URL to
represent the data that in this case represents from readings of the simulated magnetometer sensor. This application starts suggesting possible match from the parking space by using Google Geocoding API.

4.1.2. Intelligent environment. Application of this intelligent is the environment/building have been conducting and implement the smart system can detect the available parking and show it to the user. The intelligent environment detects sensing result from the sensor in a parking area and then stores in on their database system to be accessed by the driver in the same area with this intelligent environment/building.

Application base on the intelligent environment has implemented on a paper from Al-Kharusy [22]. This intelligent parking, develop a figuring of the occupied parking space using wireless signal transmission. An obtained data of parking information is a result from image processing using a camera that has spread across several points in the parking lot at Massey University. The capture a predicted image and classify empty parking spots. Then transfer captured information wirelessly using transmitter from a radio transmitter, send it to the receiver in control room to pre-processing segment, and filter the image result using a computer with FPGA (Field-Programmable-Gate-Array) program to filter the noise.

4.1.3. Intelligent device and environment. Application base on this category is device and the environment already engaging to each other, just said that the vehicle it is been one of a member of it intelligent environment. In another word, the vehicles it’s already integrated with the environment using a device to communicate with the intelligent environment. Here are samples from surveyed papers, which is an application base on an intelligent device according to data from table 3. Atif [27] and Charles [23] elaborate a dimension that in their system that includes machine learning, applies the algorithm to achieve adaptive systems that can respond to environmental changes that can have an impact on the smart parking system they develop.

Application base on an intelligent device and environment has been deployed in a paper from Caballero-Gil [22]. Purpose of this project is to provide a communication between smartphone and Server on parking space and then guide the driver to the recommendation parking space. Communicate the parking areas of the smartphone through embedded technology in the smartphone that is BLE, NFC, QR, and Bluetooth. Data readied by the system on the server and from the user application. Directly the data sent from application to the server as well as vice versa, so that data from the location of the vehicle can be stored on integrated systems.

In addition, Ahad [11] has implemented an intelligent device and environment in his project “Park Easy”. This project proposed to provide the shortest way and provide information from predicted availability parking obtained from accurate sensor detection updated. Park Easy is using wireless NFC (Near Field Communication) to detect the availability of parking space by capturing the image by integrated cameras in the parking area. Assist a camera sensor with ultrasonic sensors for detection from the specified parking space. Then, transmits the data to the control unit into the next is instantly sent to the application of users who are approximately the parking area via user mobile devices.

4.2. Deployment of smart parking base on device platform
The current smart parking technology has made it possible to apply in various media. Establishment of smart parking framework in actualized on registering gadgets which cover smartphones, integrated sensors, desktop computer and smart display increasingly turned out to be litter, less expensive and more powerful [13]. The following application of smart parking application in various media that have been collected from surveyed papers as shown in table 4 below.
Table 4. Smart parking application base on device platform and feature.

| ref | Author                              | Mobile App | Desktop App | Web App | QR | Dir | Map |
|-----|-------------------------------------|------------|-------------|---------|----|-----|-----|
| [20] | Liang (2017)                        | √          | -           | -       | √  |     |     |
| [11] | Ahad (2016)                         | √          | -           | -       |    |     |     |
| [21] | Narasimha-Mohanasamy (2016)         | -          | -           | √       | -  | -   | √   |
| [27] | Atif (2016)                         | √          | -           | -       |    |     |     |
| [22] | Caballero-Gil (2016)                | √          | -           | -       | -  |     |     |
| [23] | Charles (2016)                      | -          | -           | √       | -  | -   | √   |
| [9]  | El-Seoud (2016)                     | √          | -           | -       |    |     |     |
| [7]  | Alkheder (2016)                     | √          | -           | -       | -  |     |     |
| [31] | Khanna (2016)                       | √          | -           | -       |    |     |     |
| [24] | Baitalmal (2015)                    | √          | -           | -       |    |     |     |
| [25] | Al-Kharusi (2014)                   | -          | √           | -       |    |     |     |
| [32] | Livio (2014)                        | √          | -           | -       | √  | -   | √   |
| [28] | Cosgrove (2013)                     | √          | -           | √       | -  | -   |     |
| [10] | Hussien (2013)                      | -          | √           | -       |    |     |     |
| [33] | Geng (2013)                         | √          | -           | √       | -  | -   |     |
| [5]  | Trusiewicz (2013)                   | √          | -           | -       |    |     |     |
| [26] | Bernspang (2011)                    | √          | -           | -       | -  |     | √   |

Feature: QR (QRcode), Dir (Direction)

Here we will explain in detail group of smart parking application that classified base on a web, mobile, and desktop. In addition, here are samples of surveyed papers is described referring to the table above.

4.2.1. Web application. Computer and online oriented application is the most appreciated applications nowadays [34]. TheWeb applications are discussed and argued by any development community as a cross-platform application. That's means, no specific device and the specific browser is required in deployment. In addition, this application can be easily run on various operating like IOS, Android, Windows, Linux and other [35]. Web applications are applications that are accessed using the web browser via internet or intranet network. The web application is also a computer software encoded in a programming language that supports web-based software such as HTML, JavaScript, CSS, Ruby, Python, Php, Java and other programming languages.

Smart parking base on the web application as done by Narasimha-Mohanasamy and Jenq [21] in a project of “ParkIt”, here author deploys an application base on a web application to deliver a ParkIt web-based application. This app can be easily redirected the driver in order to show indoor parking garage which associated with a system of ParkIt. Parking information can be acquired from a pattern recognition subsystem.

Web application from smart parking also has implemented in Hussien project [10]. This work is an online car booking system, this app instantly adds value to client website with a graphical user interface and web users access to book a parking space, pay online, update the booked space before the exit date, finding the way to available vacant space and the status of pre-booking before them heading to the airport.

4.2.2. Mobile application. Users of smart phones and mobile applications have increased over the past decade around the world and have become a leading technology segment. Which consists of software to do certain tasks for mobile users [36]. Multi-platform mobile application development advancement system is picking up prevalence due to their trademark to order the application source code for multi-OS (operating system) [37]. The relationship between mobile application web applications is so close to each other, with parking coordination on this makes it applicable to a smart device due to its mobility that is easy to deploy [38]. To determine the absence of functionality equipment, at the same points to even now fulfill the craving to convey normal Web innovation, cross approaches developed as a mix of Web technology and native function [39]. The most noticeable example of this approach is PhoneGap.
Smart parking application which stands on a mobile application has developed by Khanna [31] in 2016 by installing the application before driver uses it, then select the destination area. The mobile application taking apart to interfacing end-users to interact with the parking system, select amount of time, make a payment using e-wallet or credit card. The application also acts as an alarm and a reminder when the driver failed to park the occupancy then the alarm will ring assume that driver/user has mistaken the parking place. If the reservation has reach, time limit has then the notification sent to user/driver, giving an option whether they want to extend their parking time or leaving the parking area.

Another paper that has implemented the mobile application on smart parking system is Bernspång [12]. By selecting a parking space base on a nearby the location and the address field. When destination address has typed, then Google Geocoding API starts suggesting possible matches parking area with contains geographic coordinates. The application will try to get the current location of the user/driver and show theirs specify coordinate. Then plotted parking space result on a map if user/driver using the near-by feature from this mobile application. This paper gives a driver that spotlights on real-time data, for example, the accessibility of free space in the parking house through which it goes through the applications introduced on the client's smartphone.

4.2.3. Desktop application. Apart from the above platform, there is also another media interface deployment that uses a desktop application to process and interfacing the data. In this case, desktop application is implemented to processes the data of available parking space. Desktop Application is an application that can be operated independently without using a browser or internet connection on an autonomous computer.

A desktop application it is has done by Al-Kharusi [25] on his work as shown in table 4. This desktop application of smart parking system is purposed to find the availability of a car park at Massey University. The project is using an FPGA program base on MatLab programming. FPGA analyzed an aerial view method, test a car park by different occupancy level. This application shows an availability car park, giving a coordinate and steer the driver to find the closest space to the parking entrance. Empty space is detected using the camera as a sensor to get image detection from a vacant car park.

4.3. Smart parking application base on framework platform

A design for the reconciliation of a various advancement is generally displayed. Determining the interface design and information content of a website is important to arouse consumers' initial interest in exploring the site further [40]. Future programming stacks have proposed a reservation, installment, expectation, keen parking application and even the framework readiness. The product frameworks are displaced by various business arrangements, such as the UI and the best approach to display parking data is very comparable. A gathering of parking places is amassed and just gives a likelihood of accessibility to drivers. The following data is collected from the framework is used by each paper to build the system they have proposed is shown in table 5 below.

| ref  | Used Technology                          | EP | RS | PS | NT |
|------|-----------------------------------------|----|----|----|----|
| [20] | JavaScript, Ionic, Google Maps API      | √  | -  | -  | √  |
| [11] | -                                       | √  | -  | -  | -  |
| [21] | MEAN Stack, Mootools, Google Maps API   | √  | -  | -  | -  |
| [27] | -                                       | √  | -  | -  | -  |
| [22] | MEAN Stack, Bootstraps                  | √  | -  | -  | -  |
| [23] | RESTful, Spring, HTML5, CSS3, Django    | √  | -  | √  | -  |
| [9]  | -                                       | √  | √  | -  | -  |
| [7]  | Google App Inventor                     | -  | √  | -  | √  |
| [31] | Apache Cordova, Angular Js, Javascript, IBM MQTT server | √  | √  | -  | -  |
| [24] | Apache Server, PHPMyAdmin, MySQL        | -  | √  | -  | -  |
| [25] | MathLab, FPGA platform                  | √  | -  | -  | -  |
| [32] | MySQL, JSON RPC, Apache Cordova, jQuery and jQuery mobile, Apache Tomcat, HTML 5 | √  | √  | √  | √  |
Table 5. Cont.

| ref | Used Technology | Service |
|-----|-----------------|---------|
|     |                 | EP      | RS   | PS   | NT    |
| [28] | MEAN Stack, Bootstraps, Zxing | -      | √    | √    | -     |
| [10] | XAMPP, PHP MyAdmin, MySQL, HTML5 | -      | √    | √    | -     |
| [33] |               | -      | √    | √    | -     |
| [5]  | C#, ASP.NET MVC 3, AJAX, JSON, JavaScript | -      | √    | -    | -     |
| [26] | Python, Django-nonrel, HTML5, CSS 3 | √      | √    | -    | -     |

Service: EP (E-Parking), RS (Reservation), PS (Payment System), and NT (Notification Time Parking).

While improving a web application, an essential part of the framework development is to pick a right innovation stack that permits fast prototyping, consistent emphasis, code reuse, most extreme proficiency, and vigor. An essential part of developing an application is selecting a right framework innovation like a LAMP or a MEAN stack framework. LAMP is most popular, free of charge, open source, web development stack is now facing a new trending technology stack, the MEAN stack [41]. It is an important aspect but difficult to learn and comprehend by the designers dealing with the front-end and the back-end. Based on follows issue then, the idea of Full Stack JavaScript was created as a solution [42]. Here the collected data, divided as shown in table 5 the data have been the framework into PHP & MySQL Base Application and Node.JS & MongoDB Base application. Descriptions from both frameworks is explain in following section.

4.3.1. PHP and MySQL base application. LAMP stack framework is a combination of Linux, Apache, MySQL, PHP/Perl and (Java EE, Spring) which a comprises various programming language. LAMP stack framework of web development has implemented by web programmers across the community even around the world. The light stack tentatively changed to a WAMP (Windows, Apache, MySQL, PHP/Perl) stack by supplanting Linux with Windows in considering the programmer experience, the PHP can be substituted with Python [43]. However, javascript comprehended the multi-language paradigm by presenting a MEAN stack development system, in a collaboration of MongoDB, Express, AngularJS, and Node.js. Which this framework is stands on a single programing language of a JavaScript. In addition, both framework LAMP/WAMP and MEAN have the same structure for building a great web application [44].

An application that developed by Hussien [10] based on the LAMP stack framework. In this thesis, authors implement two component of an architectural system, which is the architecture of DBMS (database management system) and the application for parking management based on the user interface. PHP and JavaScript generate an interface as a connection from the webpage. MySQL database store the data of the car park and implement the DBMS to manage them. Connecting DBMS to PHP bridge linker is used which it’s a part of APACHE that supported by XAMPP package. The entire desktop application construction is J2EE, PHP and DBMS based.

4.3.2. NodeJS and MongoDB base application. Currently, most developers are switching to javascript based application programming. Examples of framework applications by utilizing the javascript language is a web programming based on MEAN stack. MEAN are a framework which consists of function i.e., node.js [45] to provides the platform for the framework, MongoDB [46] to provides the backend data store, Express [47] to provides the web server, and AngularJS [48] to provides the client-side framework for modern web applications [49]. To support a Real-time data updates, almost all of developer and researcher put AJAX (Asynchronous JavaScript and XML) which a system for sending and receiving data from a server without page refresh [50]. The "Asynchronous" section refers to the fact that when JavaScript delivers an AJAX call to the web server, it keeps running until it gets a response, it does not block and quit when data is being processed by the server.

This framework has been implemented by Jenq [21] that is application based on Node.js and MongoDB. In this work, the authors build client-side applications that build web browsers using JQuery and Mootools to provide PakitPage, ParkitRegion and as bookmarks. In server-side programming, nodeJS has chosen as follows with express, MongoDB, and Mootools. Using GoogleAPI Maps to
indicate where to park. Saving APIs retrieves parking information using Google's near-by-search AJAX spots and APIs (createMarker) to bookmark maps. Using MongoDB database to store parking space availability.

5. Conclusion

The number of vehicles is increasing along with population growth in urban areas. During the process of parking their vehicles, it causes various negative impacts such as congestion in the effect of inefficient from parking management. This impact has contributed to 30-40% of the congestion on the street. A solution to overcome this problem is to apply the advancement system of smart parking. The scientists in have advanced a lot of innovative methodologies smart parking any interdisciplinary of science. With the aim to address this parking problem, to support the increasing mobility in big cities.

This survey paper has been discussed the deployment of smart parking systems based on the application. By combining and summarizing the fundamental philosophies used as part of the present work. Revealing a comparative representation of combined ideas for utilizing methods in the current parking application system. For examples are LoRaWAN network communication, multi-criteria ranking method ELECTRE III, expert system, GPS-based, vision-based correspondence which captured by an integrated camera, wireless communication base on QR codes, NFC tags, and BLE technology. The implemented framework be able to encourage the public and even the parking sector in terms of financial, social, and welfare. Implementing this system is supposed to be an eco-friendly system, saving fuel, time and effort. Improving future development of smart parking application system in accordance with the latest situation. Utilizing technological advancements that vary and integrate various parking systems in innovatively different technologies from mechanisms in smart parking areas. This paper intends to determine the most efficient framework technology as a solution covering several aspects such as smoothness, security, reliability in deployment to overcome parking problems.

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