AN INNOVATIVE APPROACH TO SMART PARKING SYSTEMS: AN OVERVIEW

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ABSTRACT

As the technology is evolving day by day so is the number of cars. There is one big problem of car parking that is going to haunt us. The objective of this paper is to study various kind of parking systems and find the most suitable parking system on different grounds. The parking systems compared are RFID based parking system, FPGA based parking systems, micro controller based and CPLD based parking.

Keywords: Complex Programmable Logic Device (CPLD);Field Programmable Gate Array (FPGA); Fuzzy systems; Radio Frequency Identification(RFID)

I. INTRODUCTION

Parking is the act of stopping and unhitching a vehicle and leaving it unoccupied at a particular place commonly known as parking lot. Parking on one or both sides of a road is often permitted, though sometimes with restrictions. Some buildings have the restriction that only buildings' users will be allowed to park in the particular parking. Different governments and sometimes private contractors designated through different authorities have rules for design and use of parking spaces. As the social and economic background of people is growing which is directly affecting their standard of living in which transportation has a major role to play. To have a better vehicle and more number of vehicles is an important signature of individual's economic level. In recent years big cities are investing lots of money in traffic management building smart parking systems and smart parking lots. There are three types of parking systems the first one being parallel parking which is considered to be very tough for beginners, in this the vehicle is parked parallel to the road and along the sideway, the second one is angle parking system in this the vehicle is parked along the curb or in front of a wall in the parking lot but it is not straight neither it is perpendicular it is at an angle less than ninety degrees and the last one is perpendicular car parking system in which the car is parked against a wall or barrier at an angle of 90 degrees.

So in this manuscript we are going to see through all of those technologies then compare them and then finally conclude the paper by suggesting the best among them based on the results.

II. VARIOUS METHODS

A. RFID Based Car Parking System:

RFID is a very advanced automated detection technology which can transfer data in a full-duplex mode without making any contact. Du Shaobo and Sun Shibao(2012)has made a model of parking system. This is done by

making a radio contact between the tag and the reader the distance and the line of sight is not important for the detection of the tag by the reader because they are coupled using an electromagnetic induction. The tag is made of antenna and a chip. This chip isembedded with a unique code. This code gives the tag one-to-one correspondence to the detection. When the RFID system is switched on the reader sends out an electromagnetic wave at a certain frequency which when strikes the tag in-range produces an inductive current which starts
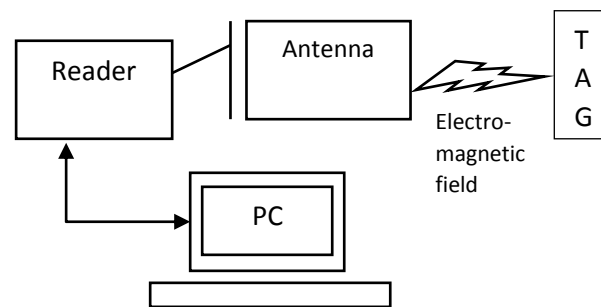

Figure 1: Model of the RFID System

flowing in the tag and it thus sends out the unique code embedded in the chip of the tag. Then the reader reads the data and then sends to data exchange and management system i.e. a personal computer for processing. The chip in the tag does not need battery power to operate it is done by the induced current.

B. **FPGA Based Car Parking System:**

This car parking uses a finite state machine, fuzzy logic and a FPGA (Field programmable gate array) to build a car that can park itself in a parallel parking fashion using fuzzy logic controller. **Insop Song, Keith Gowan, Jason Nery, Henrick Han, Tony Sheng, Howard Li, Fakhreddine Karray (2006)** in their model of parking system are using sensors on the side, back and the front of the car to sense the distance of the car and the wall to find the gap for parallel parking. First of all the sensors on the side of the car keep sensing the distance between the car and the wall and as soon as the sensor senses a gap it starts to measure the distance of the gap i.e. if the car will be able to fit the gap if the gap is enough the car is then ready to park itself. Then the car automatically takes a hard right turn and moves backward. The sensors still sensing the distances while moving backwards the car keeps turning the steering to straight and then to left when the back sensors triggers then the car needs to stop and move in the forward direction until the front sensor triggers, then the car needs to stop and the parking procedure has been completed successfully. The fuzzy logic controller is used to decide the distance between the wall and the car when it is far enough to stop the car and when it is not far enough. This parking system uses VHDL to simulate the software part of the parking systems and then those simulated code is then burned onto FPGA.
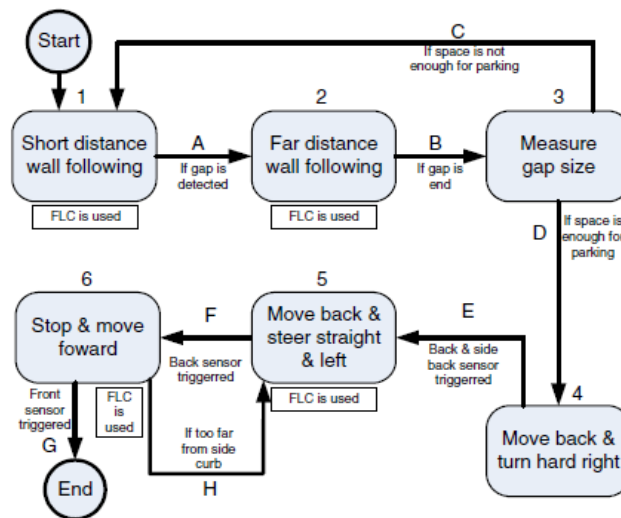
Figure 2: Simplified State Diagram of the System [23]

C. Microcontroller Based Car Parking System:

This parking system made by **TRONG-YEN LEE, CHI-FENG LEE (2012)**has been surveyed in this section. The study is based on the process of parking a car automatically. The system is capable of performing parking trajectory algorithm, turningcontrol, parking space detection as shown in the figure below.
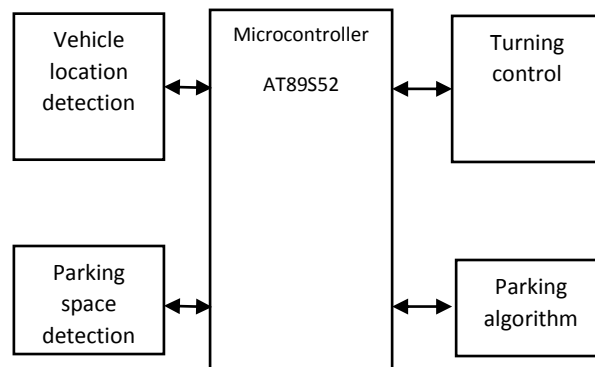

Figure 3: Parking System Block Diagram [24]

Parking space detection in the system detects if or not parking space is sufficient for parking the vehicle. The vehicle location detection used to find the current location of the vehicle with respect to the parking space and then it is fused along with the parking algorithm to implement the complete system. Ultrasonic sensors are used to detect the environment and the parking space. The chip of AT98S52 microcontroller uses to implement the proposed parking algorithm and turning control [24]. The parking system is divided into five parts,which are stated as follows:

(1) Finding the parking space.

(2) Passing through the parking space detected by sensors.

(3) Parking space found.

(4) Parking automatically using the two-turn algorithm.

(5) Finished the parking of the vehicle.

The devised algorithm for parking and a formula looking at the conditions for the parking are then put it in the algorithm. Then the program is burned into the microcontroller and then the emulation is executed. Then we see the results and thus the car is parked in specific spot which it has found, based on the algorithm that has been devised in the paper. The flow chart of the algorithm is given below:
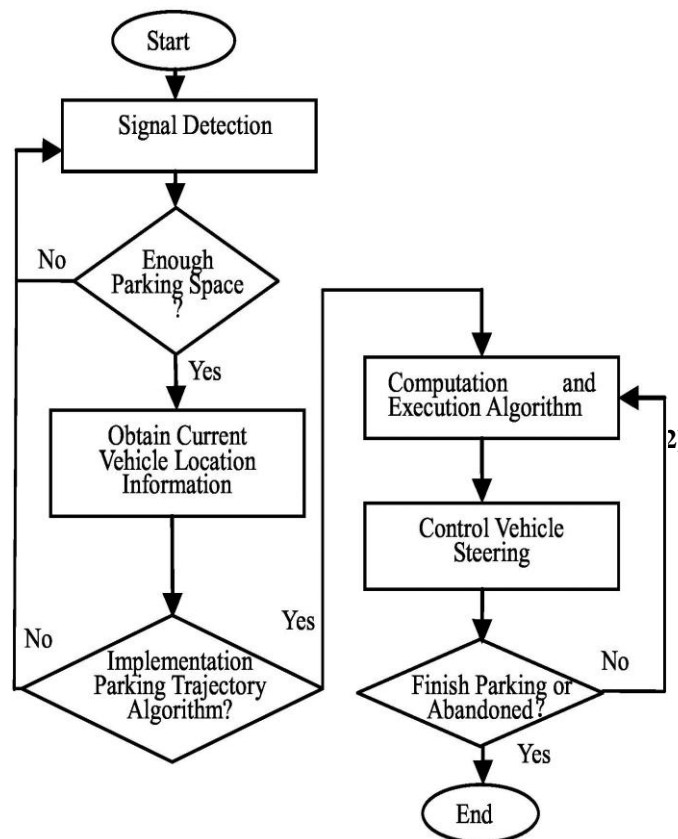

Figure 4: Parking Flow Chart [24]

D. CPLD based parking system:

CPLD has lesser number of logic blocks than that in a FPGA and it is able to implement more number of logic expressions than that in PLA and PAL. This model of parking system has been developed by Divya K. Shah, Chaurasiya Rohit B., Devdip Sen, Shashwat Goyal(2015).The main advantage of CPLD over processors is that parallel processing can be done in CPLD to a large extent. In other words a large number of operations can be performed in a single clock cycle in CPLD which is limited in processors[22].This parking system is divided into two types, the first one is the ordinary parking system and the next one is VIP parking system.

In normal parking system six infrared sensors are used to detect six different parking spaces. When a vehicle parks in any of the given six parking spaces the IR sensor detects the presenceof the vehicle and sends the command to the microcontroller which further processes it and switches off the corresponding LED on the board which is placed outside of the parking lot. This is how the complete system executes in case of normal parking system.

In VIP parking, the member will be having a code which when he enters via mobile phone the frequency generated by the keys will be decoded into their BCD format by the DTMF decoder which will be fed to CPLD and thus the CPLD will send the command to the motor driver to open the gate and let the vehicle enter the VIP slot. This is how the system provides the VIP slot to the person who has entered the correct password.

III. CONCLUSION AND DISCUSSION

This overview paper shows various methodology adopted for making different kind of parking systems, all of them have been discussed earlier in the above section such as the RFID based parking system and CPLD based car parking system is used for management of the parking lot. The microcontroller based and FPGA based car parking system are completely automatic car parking systems i.e. without the intervention of driver the car will park itself once it has found itself a space suitable enough to park itself. After studying through all the literature related to parking systems I found that FPGA based parking systems are more efficient because firstly we can always check our design in the simulator which is not present in microcontroller based parking systems nor in RFID based systems. We can simulate the design in CPLD too but it not as efficient nor as fast as FPGA. This paper provides us a comprehensive overview on different approach of making a smart parking systems and also points out the best suitable choice among them.
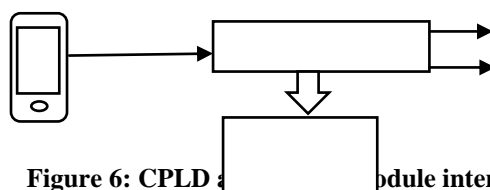
IV. ACKNOWLEDGEMENT

Figure 6: CPLD and module interfacing

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