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Vehicle parking: A smart solution

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Abstract

The system proposed in this paper provides an effective solution in finding the vacant space and manages the vehicles entering in and out of parking area. The system consists of Arduino Uno, Liquid Crystal Display (LCD), Servo motor and Infrared (IR) Sensors. Two IR Sensors placed just before and after the entrance of the gate which detects the motion of the vehicle either entering or leaving the gate or slot area. The Arduino Uno, a microcontroller counts the number of available slots based on the entry or exit of the vehicle and the state of each slot i.e., either the slot is empty or full and provides a feedback which is displayed on the LCD. This whole process makes the system fully automated and thus provides a solution for vehicle parking in a smart way. The proposed automated system causes the driver to navigate in reaching to the vacant slot using display thus reduces search time. The proposed system can be implemented at places where heavy number of vehicles needs to be parked.

Keywords: Arduino Uno; LCD; IR Sensor; Servo motor

1. Introduction

Today's rapid economic development is mirrored in an increase in the number of automobiles on the world's roads. In many public locations, including malls, hospitals, IT hubs, stadiums, market areas, hospitals, and airports, where a large number of vehicles are parked, it is challenging to find a spot to park the vehicle, there is a lack of available vehicle parking spaces. One must search for every parking space before they can park their vehicle. Additionally, this requires a lot of hard labor and money. Most of them are operated manually and are only somewhat effective. Time wasted looking for a parking spot is an issue that always arises at the vehicle parking. Users will continue to circle the parking lot until they find a free spot. This issue typically arises in urban areas when the number of automobiles exceeds the quantity of parking spaces. As a result, the system described in this work may access data on the slots that are open as well as the status of each slot, such as filled or empty.

2. Related works

Various parking solutions based on different methods have been presented in [1-10]. The Smart Car Parking System which is designed to make it easier for the owner of a vehicle to find out the number of parking spaces available is presented in [1]. It gives information that the number of open slots, but it leaves out the specific slot.

The smart parking system based on reservations and optimal resource allocation is presented in [2]. In this, drivers can use a mobile phone or the internet to access the system. This method specifically allots and reserves drivers the best parking spaces. It is based on reservations, which implies that one must reserve a slot in advance. This saves time, but it's possible that not everyone is aware of it. And that reservation request is based on the walking distance between the driver's intended destination and the parking spot and related fees.

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A parking system developed by [3] using fixed and moving arduinos to identify the wrong parking. An advanced system to park the cars is developed in [4]. An authorization for a user is needed to park the vehicle if the parking slot is available.

A prototype of rotational parking system in which multiple cars can be parked in a narrow space is developed in [5]. The prototype uses an arduino, an actuator, stepper motor and push buttons. A parking system [6] using wireless sensor network is developed to maximize the use of available space.

This paper proposes a method of parking where the number of parking slots available and state of each slot area is generally displayed on display board at entry of vehicle parking. The system helps to reduce the fuel consumption as the travel time is reduced because of the information provided. Therefore the proposed system is beneficial in finding the best way to get a free parking slot in short time.

3. Methodology

The proposed system consists of Arduino Uno, I2C module, LCD display, IR sensors and a servo motor. The Arduino UNO includes 6 pins for analog inputs and 14 pins for digital I/O pins (of which 6 provide PWM output).It takes digital input from the IR sensors and provides analog output through I2C module. The block diagram, simulated model and prototype of the proposed system are shown in Figure 1, Figure 2 and Figure 3 respectively.

- The I2C (Inter Integrated Circuit) module used for holding the data. It converts the serial data into parallel data for LCD display.
- The LCD display (20X4) can display 20 characters per line and there are 4 such lines.
- It displays the parallel data which is converted by I2C module.
- The IR (Infrared) sensors has two LED's in which, one is IR emitter LED and other is IR receiver.IR sensors are used to detect an object and pass the information to the Arduino UNO.
- The function of servo motor is to rotate the object. It is linear actuator and it rotates the gate linearly according to the information provided by the Arduino.
- Battery is a source of electric power to electrical devices.

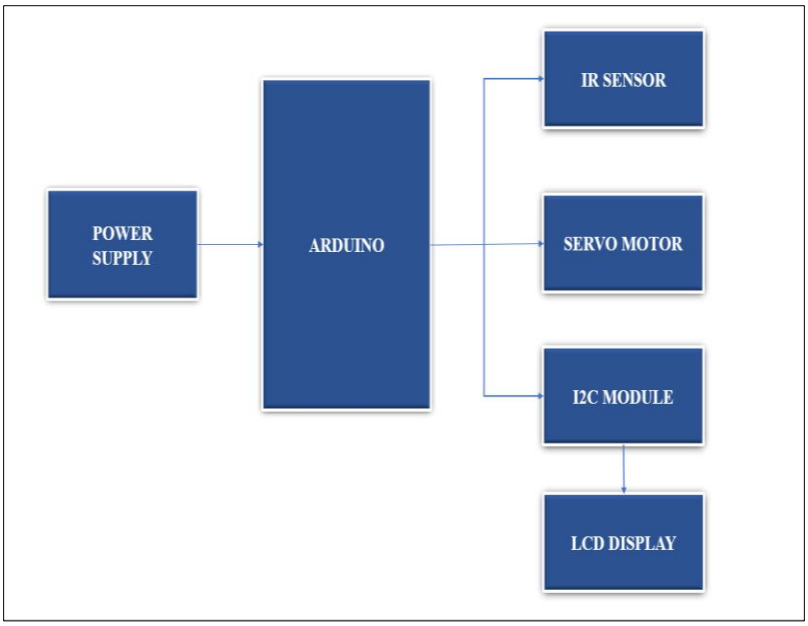

Figure 1 Block diagram

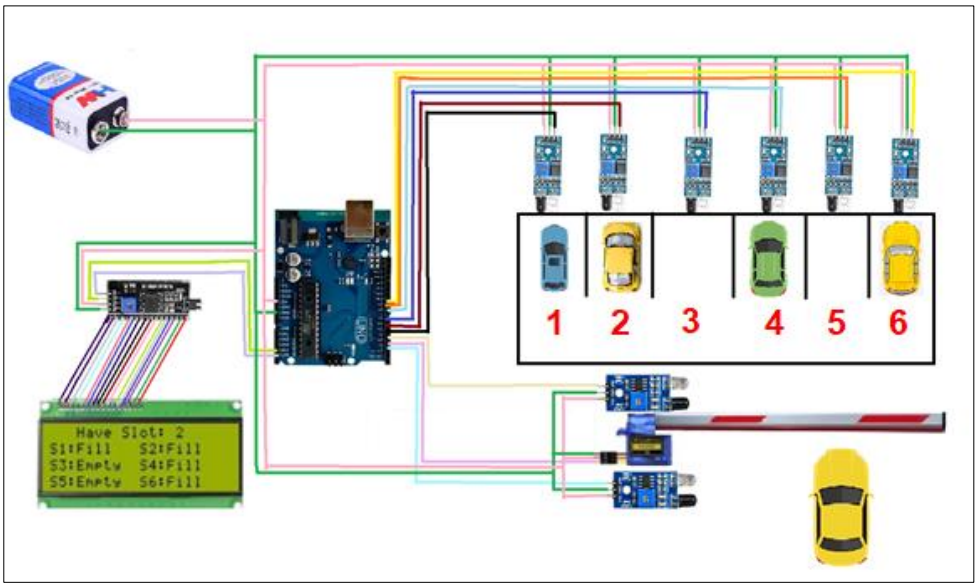

Figure 2 Simulated model of the proposed system

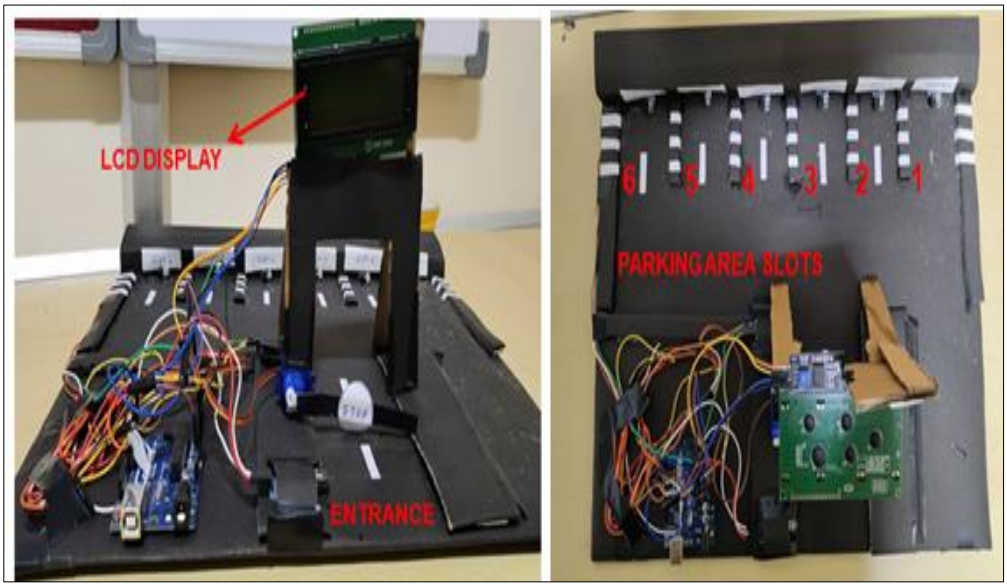

Figure 3 Prototype of the proposed system

4. Principle of Operation

The principle of operation of proposed system is represented in a flow chart and is shown in Figure 4. When the process started the sensors will be initialized. If there is a vehicle it will check for either the vehicle is going in or going out by using the entrance and the exit sensors which are placed both sides of the gate.

If the vehicle is going in, then the counter value will be decremented that means the number of available slots will be decremented otherwise the counter value will be incremented. The display will be updated accordingly.

While coming to the individual slots, if the vehicle is entering into slot then in the display the respective slot will be updated as “FULL”. If the vehicle is leaving the slot then in the display the respective slot will be updated as “EMPTY”. Otherwise the status of the display will remain same.

When the vehicles entered into the parking area, the IR sensors identifies them and the number of available slots decremented but the state of the slots remains same until the IR sensor placed in slot area detects the vehicle. If the

sensor placed in the respective slots detects the vehicle, that particular slot condition will be changed accordingly. The information regarding the entrance of the vehicle at the gate is transmitted to Arduino Uno by using I2C module which converts the parallel data into serial data bus for LCD display. Then it will check for the number of slots, if the number of available slots is less than the total number of slots then only Servo Motor will make the gate open by rotating it and the procedure repeats in case of leaving too. If number of available slots is equal to total number of slots, gate will not open. LCD is placed before the entrance of parking area. When vehicle enters, LCD displays the information about total number of available slots, state of each slot. When any vehicle leaves, that particular slot will be updated as EMPTY. If the parking is completely filled, the display shows "SORRY PARKING FULL" on LCD. This whole process makes the system fully automated and thus provides a solution for vehicle parking in a smart way.

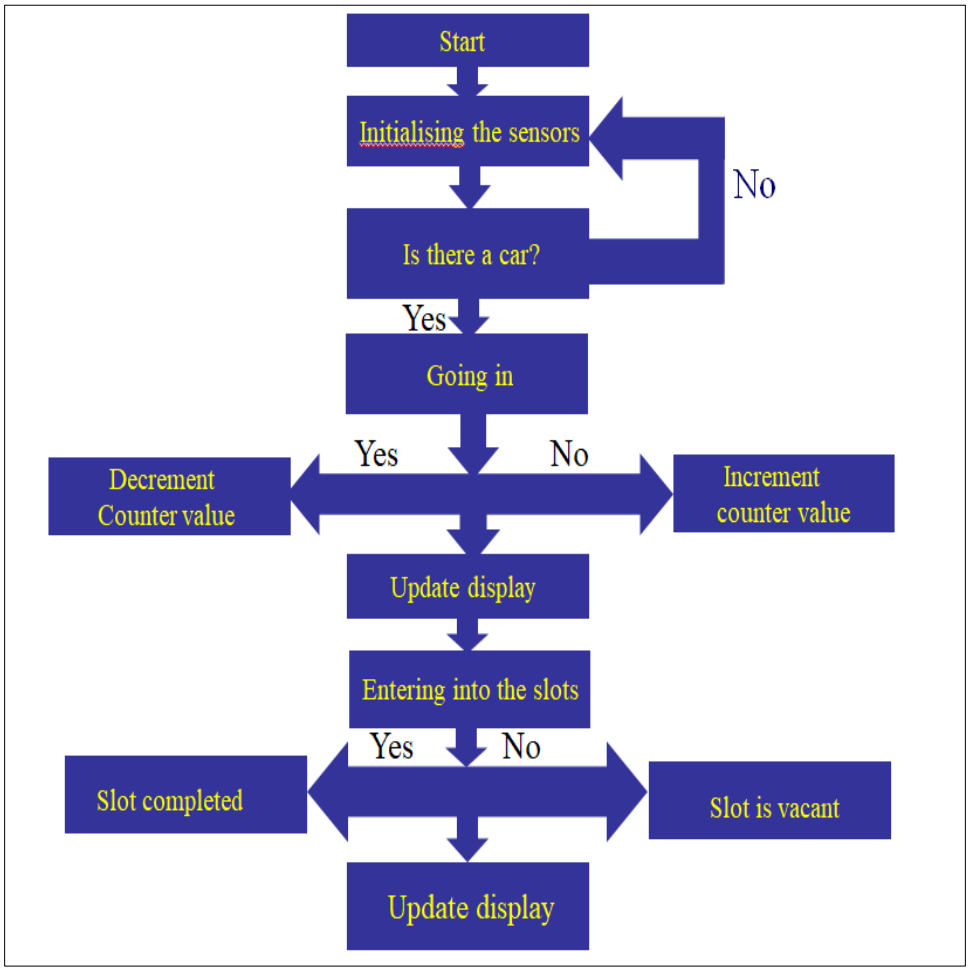

Figure 4 Flow chart

5. Results and discussion

5.1. System Testing

The whole parking area consists of six slots namely S1, S2, S3, S4, S5 and S6 in which six IR sensors are placed in each slot. Two sensors have placed at before the entrance of the parking area and after the entrance of parking area (Before and After the Gate). IR Sensors are used to detect the presence of vehicle. This system has tested with a dummy vehicle. There are usually two possibilities:

- Entry: While entering, the vehicle is noticed by the IR Sensor which is present just before the Entrance of Parking Area and the number of available slots got decreased by 1 but there is no change in Slots until the vehicle is detected by the any one of the IR Sensor present in the Slot.
- Exit: In this case, the vehicle is noticed by the IR Sensor which is present just after the gate of Parking Area.

This whole process includes the use of Arduino UNO, LCD, Servo motor and IR Sensor. There's an entry and exit path in any parking area. Here, this parking area has six slots those are S1, S2, S3, S4, S5 and S6 respectively. Two IR Sensors are required to place just before and after the entrance of the gate and it also requires 6 more IR sensors for 6 slots to place in each slot. The IR Sensors detects the motion of the vehicle either it is entering or leaving the gate and slot areas. The system counts the number of available slots and the state of each slot i.e., either the slot is empty or full. When the vehicles entered into the parking area, the IR sensors identifies them and the number of available slots decremented but the state of the slots remains same until the IR sensor placed in slot area detects the vehicle. If the sensor placed in the respective slots detects the vehicle, that particular slot condition will be changed accordingly.

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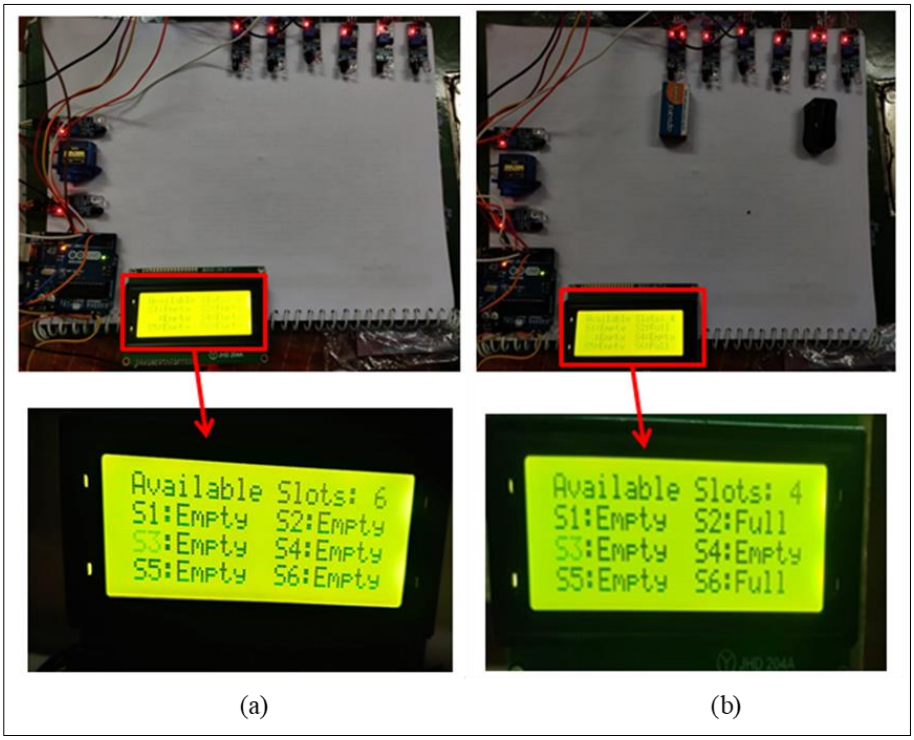

Figure 5 Changes on LCD display before and after detecting the vehicle

Here in this, it has 6 slots namely S1, S2, S3, S4, S5, S6 locating from right to left in which IR sensor is placed in each slot. And 2 IR sensors are placed beside the both sides of the gate which is used to identify either the vehicle is entering or leaving the parking area.

In the Figure 5 (a), there is no vehicle in the parking area so the number of available slots displayed is 6 and each slot is displayed as "EMPTY". Where as in the Figure 5(b) there are vehicles in 2nd and the 6th slots, so it shows the number of available slots are 4 and S2, S4 slots are updated as "FULL". Remaining slots remains same.

6. Conclusion

The proposed system can be useful for parking the vehicles, reducing the time wastage as information is already given before; it is highly demanded in urban areas where people stuck in poor management by searching for an empty parking slot. It operates automatically and the data is updated on LCD display. This feature saves the time and fuel required to search for the parking slot. In future, there will be a mass necessity for parking, increase in technology leads to further development of managing the parking space. It has been foreseen that the developed technology for smart parking system will ensure the facility and security for both the users and the parking companies.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have no conflicts of interest to declare.

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