Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 7, July, 2021:1136 – 1143

Smart Parking: A Parallel Parking System

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Abstract

Attempting to reduce vehicle theft, as well as space consume in the parking system after increasing the population worldwide. The Smart Parking system is designed to make a secure and less space-consuming parking system. Smart Parking system achieved higher security as well as it consumes less space. In the Smart Parking system in place of horizontal concept, a vertical type of concept is used. Smart Parking uses a stepper motor for the up-down purpose and it gives better performance. Smart parking also uses switched reluctance motor for the rolling and angular movement. When a car arrives at the Smart Parking station, at the entrance digital security system will ask for the Radio Frequency Identification (RFID) card, it will permit to park a car in the parking building. In all parking slots, there is an Infrared (IR) module attached to the wall. This whole system will also work on renewable energy sources such as Solar PV system, Windmill. This whole system can work autonomously without any human

Keywords: Edge Detection; IP Camera; IR Module; Microcontroller; Motor Driver Module; Power Controller; Processing Unit; Renewable Energy Sources; RFID System; Smart Parking; Stepper Motor; Switched Reluctance Motor

1. Introduction

A. Conventional Parking system

The Conventional parking system has a horizontal concept, so it consumes more land area. Population is increasing day by day so vehicles are increasing too, due to this land area is decreasing as well as the cost of land is also increasing. Conventional car parking has limited space so a person must look for a vacant space before parking, this process is more time as well as fuel consuming. In the conventional parking system possibility of a car-theft is very high. For the security of the car, a person is needed in the conventional parking system though there is a possibility of car-theft. Due to lack of awareness and lack of management, there will be more traffic in the parking area hence, there is more noise- pollution and air- pollution [1]. This leads to global warming, more pollution as well as more consumption of non-renewable fuels.

B. Smart Parking System

The Smart Parking system has a vertical as well as a parallel concept, which consumes less land area. Smart Parking system will overcome the blockage of car, which occurred due to congested parking. Smart Parking does not need any guard for security purposes as well as guiding the person. Smart Parking system is more secure than a conventional parking system, so there is no possibility of car theft because there is no possibility of humans or animals entering the parking building. Smart parking uses an RFID system [2], an image processing camera for number plate scanning to increase security also, there will be several CCTV cameras at

the parking building [3]. There is no wastage of time as well as fuel in this system. Smart Parking system will reduce air pollution as well as noise pollution.

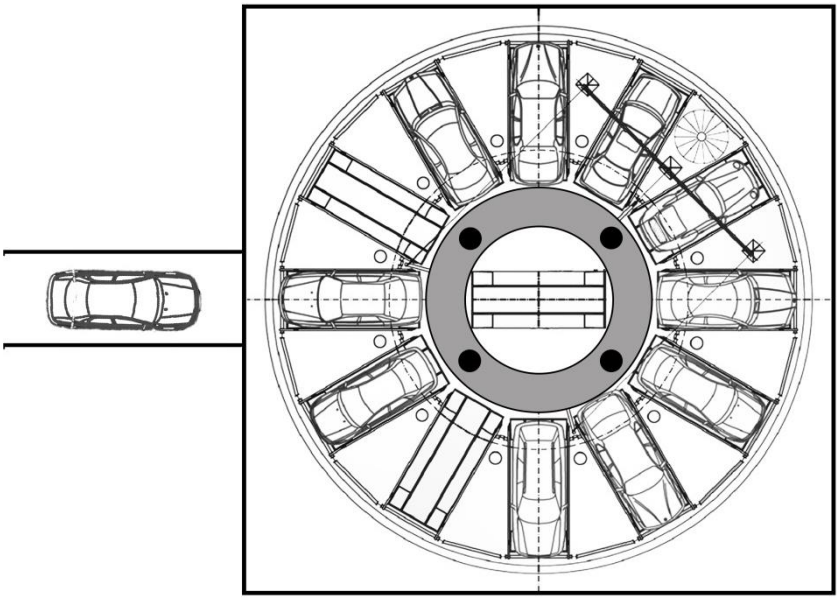

Figure 1. Smart parking system.

As shown in the figure 2 a car will enter into the parking building using its RFID card [2]. Person has to place a car on the middle platform and it will take this car automatically to the empty parking slot of the building. When a person wants to receive the car, system will ask for the RFID card and system match it with an existing database, then middle platform will go at the designated floor and bring a car automatically [2].

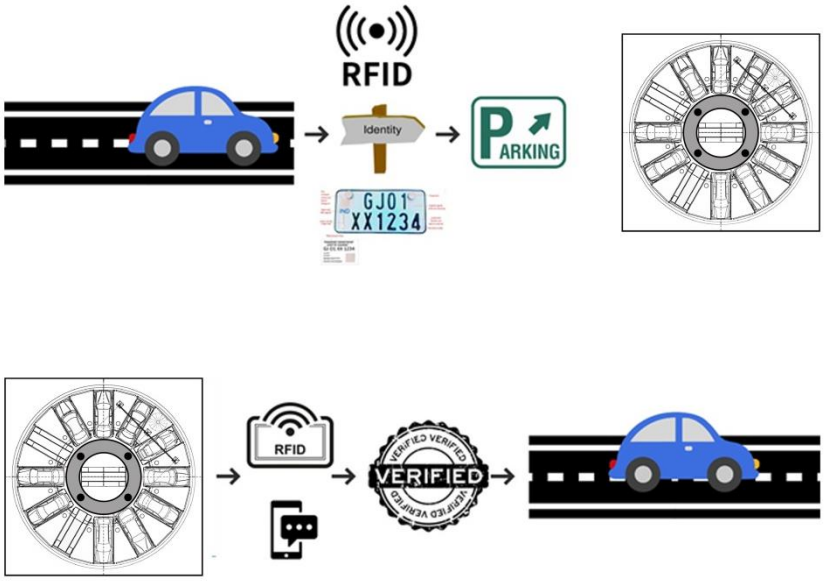

Figure 2. Smart parking system.

2. Methodology

To overcome issues of conventional parking system smart parking system is design. Smart Parking system is divided into two main blocks such as power-flow block diagram and data- processing block diagram [1].

A. Power-flow block diagram

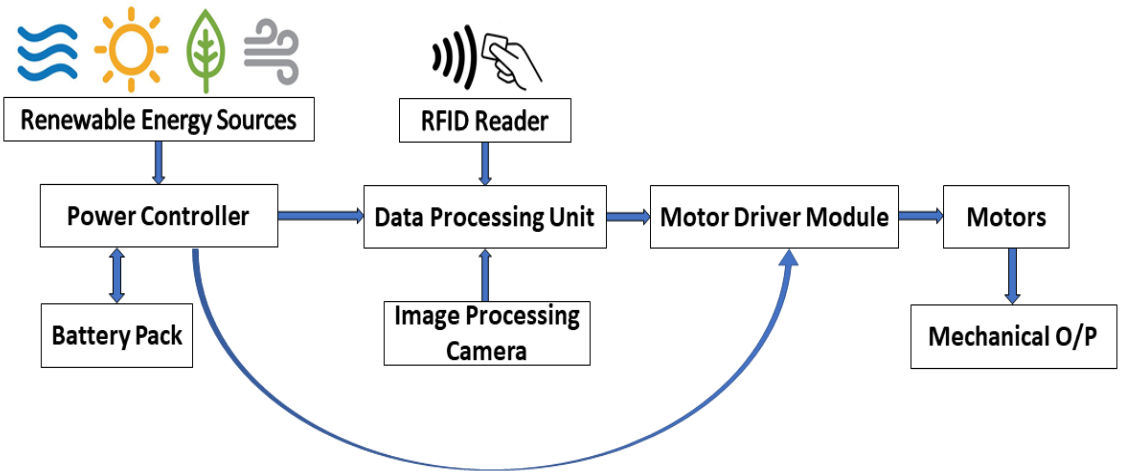

Figure 3. Power-flow block diagram

As shown in the figure 3, electric supply of the model will be generated by renewable or non-renewable sources [4]. This supply will be given to the power controller which will divide power into different voltage levels as per requirement. Power controller will decide whether the supply can be taken from renewable energy sources, non-renewable energy sources or battery pack [5]. Power controller is connected to a data processing unit that processes all the data of the RFID card and image processing cameras in real-time [3]. Motor driver will get supply from the power controller to run electric motors. When motor will give mechanical output, a car will move according to the algorithms which were already set in the data processing units [6].

B. Data processing block diagram

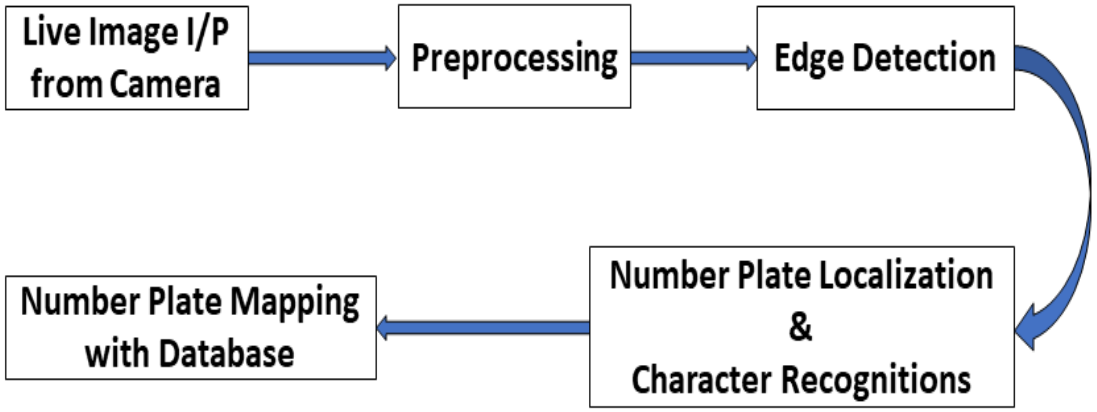

Figure 4. Image processing block diagram

The figure 4 shows how image data will process in the smart parking system. As mention in the above block diagram, live images from the image processing camera will further transmit to the processing unit. In this processing, there will be edge detection and character recognition from the number plate. After processing, this data will send to the database and it will cross-check number plate data with the existing database [3].

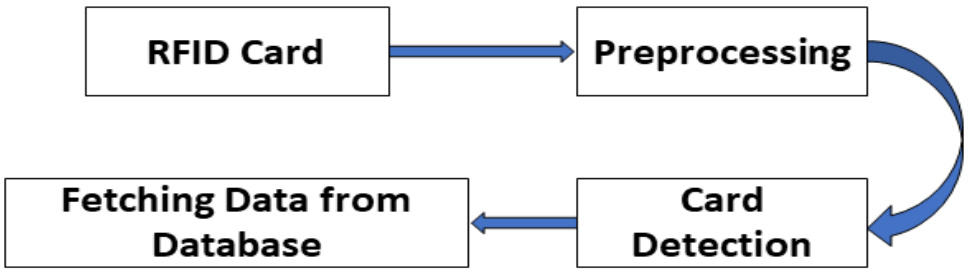

Figure 5. RFID data processing block diagram

The figure 5 shows how RFID data will process in the smart parking system. After detection of the RFID card from the RFID reader, it will send data to the database and it will cross-check data from the existing database [2].

In all parking slots, there is an Infrared (IR) module attached to the wall. These IR modules send data of empty or filled parking slots to the data processing unit. According to this data, the data processing unit will send a car to the parking slot [7].

C. Flow charts of algorithm

There are two parts of algorithm one is when a car coming for the parking and second is when a person will come to receive a car. The two parts of the algorithm are shown below in the form of flow charts.

- At the time of parking a car

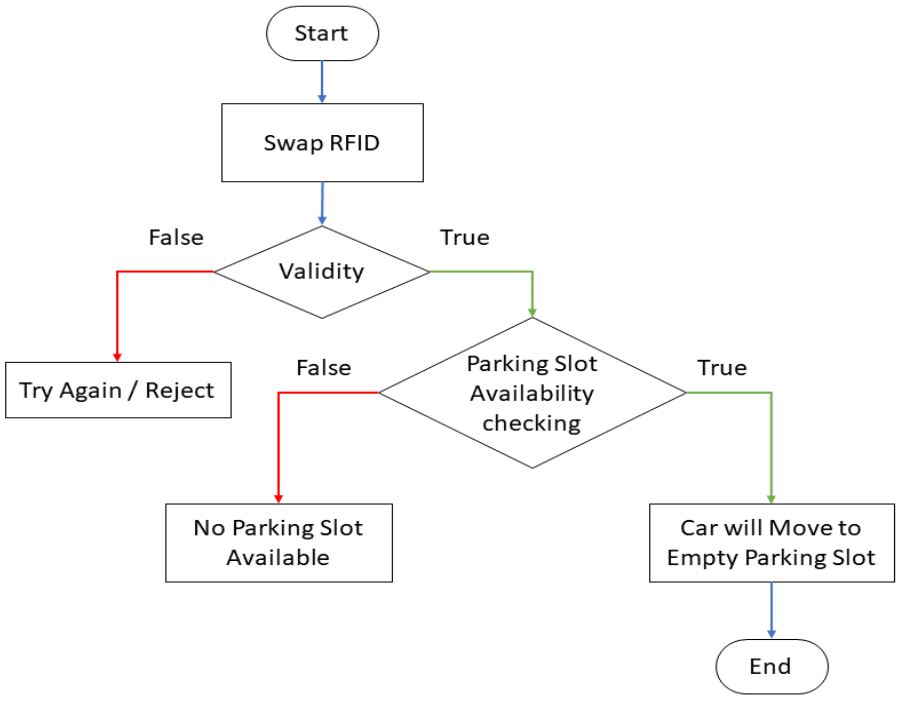

Figure 6. Flow chart of "at the time of parking a car"

As shown in the above flow chart (figure 6) when a car will come at the entry person will have to swap a valid RFID card. If the RFID card does not match with the existing database then it will display the message as "Try again". IF RFID card matches with the existing database then system will check the availability of parking slots in the whole building [2]. If there is no space for parking, system will display a message as "No parking slot available in the building". If parking slot is available then, system will open level crossing gate automatically and a person can put a car at the middle platform and system will park a car automatically at the empty slot. Then system will record the parking slot in the existing data with the RFID card [2].

- At the time of receiving a car

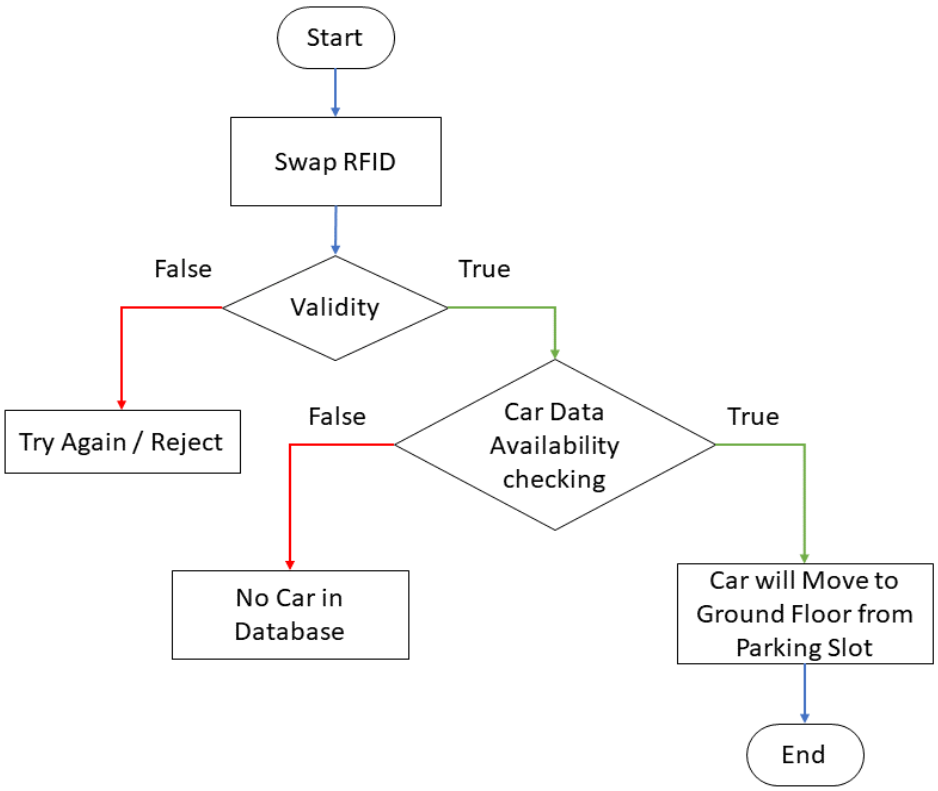

Figure 7. Flow chart of "at the time of receiving a car"

As shown in the above flow chart (figure 7) when a person will come to the receiving platform, a person will have to swap a valid RFID card. If an RFID card does not match with the park car's database then it will display the message as "Try again". If RFID card matches with a parked car's database then system will check all parked cars in the database [2]. If there is no matched car in the parking, system will display a message as "No matched car available in the building". If a matched car is available then, system will automatically go to the parking slot and system will deliver a car to the person.

D. Lift Mechanism

Lift mechanism of Smart Parking system designed such as, it works on the lower electric power input though it will give maximum mechanical output. Lift mechanism of Smart Parking system consists of four stepper motors [8].

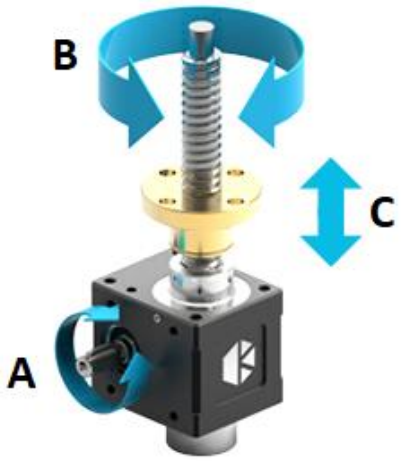

Figure 8. Lift mechanism of Smart Parking system

Figure 8 shows gear mechanism of the lift which is used in the Smart Parking System. Stepper motor shaft is

coupled with a shaft 'A' of gear mechanism. If motor is rotating in a clockwise direction then shaft 'B' rotates in an anticlockwise direction and vice-versa. If 'B' rotates in anticlockwise direction then supporter 'C' will go upward and vice-versa [9].

There are four lift mechanisms same as above and four supporters used in the Smart Parking system for the lifting purpose. These four supporters are placed with a circular plate. In this circular plate rolling and angular movement mechanism is placed for the accurate parking of a car, switched reluctance motor is used for angular movement [10]. This whole lift system can run on renewable or non-renewable or on-line sources [4].

3. dimension of Smart Parking Model

Dimension of Smart Parking model is shown below.

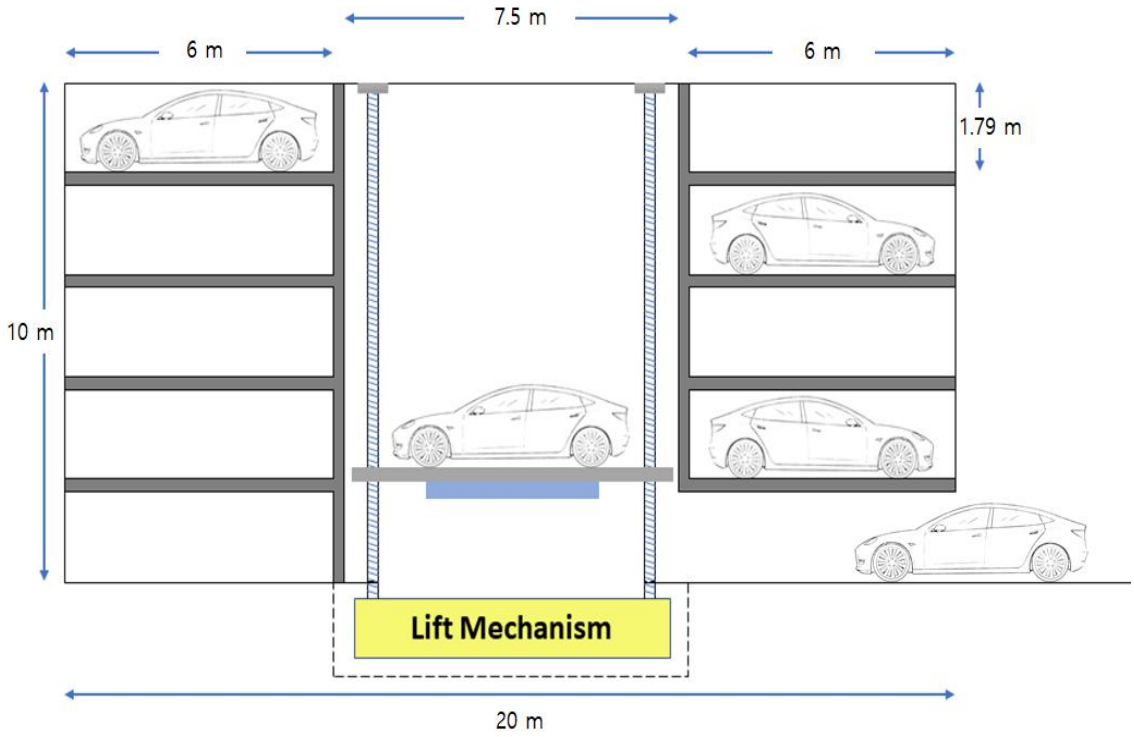

Figure 9. Front view of a smart parking system with dimension

Figure 9 shows approximate dimension of the building. In Smart Parking System, there will be 59 cars can park. An area of one car is left for the entry and exit purposes on the ground floor. Area of the building is 314 m2. Height of the building is 10 m. Diameter of a building is 20 m it can be expanded as per the requirement of parking slots is more. Average height of cars is 1.4 m-1.6 m hence, height of a floor in the Smart parking system is 1.79 m. Average length of cars is 5.5 m- 5.7 m hence, length of the parking slot in the Smart parking system is 6 m. Average width of cars is 1.5 m – 1.6 m hence, width of the parking floor in the Smart parking system is 1.7 m. A minimum thickness of 0.254 m slab is required. Length of a lift platform is 7 m.

TABLE I. MEASUREMENTS OF BUILDING

1	***Dimensions of Smart Parking model***	
	Height of the building	10 m
	Diameter of the building	20 m
	Length of a Parking slot	6 m
	Width of a Parking slot	1.7 m
	Height of a floor	1.79 m
	Thickness of slab	0.254 m
2	***Area of Smart Parking model***	

1	***Dimensions of Smart Parking model***	
	Building	314 m2
	One parking slot	10.2 m2
	Lift mechanism	176.625 m2

4. Conclusion

In the past few years, demand for parking space had increased because of an increase in population and the conventional parking system has many disadvantages such as car theft, more space consumption, wastage of time as well as fuel. A smart parking system has overcome all issues of conventional parking system. A smart parking system has very low theft possibilities because it uses RFID system and image processing cameras for security. Smart parking does not require much space because it is vertical as well as parallel parking concept. It consumes very low of fuel and time because it fully works automatically. A smart parking system can work on lower electrical power because it uses screw lifting mechanism and highly efficient stepper motors as well as switched reluctance motor.

5. Future Scope

- In the future, if the efficiency of renewable sources will increase then Smart Power system can drive on green energy sources.
- To achieve more security there will 100% accurate facial recognition can be used in the Smart Parking system.
- In place of RFID card retina scanner will be used for better performance in the Smart Parking system.
- There will be wireless charging available for future electric vehicles.
- Smart Parking system will be more accurate, faster, more, and more stable if accuracy of motor will increase.
- Building size of Parking system can be varied according to user's requirement.

Acknowledgment

Special thanks are to Dr. Hitesh Shah, Head of the Electronics and Communication Department, Dr. Vijay Makawana, Head of the Electrical Department, and Dr. Himanshu Soni, Principal GCET, Vallabh Vidyanagar.

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