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Development of A Smart Car Parking System by Using Arduino Uno

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Abstract

In most metropolitan areas, finding a parking place is challenging and is particularly true at rush hour. The issue arises from a lack of knowledge about where available parking spots are at any one time. Though this information exists, multiple vehicles may seek out relatively limited parking spaces, producing significant traffic congestion. Furthermore, as the number of car users grows, the demand for parking rises. This study offers the Smart Parking System to provide confusion-free and easy parking. This project assists car drivers in parking their vehicles with the least amount of wasted time by providing reliable information on the availability of parking spaces. The Arduino Uno is the major component used in this project as the microcontroller unit. This device can automatically detect open, empty parking spots, allowing new vehicles to join the automated automobile parking if the slot is empty; otherwise, if the system does not identify an empty slot, the entrance is halted by the servo barrier. The servo motors then represent the car's status by detecting the vehicle's movement using IR sensors. The Liquid Crystalline Display (LCD 1602) will display the availability of the parking space, while the Infrared sensors will keep track of the number of cars entering and exiting the parking space.

Keywords: - Internet of Things; smart parking; IR sensor; Arduino Uno; infrared sensor

1. Introduction

Parking is an integral part of city transportation, mobility, and infrastructure prosperity, and it is a thriving corporate and public sector economy. The automotive parking market has grown in importance in parallel with the rise of the vehicle market (Aramane, 2021). Parking has become an essential part of journey mobility, as vehicles have. The parking business has always been essential in urban mobility since it is a critical component of achieving a high level of accessibility in a city. Many businesses and communities believe adequate parking, particularly for visitors, is critical to competitiveness. Indeed, many businesses and communities believe adequate parking is essential to their competitiveness, particularly for visitors.

As the number of vehicles grows and there are no efforts or solutions to address the current situation, various issues arise, most notably concerning the limited public parking lots. This can have a significant impact, especially on commercial real estate. As a response to public behaviour, parking issues arise. Ordinary persons can drive their cars toward the market and park anywhere and whenever they like (Charette, 2007).

According to recent research conducted in major cities, the smart parking problem can be approached from various perspectives. The route has a high density of cars (Charette, 2007). Vehicles face a frustrating situation because obtaining a parking space is difficult. In most cases, drivers waste time and energy looking for a parking spot and risk parking on the street. In the worst-case scenario, users cannot find a parking spot, especially during peak hours and the holiday season.

Every person who owns a car requires a parking spot. The request for parking spots grows in lockstep with the number of cars on the road. For example, India's motor vehicle population has increased by about 400% since 2001. In addition, according to the Ministry of Transportation and Highways, from 55 million in 2001 to 210 million in 2015 (Compilador, 2003). The rate of increase of motor vehicles is significantly quicker in densely populated urban centres like Delhi, Mumbai, and Bangalore. Surprisingly, while the rate of population growth in Delhi's National Capital Region is around 1%, the pace of growth in motor vehicles is around 7%. (Economic and Statistics Directorate, 2018) (Compilador, 2003).

Due to this rapid expansion, the car park has become a vital feature of both roads and buildings. As a result, it creates a necessary condition for infrastructure planning. Car parking is a severe challenge at municipal and strategic planning levels. It is a critical factor to consider during the planning process of any piece of infrastructure (Compilador, 2003). If uncontrolled, it leads to accidents, congestion and infractions, injuries and fatalities, and time and budget waste. According to a few older parking studies, people's desire to park precisely in front of their location's entrance (Compilador, 2003) causes the parking problem.

Thus, the implementation of this project prototype can serve as a parking lot guide and indicate available parking places. It's a project that uses an Arduino microcontroller. It uses an infrared sensor to detect vacancies in each parking place on a parking level. It sends a wireless signal to the microprocessor, which processes and shows the number of available parking slots on 16x2 LCDs. Finding an empty parking spot in a modern, advanced country where everybody owns a car and vehicle is challenging. For many people worldwide, looking for a parking space is a common and often irritating task. Time and money are the two most significant things in a person's daily life.

As a result, any company that has a large or small facility must provide adequate parking for visitors. From the driver's point of view, Smart Parking System helps to save time consumption because the trip time is lowered due to the information provided. In addition, drivers can avoid searching for a vacant parking space that is fully occupied based on the information provided.

The research for this project was carried out in an active parking structure, such as a mall or retail centre. This initiative was created to address the problem of certain parking lots being challenging to find. The goal of this project is to inform motorists when a parking space becomes available as well as notify them when one does so before they enter the parking lot. Numerous people will be satisfied. As a result of this because it will reduce fuel consumption and save time.

2. Literature Review on Smart Parking System (SPS) Architecture

Ultrasonic sensors emit sound waves with wavelengths ranging from 25 to 50 kHz. As shown in Fig. 1, the author (Aramane, 2021) uses reflected radiation to inspect and detect the status of a parking spot. The heads of an ultrasonic automobile detection sensor emit ultrasonic waves every 60 milliseconds, and timing disparities between produced and receiving signals are used to verify the presence or absence of vehicles. Ultrasonic sensors can detect cars and determine if a parking space is full. Ultrasonic sensors, while effective and convenient, have considerable limitations, the most noticeable of which are their sensitivity to temperature fluctuations and strong air turbulence (Aramane, 2021).

Fig. 1. Ultrasonic sensor detection area (Aramane, 2021)

In a nutshell, smart parking system users and Drivers use an LED display board to discover unoccupied spaces, which shows how many and what type of vacant spaces are available at each level at any given time. After reaching the chosen parking level, drivers examine internal indicators suspended from the ceiling at the end of each aisle (Aramane, 2021). The number of available spots and the orientation (left, right, or forward) of the aisle with a vacant place are displayed on each interior sign. In addition, each parking space has LED lights above it that may display green, red, blue, or yellow. Green indicates that the spot is vacant, red indicates that it is occupied, blue indicates that it is designated for disabled drivers, and yellow indicates that it has been reserved or is a VIP or reserved area for specific reasons.

A smart parking system has been developed based on an embedded system and a sensor network. The system is a low-cost intelligent parking system that uses WSN (IR Sensor). It produces an android-based application that uses a cluster-based allocation technique and performs automatic billing for multi-level parking facilities. The device keeps track of available parking spots and steers the vehicle to the closest one. The cost is cut while the

dependability is maintained by lowering the number of sensors (Idris et al., 2009).

The system runs on a Raspberry Pi 2B model with an ARM cortex-A7 quad-core, 900MHz CPU and runs Raspbian OS, which is based on Debian. The device comes with a 16GB class 10 SD card that is used to install the Raspbian operating system. It also includes four USB connections, forty GPIO pins, a Full HDMI port, an Ethernet port, and a micro SD card slot (M.Y.I. Idris et al., 2009). The system is set up to use Raspberry Pi as a web server. The device interacts with IR sensors and tricolour LEDs using 24 GPIO pins. They share a common VCC and GND (Idris et al., 2009).

Android studio is used to design an Android application. The JAVA code is used to create Android applications. The source files are transformed into JAVA class files using the JAVA compiler. An apk (Android Package) file contains the. dex file, as well as the resources of an android application. The resulting. apk document includes all the data needed to execute the Application software and can be installed on an Android device with the ADB tool. Visual Studio 2012 was used to create the Windows application (Idris et al., 2009). We can construct windows forms and runnable programs with Visual Studio. According to Net Framework's safety guidelines, this application has a set of basic criteria. This platform creates a setup file for "Smart Parking" and allows us to execute the.exe to create a parking reservation account (Idris et al., 2009). These applications for "Smart parking" were created using a slot allocation approach. The channel allocation method can be used to reserve a slot. On the server, the request is modified and forwarded to the parking lot. Users can enter the parking arrival and departure hours on the platform. Both platform applications ensure parking spaces can be reserved up to two days before the reservation date. The reserved parking location will become available again only three hours after the previously scheduled vehicle's departure time, providing a buffer for subsequent reservations with the same parking spot (Kaliappan, 2018).

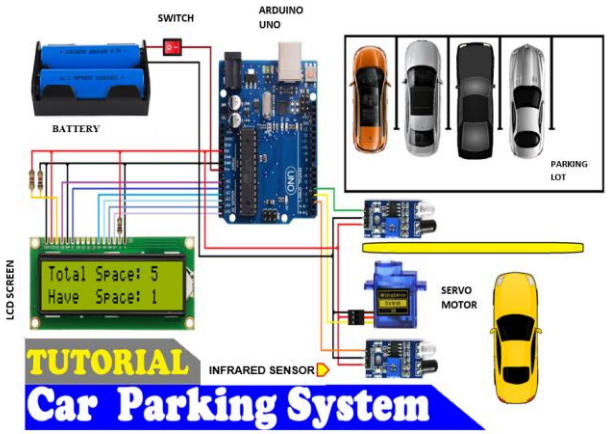
One of the most annoying problems for drivers is finding a parking space. Even inside the park, drivers waste time and gas looking for a place to park. These problems are effectively addressed by the smart parking system that the researchers devised and designed for their study. They also focus on useful smart parking solutions designed to solve current problems by utilising wireless sensor networks and processing sensor data in real time. Furthermore, by giving accurate information on the availability of parking places, this technology helps automobile owners park their vehicles with the least amount of lost time. A smart parking system for vehicles is made using Arduino Uno. The device helps the driver find parking in a new city by using IR sensors positioned in parking spaces to detect vacant slots. An Arduino Uno microcontroller is attached to the servo motors, LCD screen, and IR sensor. The IR sensors count the number of cars entering and leaving the parking lot while the LCD displays the available space. (Satyanarayana, Akhil & Padmini, 2022).

The researcher's suggested system makes use of infrared transmitter-receiver pairs to remotely communicate the occupancy status of parking spaces to the Arduino and display the open spaces on a display at the parking lot entrance so that the user is aware of the parking space's availability or unavailability before entering the parking lot. In addition, the researcher incorporates an Infrared Resistor (IR) sensor and a microcontroller (Arduino) to monitor vehicle entry and exit. Only when a vehicle swipes a legitimate RFID tag at the entrance are they permitted entry. An IR sensor will be installed in each parking space to track whether it is empty or full and to update the information on the Liquid Crystal Display (LCD) device. (Okoh, 2020)

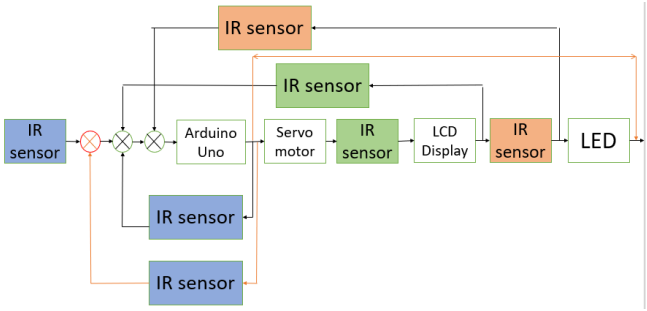
The existing project was used as a reference for the Automated Parking System that was created using Arduino. The use of Arduino Uno distinguishes the existing project from the one to be built. An Arduino Uno controls the IR Sensor. When the IR sensor detects an automobile, it sends a signal to the servo motor to open the gate and to the LCD. The LCD will show the current parking capacity.

3. Circuit and Block Diagram of Proposed System

Fig. 2(a) and (b) show the circuit of the proposed system. From the figure, the input of this system is cars going into the car park, and the output of this system is LCD displaying the words and the LEDs. The component consists in this project are Arduino Uno, IR sensor, LCD and servo motor.



(a)



(b)

Fig. 2. (a) Circuit and (b) Block diagram of the proposed smart parking system

Based on the block diagram above, the blue colour boxes' and green colour boxes' IR sensors are installed at the bar gate. While the red colour boxes' IR sensor is installed in the parking space.

Fig. 2(b), shown in the block diagram with a blue colour line is, represents the process when the parking lot is full.

4. Result and Discussion

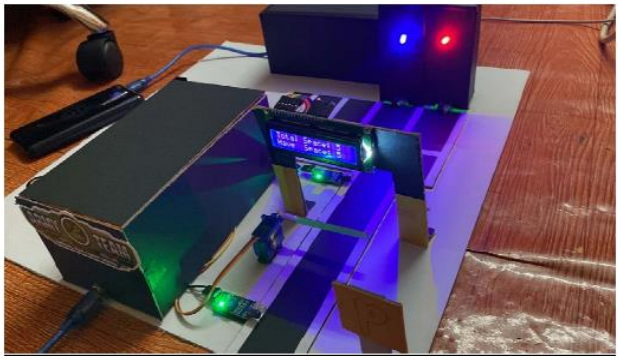
At the end of the project, the prototype has been completed, designed and implemented, as shown in Fig. 3(a) and (b). Therefore, this Smart Car Parking System, with a small size, was able to perform four maximum spaces for the car to enter, pass through the bar, and arrive at a vacant spot; we can see that the empty spot has an IR sensor, which will switch on the light. When the automobile exits, the Infrared sensor and the LED will switch off automatically. In addition, the barrier will not open when the third car arrives, and the LCD will display "No available places.".

The process of this system is not complicated, and it is a user-friendly system. When a car goes into the parking lot, the IR sensor at the gate will sense it. The IR sensor will transmit the data into Arduino UNO. Arduino UNO will process the data from the IR sensor at the gate, and it will decide whether to open the gate bar. If there is space in the car park, the Arduino UNO will send a signal/ message to the servo motor to open the gate so the car can go through. When the car passes through the servo motor, the IR sensor at the gate will sense the car and transmit the data into Arduino UNO. The Arduino UNO will instruct the servo motor to close the gate bar. When a car goes into the parking lot, Arduino UNO will send a signal to LCD to display the number of car parks has decreased. When the car is parked in the parking space, the IR sensor at the parking space will sense the car. The IR sensor will transmit the data into Arduino UNO. Arduino UNO will instruct the LED to turn off and vice versa. The LED will be on when there is no car in the parking space.

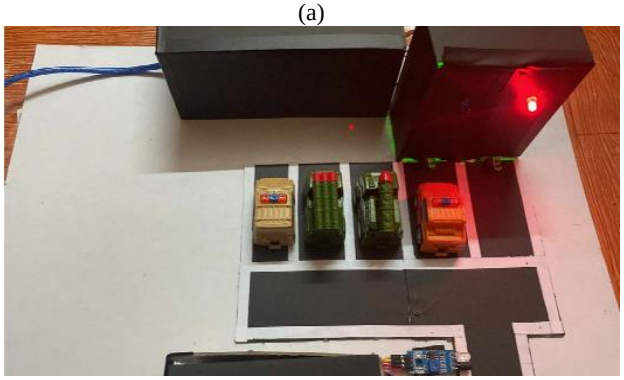
When a car leaves the parking lot, the IR sensor will sense the car and send a message to Arduino UNO. Arduino UNO will instruct the servo motor to open the gate bar after it processes the data that send by the IR sensor. When the IR sensor senses the car, it sends a signal/message to Arduino UNO. Arduino UNO will instruct servo motors to close the gate bar. When a car goes out of the parking lot, Arduino UNO will send a message to LCD to print that the number of the car park has increased and vice versa.

If the parking lot is full, the process is almost the same, but there are some differences. After the first IR sensor senses the car, the IR sensor will send a signal/message to Arduino UNO. After that, Arduino UNO will send a message to the LCD to print, "sorry, no space".

For future upgrading, a suggestion would be implementing RFID and IOT, trying to make an early reservation.



(a)



(b)

Fig. 3. (a) Side view and (b) Top view of the proposed smart parking system prototype

The device detected and followed the car's movement during the functioning test. This applied to both cars entering in and exiting the parking space. Overall, it is possible to infer that these findings satisfied the project's initial goals and that, for the most part, they infer that these outcomes satisfied the project's initial objectives and that the device's functionality met design requirements. In addition, the operating system's actual performance is excellent and error-free.

5. Conclusion

The advantages of smart parking for the system go far beyond preventing time waste. This paper focuses on employing sensors to construct a car parking system detection. However, while the project successfully

produced a device with the essential characteristics, there are still significant areas for improvement and limitations in the device's functioning, as highlighted in the debate.

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