CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Here in this chapter we present three tenors, depending on previous studies. Automated parking and many modules systems in details, and Hoboken garage as a solution of many parking problems.

2.2 Automated Parking

Automated parking is a method of automatically parking and retrieving cars or vehicles to solve the problem of increasing demand for safe and convenient parking as the number of vehicles are increasing day by day. The driver parks his car at the entrance of the car park structure and from there, the car is automatically moved through the garage and stored in an open parking space. All these are done by utilizing computer controlled system of pallets, conveyors, shuttles, carriers and lifts in transporting cars from the arrival level to a parking space and vice versa without human assistance. Later the car will be returned to the driver using a signaling device outside the building [5].

2.3 Modular Automated Parking System (MAPS)

The Modular Automated Parking System (MAPS) integrates computerization with mechanical lifts, pallets, carriers and conveyors to park and retrieve vehicles in multilevel modular garages. These garages have units that are standard in size and design and they can be arranged or fitted together in a variety of ways. They can also be fully customized

system to achieve specific requirements besides ensuring optimum occupancy of spaces by vehicles [3].

There are four models of MAPS:

1. Model Rotary Parking Systems (RPS) 1000.
2. Model RPS 100.
3. Model RPS 20W.
4. Model RPS 20L.

Operation of MAPS is made possible by flexibility transfer technology. This is a type of transport technology that is also being used in automobile assembly lines. Improvement that has been done in MAPS is that a new fuzzy logic based technology has been developed and integrated with the flexible transfer application in order to optimize the movement of the carriers and lifts. Other than that, it also allows several cars to be moved independently through the garage. This will help in making the vehicle storage and retrieval in a shorter time. MAPS is monitored by computer and human machine interface (HMI) will show real time car movements. Besides that, the HMI facilitates the maintenance and diagnostics of the car park system. The computer which is installed at the garage is accessible from any remote location. Additionally, all systems are equipped with backup system and are based on the safety philosophy of one out of two failures. This means that at least two of every major component is installed on site. At all times, every parking space can be monitored simultaneously by at least two independent units [3].

2.3.1 Model RPS 1000

Model RPS 1000 is a large parking garage which is able to accommodate from 200 to 5000 cars. It is a very flexible and modular

design suitable for applications above ground, underground, inside a building, on top of a building or under a building. This model offers one of the highest level of redundancy in the industry and a greater level of reliability. This is because all major components have at least one back up system. Thus, the chances of inoperable of the system due to failures are very low. Other than that, the HMI offers a very sophisticated system of diagnostics which provides high level of detection in advance of any failures. It is understood that any mechanical or electronic devices can fail but this failure can be overcome by early warning signals and repair [3].

2.3.2 Model RPS 100

Model RPS 100 is an intermediate sized automated parking garage with a capacity of 30 to 200 cars. It is an ideal solution for small sites with a high demand for parking. This model also provides redundancy and the HMI diagnostic tool helps in ensuring the operation of the garage is not interrupted. It is an intermediate sized garage with true redundancy which means it has the actual back up of the complete unit. Therefore the capability of the system to operate with minimal failures is guaranteed [3].

2.3.3 Model RPS 20W and Model RPS 20L

Model RPS 20W and Model RPS 20L are the ultimate space efficient solution. They are automated parking systems for small applications with a need of 10 to 30 cars per model. However, the capability of occupying more cars can be achieved by building the model adjacently. These models are ideally suited for condominium, apartment, hotel and small office building development projects where land is limited and expensive. In the function wise, there is no difference between Model RPS 20W and Model RPS 20L. But they do have difference physically in design where the way of entering, leaving and, also the arrangement of car park spaces are not the same.

2.4 Hoboken Garage

Hoboken Garage is an automated parking system operating in New Jersey, United States of America since May 2002. However it was officially opened only in October 2002. A total of $6.2 million has been spent on this facility. The Hoboken Garage automated parking system offers a patented Modular Automated Parking System (MAPS) which uses the latest electronic and automation technology. The Hoboken parking garage is capable to accommodate 312 cars in its seven storey residential parking garage which in comparison, a conventional ramp style garage can only accommodates 90 cars. It is developed on a 1000ft2 lot, standing 56ft high and with about 7.5ft from level to level. The garage also allocates parking spaces for the incoming cars, retrieves parked cars as requested and monitors the whole system to prevent failures and also for maintenance [3].

2.4.1 Motion Control System and Robot

A GE Fanuc integrated motion control system manages 35 independently operating robots. These robots will transport vehicles from the entrance bay into an xxi open parking space utilizing the automated system to move pallets, lifts and carriers. As it is noticed, each axis of motion employs a pair of servo systems in sharing the load. Either motor can independently supply adequate power to move vehicles during maintenance as the servos are sized to accommodate such load [7].

2.4.2 CIMPLICITY Software

The GE Fanuc hardware is linked to software named CIMPLICITY. It is an open system framework that provides a graphical environment to monitor and control the automation system. It also provides a graphical

interface with real time displays. Additionally, CIMPLICITY collects and compiles data from the parking system. CIMPLICITY will generate maintenance and diagnostics reports to increase troubleshooting, efficiency and to enable a quick response when system problems occur [5].

2.4.3 Parking and Retrieval Process

The Hoboken Garage is a monthly garage only for local residents. Therefore each patron has a card similar to a pass. As the patron drives to the garage, the card that is positioned in their windshield is detected by a sensor and sends signal to the computer that a patron is approaching. A green light at an available bay indicates entrance for the patron. Then they will proceed into the open bay, position their car, get out of the car and push a button to initiate the parking process. The central computer system guides a carrier on steel rails along an open aisle way to a position adjacent to the arrival station and the pallet at the arrival station. An additional rack entry module moves above the upper surface of the carrier and is inserted beneath the pallet. Then the pallet and the vehicle are transferred to the carrier. Under the direction of the computer, the carrier with the pallet and vehicle is moved from the arrival station to a multilevel lifting device. Then the pallet and the vehicle are transferred to the lift. When the lift reaches the designated parking level, the pallet and the vehicle are transferred to another carrier. This carrier will transport the pallet and the vehicle to the designated parking slot. Lastly, the pallet and the vehicle are transferred into the parking slot by the rack entry module. When the patron's car needs to be retrieved, the patron will go to the lobby and enters a pin number into a keypad. Then their car is automatically located and retrieved in a forward drive position to an available bay. The patron's name is displayed on a marquee indicating which bay their car will be brought to. The vehicle is

retrieved and is placed in the bay in about one and a half or two minutes. Once the car arrives, the patron can simply just drive away [2].

2.4.4 A Secure and Intelligent Parking System Using NOTICE

Parking is limited in almost every major city in the world contributing to traffic congestion, air pollution, and driver frustration. For example, the Manhattan Central Business District (CBD) has 109,222 off-street public parking spots [NYC06], for a ratio of approximately one off-street public spot for every 16 CBD workers. Yet, often parking spots are wasted. In large parking lots, a driver may exit the lot without knowing about new spots that have just become vacant. Finding an empty parking spot may also lead to driver frustration if another car takes the spot before the driver can reach it.

Thus, innovative parking systems for meeting near-term parking demand are needed. With wireless communications, computer, control, and electronics technologies, intelligent service-oriented parking management can improve parking space utilization and improve driver experience. This propose is a novel, secure and intelligent parking application system based on the concept and framework of NOTICE, which is a secure and privacy aware architecture for the notification of traffic incidents. The proposed system called Smart Parking is a security/privacy aware parking system. Parking information, order information, and vehicle information are protected by the NOTICE infrastructure. The proposed infrastructure prevents most security privacy attacks. The proposed Smart Parking is an intelligent parking system. Drivers can view and reserve a parking spot on the fly. The parking process can be a straightforward and non-stop process [6].

2.4.5 Smart Parking Systems and Sensors

The parking system face many problems in the parking environment. In order, to solve those problems, smart parking system has been developed. Various approaches and research are made to overcome the difficulties of parking area. As a result, many systems and technologies are developed for parking. The categories of various systems and technologies are explained in following sections. The technologies of the parking system uses wireless sensor network (WSN) for identification an communication [7].

2.4.6 Smart Parking Service based on Wireless Sensor Networks

Wireless sensor network mote is a tiny device which usually consists of a low cost-sensor module, a microprocessor module and a communication module, and provides a powerful consortium of distributed sensing, computing and communication. These module scan rapidly and easily be deployed to collect, process, and transmit information. The wireless sensor networks can be applied to many field areas such as environmental monitoring, surveillance, smart home, agriculture child education, emergency medical care with mobile device, etc. In metropolitan areas, most vehicle drivers have the daily Concern of finding a vacant parking space especially during the Rush hours. It is time-consuming and it is leading to more Traffic congestion, air pollution and driver frustration. A recent Report presents that the traffic congestion is generated by Vehicles searching for parking spaces takes up to 45% of the Total traffic .So, many parking management systems have been Deployed in order to reduce such traffic congestion and improve the convenience for vehicle drivers. A few systems focused on the applications of vehicle parking system using Video camera sensor technologies, to collect the Information in vehicle parking

field. However, a video camera Sensor is expensive, and can generate a large amount of data that can be difficult to transmit in wireless network. In recent years, wireless sensor networks technologies, have a great potential method for providing a low-cost solution in order to implement vehicle-parking service with respect to some reasons as following: easy deployment in existing parking lots without having to install new components (e.g. expensive with sophisticated but cheap sensors for accurately keeping track of vehicles. Moreover, parking information can be gathered by each node and can be collaboratively processed to evaluate other meaningful metrics such as parking times, Billing and payment, etc., to improve the benefit of vehicle Drivers and managers of parking places. This paper introduces a smart parking service based on Wireless sensor networks and mobile phone application for Vehicle drivers. We have designed and implemented a Prototype system of smart parking services that allows vehicle Drivers to effectively find the vacant parking spaces, both in outdoors and indoors environments. The proposed smart Parking system consists of wireless sensor networks, embedded web-server, central web-server and mobile phone application as Android and iPhone. In this system, low-cost wireless sensors network modules are deployed into each parking slot equipped with one sensor node. The state of the parking slot is detected by sensor node and is reported periodically to the embedded web-server via the deployed wireless sensor network. And this information is sent to central web-server using WIFI networks in real-time, and the vehicle driver can also find vacant parking lots using a mobile phone or a tablet [8].

2.4.7 An intelligent driver location system for smart parking

Searching for street parking in crowded urban areas creates many problems and frustrations for drivers. It has been shown that over 40% of the total traffic volume in urban areas is composed of vehicles cruising for parking. A long queue of cruising vehicles can cause serious congestion with the blocking of only a few streets. In addition, low speed cruising can produce significant amounts of automobile emissions, increasing air pollution. A prior study found that in one area of Los Angeles vehicles searching for parking produced 730 tons of carbon dioxide, and burned 47,000 gallons of gasoline over one year [6].

In [5], the proposed solution is that utilizes the sensors (such as a GPS, accelerometer, gyroscope, and digital compass) in a smart-phone to detect the driver's parking/un-parking activities. Such information can then be broadcast (e.g. through the Internet) to people who are trying to find a parking space. To detect parking, a prior work has shown that it is possible to detect the driver's transportation mode (e.g., driving, stationary, and walking) using the sensors in a smartphone. For example, if we detect a transition pattern like driving? Stationary? Walking, we may conclude the car has been parked at the stationary point.

Yan focus on how to detect the UN parking activity by tracking the walking trajectory of the driver using the smart-phone's sensors. The idea is a simple one. If the phone detects that the driver is approach where they parked their car, it is likely the driver is about to leave the area and the parking space will become available very soon. In this paper, we consider a social network formed by drivers, similar to the Crowd park platform [6].

In [9] a driver who is currently parked can provide advance notification about when they plan to leave, and this information may be sold to another driver who is willing to pay via a virtual currency such as Bit Coin to reserve the parking spot. The buyer arrives at the reserved parking spot close to the Leaving time of the seller, and can occupy the spot when the seller leaves. Since the drivers transact only parking availability information, our paradigm presents a loose reservation model for the parking spot, and the buyer is charged only when they successfully park their car in the focal location. Our system provides an incentive for sellers to contribute their leaving information, and also encourages the buyers to re-sell the parking spaces when they leave. Each participant in this system is assigned a random unique ID when joining the social network, and thus their real identity will not be revealed to the other users [9].

2.4.8 A Reservation-based Smart Parking System

The study of Cyber-Physical System (CPS) has become a key area of research. It refers to a new generation of systems with integrated computation and communication capabilities that allow users to interact with the physical world. The ability of interaction with physical world is a key catalyst for future technology development. CPS, therefore, provides significant opportunities for design and development of next-generation traffic management solutions. As an important component of traffic system, parking management system is playing an important role and affecting people's daily life. By detecting and processing the information from parking lots, smart parking system allows drivers to obtain real-time parking information and alleviates parking contentions, which is a practical application of CPS. The parking industry generates billions of dollars in annual revenue in the United States alone, and parking regulations may

affect people's concerns about traffic congestion, air pollution, drivers' frustration about parking searching, and municipal objectives. For instance, a recent survey shows that during rush hour in most big cities, the traffic generated by cars searching for parking spaces takes up to 40% of the total traffic. Therefore, in these densely populated urban areas, a certain amount of traffic congestion and delay are due to parking. A recent study shows, in a business district of Los Angeles, vehicles looking for parking burn 47,000 gallons of gasoline and produced 730 tons of carbon dioxide, which is equivalent of 38 trips around the world. Clearly, the problems associated with parking imposes significant societal costs, both economically and ecologically. In order to address these problems associated with parking, smart parking systems aiming to satisfy the involved parties (e.g., parking service providers and drivers) have been developed. However, most current smart parking or parking guidance systems only collect and publish live parking information to direct drivers to available parking spaces near their destinations. These systems are not "smart" enough, because they cannot successfully help drivers find a desired parking space in crowded areas, and sometimes make the situation worse. For example, if available spaces in a congested area are less than the spaces in demand, more drivers trying to park will head for the limited available spaces, causing severer congestion. In this case, detailed information associated with parking availability would allow drivers to make better decisions on use of parking lots and road-side parking. In contrast to such parking information guidance systems, this thesis presents a Reservation-based Smart Parking System (RSPS) that not only to broadcast real-time parking price based on the parking availability to the drivers as part of a communal application, but also to provide reservation service as part of user-targeted service. Built on advanced

sensing and mobile communication techniques, RSPS processes streams of timestamped sensing data from sensor network in parking lot, calculates the real-time parking price based on parking availability information and publishes the parking price to the drivers. On the other side, the drivers can retrieve parking price and reserve their desired vacant spaces via Wi-Fi or Internet [10].

2.4.9 An Automated Parking Management System

Imagine a scenario that you look at your smart phone to find a parking spot close to your destination, drive there, and just park. You do not waste your time and money to drive around in order to find one parking spot amidst a sea of cars. We develop the Part-A-Lot, the parking lot monitoring system, which would not only help us, but also people in urban parking scenarios. According to a survey by Department of Transportation in 2007, there were estimated 254.4 million registered passenger vehicles in United States, with the number still increasing at a very rapid rate. According to United States Department of Energy, the rate of motorization in 2007 peaked at 842.6 vehicles per 1000 people. To easily find an unoccupied parking space in a large car park is a problem for many drivers. With the increasing growth of automotive industry, the demand for intelligent parking service is expected to grow rapidly in the near future. With the increasing volume of automobiles, as the number of student increases in the campus area, the possibility of finding the best location for the parking spot decreases. During the peak hour of campus, it becomes even harder to find a parking spot in the whole campus and the possibility of missing classes or appointments increases. This problem persists in urban areas too and people lose time and fuel while driving around looking for a parking spot. Higher density of consumer vehicles demands an

implementation of automated parking lots who information can be easily sustained and monitored. This emerging service will provide automatic management of parking lots by accurate monitoring and making that information available to customers and facility administrators. We cannot avoid this problem by simply adding more parking spots. We need to efficiently manage what parking spot we already have. To avoid the case of having to spend more money on building more parking lots and help guide students to the proper parking spot so that they can efficiently make use of time they would otherwise spend searching for empty parking spot. Some of the possible solutions available in the market provides services to find empty parking spot but can be monitored through the server itself. It would help a lot if the monitoring could be done by everyone online even using smart phones or any other web capable device. Current technology facilitates the opening and closing of gates only after swiping of the card but it would help a lot if the gate would automatically open as the vehicle approaches. Thus it is useful to have technical solutions which can provide information on parking space occupancy. There are many other systems to monitor and maintain parking lots and many technologies such as ultrasonic distance sensors, magnetic sensors, image processing or even hybrid of these technologies have been research upon by many other scholars .So the solution we came up with a new monitor system, Park-A-Lot, which comes with its own platform-independent web-page interface that is easily accessible using any devices like iPhone, computer or android and can be used anywhere with the access to web. It is based on Ultrasonic sensors. It provides occupancy information for car park users and helps them to place the car in a very efficient way [11].

2.4.10 Social Network for Optimized Mobility

Seamless mobility, provided by intermodal mobility chains, is a great challenge, especially in rural contexts. We understand inter modality as follows, though focusing only on human transportation Inter modality is a quality indicator of the level of integration between the different modes: more inter modality means more integration and complementarity between modes, which provides scope for a more efficient use of the transport system. The economic basis for inter modality is that transport modes which display favorable intrinsic economic and operational characteristics individually, can be integrated into a door-to-door transport chain in order to improve the overall efficiency of the transport system. Providing efficient mobility across individual means of transportation and offered by several independent mobility providers, is a challenge for personal mobility in tomorrow's networked society. In contrast to the trend of urbanization where especially younger people move to the growing cities, elderly people Are staying in rural environments. These creates addition all challenges to the mobility chains, i.e. be accessible for people with special needs such as elderly people, people with limited physical mobility (i.e. due to handicaps), people with baby carriages, etc. Barrier free accessibility according to the existing norms can address these problems only partially. Broader and holistic concepts are needed here. In rural areas, even fit people that do not need to carry anything around can have problems traveling only a few kilometers when they do not own a private car. Given that most privately owned cars are standing for more than 90% of the day and the costs of ownership and mobility, alternatives are needed that ensure personal mobility in the future Therefore, many people are dependent on the assistance of people owning a car, or have to stick to the sparse public

transportation schedules. In order to improve the mobility situation with these users in mind, we have designed our vision of MOBILINET. MOBILINET is a user-oriented approach for optimizing mobility chains for all kinds of user groups, not limited to people needing barrier-free access or other support. Our social network-like system allows for allocation and coordination of mobility services and can be accessed by all Internet-connected devices. We, by this approach, treat the network of vehicles like a social network, as it has e.g. be done with objects in the context of the Internet of Things. This allows using the system from everywhere. And due to the great success of smartphones and tablet PCs, most people could even use the system while traveling. The usage of modern Internet connected devices does not automatically mean the exclusion of elderly people. For example, Kobayashi et al. have evaluated the touchscreen interaction of elderly users and created a set of guidelines for creating user interfaces that can satisfy the demands of all age groups. Following rules like that, one should be able to create a system that could be operated by everybody.

MobiliNet is based on a platform which interlinks not only people with each other, but also vehicles, public transport stations, parking lots, and other mobility related systems and services. The integration of things into Internet-services is often referred to with the term Internet of Things Adapting this term to our approach; one could say that MobiliNet is a service for the Internet of Mobility. The remainder of the paper is structured as follows: We first situate our vision with respect to future visions and existing systems. Then, we describe the concept behind MobiliNet and discuss technological possibilities for the realization of the system. After that, a sample trip plan shall, in form of a scenario, highlight the capabilities

of the system. In the conclusion, we give a summary and provide an outlook towards a working prototype we are currently working on [12].

2.5 Summary

Many past studies discussed how the parking problems can be solved, beginning with automating parking and retrieving cars and some modules are mentioned as examples of automation process. Improving the security and safety in parking. Wireless or social network systems used. And interring the automated parking systems into internet of things term. And methodologies to manage these parking systems.