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Energy Efficient and Secured Smart Car Parking System

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Abstract:
Present industry is increasingly shifting towards automation. In order to aid for the tedious work and to serve the mankind, today there is a need to develop an intelligent operation. This paper has shown the concept of a smart car parking system. Everything in the modern world is being smart enough, we have built a system which can allot a unique vacant slot by prioritizing in such a way that the available slot nearest to the entry for the every incoming car. This automated car parking system reduces the time taken to check the space for vehicles by displaying the available spaces for parking on a LCD by using infra-red (IR) sensors installed at the every slot. In our proposed system the user is informed about the parking slot availability and where to park i.e. displaying the slot number on LCD. At Entry and exit point authentication is done by RFID technology. Parking-lot payment is also done automatically through authenticated gateway. Costs will be reduced considerably using this technology and also traffic can be avoided to a large extent.

Keywords: *RFID, Microcontroller, IR sensor*

1. Introduction

In this modern world, there is a humongous raise in the number of automobiles, which leads to lack of free parking space, especially in shopping malls, 5-star hotels, multiplex cinema halls etc. There arises a need to develop an automated car parking system which makes efficient use of space and avoids traffic. The aim of this proposed system is to develop and implement an automatic and secured parking system that will increase convenience for the public to park as well as collecting parking fees without human by using RFID technology and microcontrollers. This system addresses a challenging design problem to park the cars in close proximity and to operate and maintain such systems.

This paper proposes a scientific technique for automated parking system which allots a unique parking slot to every car thus reduces the burden to the driver to search for a vacant slot and also requires no manpower. This system can accommodate multiple cars at the same time instead of stalling the driver at the entrance. In this proposed system car parking payment is done by using RFID technology. RFID technology is better because the work load can be decreased to a great extent; it is efficient and much more secure than any other networks. Some of the existing technologies in this field use Vision Based Systems and sensor based system. Microcontroller based system are found to be economical and less complex.

Radio frequency identification (RFID) is a form of wireless communication that uses radio waves to identify and track objects. RFID technology has the following advantages

- Uniquely identify an individual item
- Identify items without direct line-of-sight
- Identify many items (up to 1,000s) simultaneously

An RFID system has readers and tags that communicate with each other by radio. RFID tags are small and require less power (even a battery isn't required to store information and exchange data with readers). This makes it easier and economical to apply tags to all commodities that people would like to identify or track.

2. System Architecture

An authorized person's tag information is stored in a tag whose ID is provided to the users, through which all the information can be accessed by the system. When the vehicle checks in, the customer swipes the tag and RFID reader reads the data of the tag. If there is no tag for the customer then the barrier will remain closed. Thereafter reading all the information of the tag, transfers it to the software. The software then starts comparing the information of the tag with the database. If the ID matches, the barrier opens. The reader will take a note of the entry time and exit time from the parking area and calculate the parking fee accordingly as shown in fig. 1.

IR sensors are placed at each parking slot in order to detect the vehicle's presence in the slot. Program is written in such a way that the LCD should display the vacant slot according to the specified priority. If the slots are filled, then it should display "parking is full".

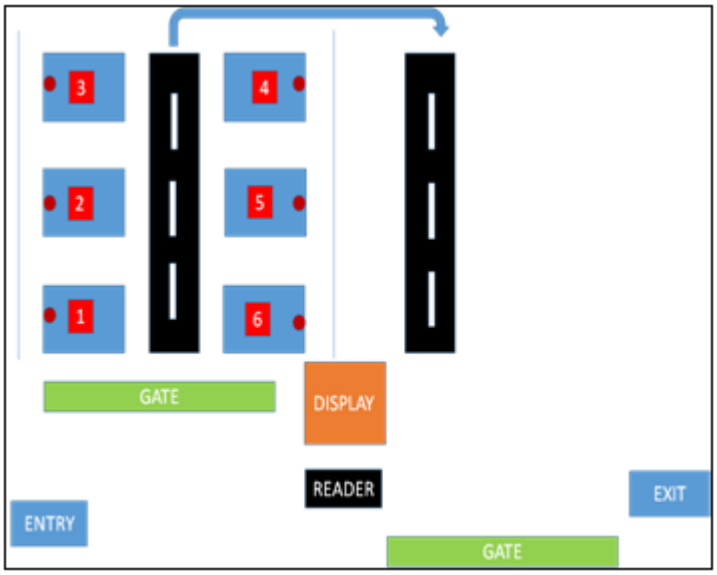
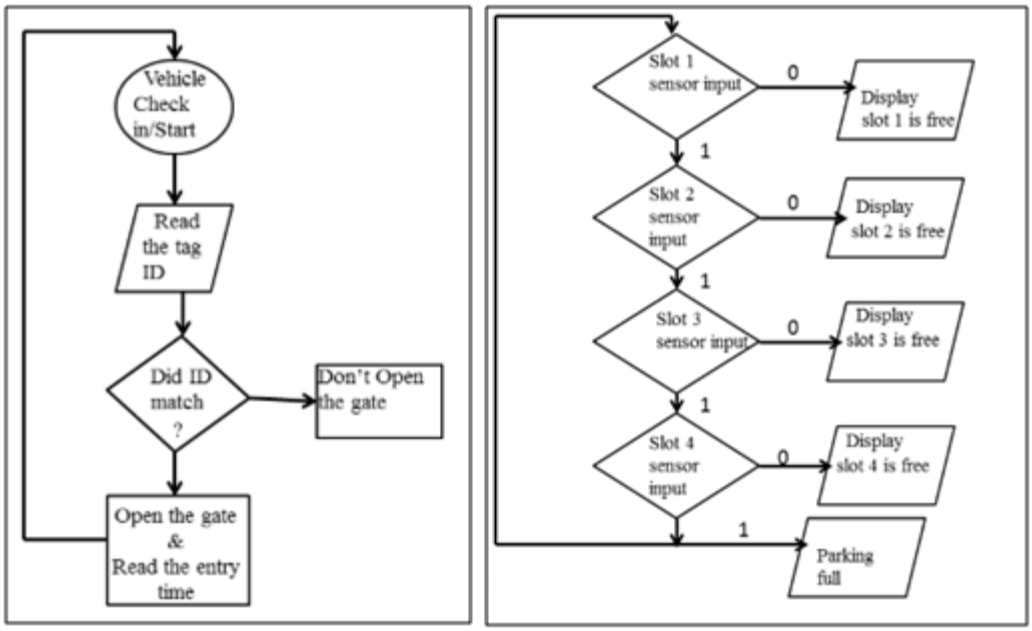


Figure 1: Layout of the system

3. Software Implementation

The complete software implementation of the system is carried out in MIKRO C as shown in the below flowchart.



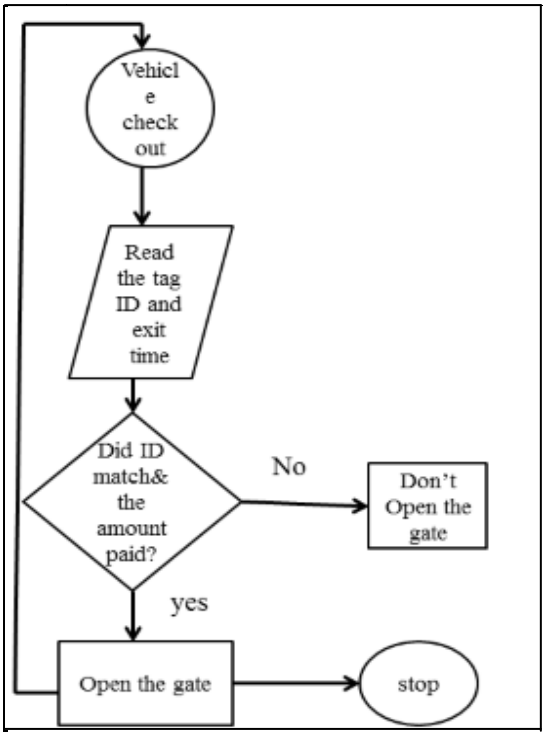


Figure 2: Flowchart showing entry, exit and slot detection

In this process, design and implementation of "Parking system using microcontroller and RFID" is done with modules of identifying the empty slot in prioritizing method. Only an authorized person can enter the parking lot. Billing happens without human intervention. Sensors are used to identify whether the slot is empty or not. The gate will open for an authorized person (who will possess a unique RFID tag). With the help of microcontroller the time of usage of parking facility will be recorded and the corresponding proportionate amount to be paid is deducted through the authenticated gateway.

4. Hardware Implementation

The hardware implementation is as shown below.

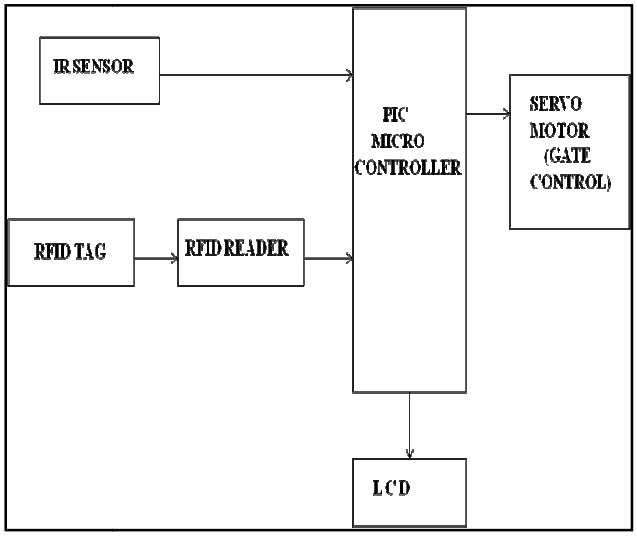


Figure 3: Block diagram of proposed system

4.1. PIC Microcontroller

PIC is a family of modified Harvard architecture microcontroller by Microchip Technology. PIC16F877A features all the components which modern microcontrollers normally have Malfunctioning of PIC percentage is very rare. RISC architecture enhances the performances of the PIC and makes it faster. Power consumption is 5V, which is very less compared to other micro controllers. It is an ideal solution in applications such as: Processes control in industry, machine control devices, measurement of different values

etc.Interfacing and programming is easier when compared to other microcontrollers.Low price; high quality and easy availability are its advantages.

4.2. IR Sensors

The IR Sensor is a general purpose proximity sensor. It is used to check the vehicle's presence in the parking slot. The module consists of an IR emitter and IR receiver pair. The high precision IR receiver always detects an IR signal. The module consists of 358 comparator IC. The output of sensor is high whenever it IR frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware. The power consumption of this module is low. It gives a digital output.

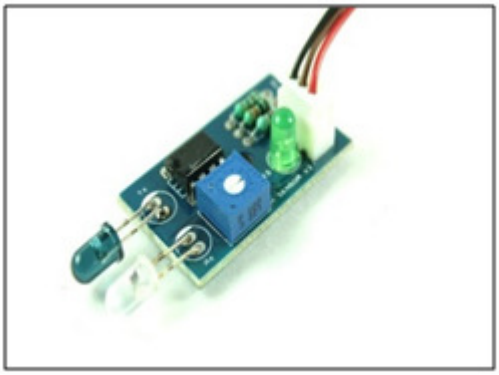


Figure 4: IR Sensor

4.3. LCD

A 16x2 LCD display is a very basic module and is commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments).

4.4. Servo Motor

In this work, Servo motors are used to drive the gates. They are tiny and lightweight with high output power. Servo motor scan rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but are smaller in size. A servo code, hardware or library is used to control the servos. They come with 3 horns (arms) and hardware. Servo motors are used primarily in robotics, CNC machinery or automated manufacturing.

Figure 5: Servo Motor

4.5. RFID Tags

Radio-frequency identification involves interrogates (also known as readers) hardware, and tags (also known as labels).Data can be stored onto tags like customer information etc. Passive tags are used to which power is given from the reader.

RFID tags are classified into three types.

1. Passive tags(operating power generated from the RF reader)
2. Active tags(active RFID systems utilize battery powered RFID tags that require no energy)
3. Semi-passive tags(Semi-passive RFID tags use internal batteries to power their circuits)

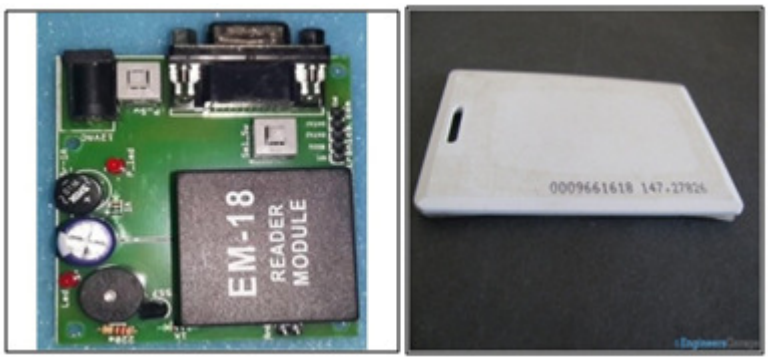


Figure 6: RFID Reader and Passive Tag

5. Results

The proposed parking system uses IR sensors, microcontroller and RFID system.

Figure 7: Display to indicate vacant slot

Priority for allocating the slots is as shown in fig 7, suppose if two slots are free it will select the nearest slot from the entrance.

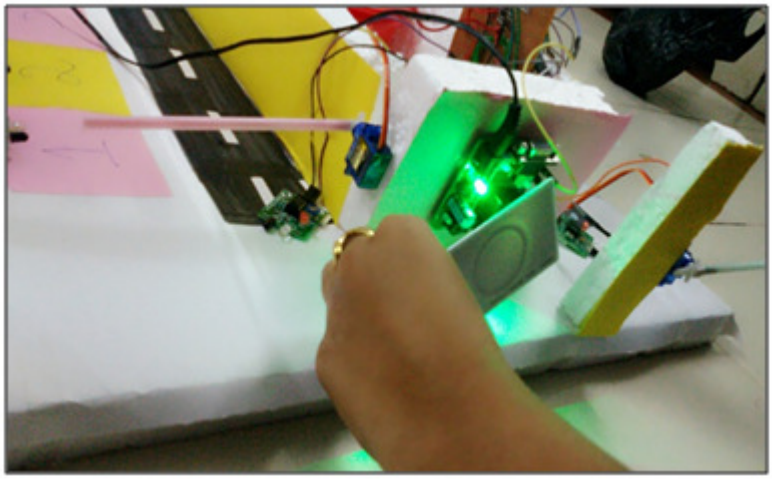


Figure 8: Swiping RFID passive Tag for authentication

From fig 8 it is clear that the gate will be opened only for the authorised persons and remains closed for unauthorised.

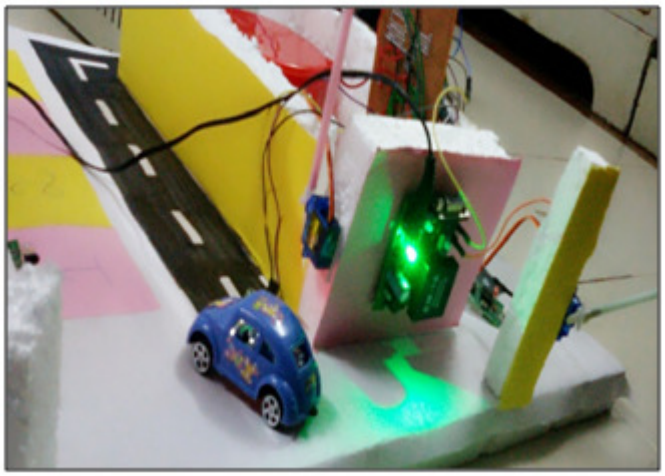


Figure 9: Gate open after authentication

Once if the tag ID matches, the gate will get opened and allows the vehicle to pass through as shown in fig 9.

6. Conclusion

Automatic car parking system provides an efficient and scientific way of car parking in the challenging times of limited space and burgeoning vehicular population. This technique finds its implementation in some of the busy parking lots of shopping malls and apartments. Corporate offices or any other area with limited floor space and large number of cars can install this technique. Traffic congestion will be minimized by faster check-in, and check-out time.

7. Acknowledgement

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8. References

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