Automatic Smart Parking

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Abstract This project proposes the development of a Smart Parking System (SPS) to address the increasing need for parking infrastructure due to the growth in automobile manufacturing and global population. The SPS utilizes infrared sensors to detect available parking spaces and inappropriate parking behavior. Various detection methods were compared to determine the optimal technique for building the SPS. The system includes features such as empty parking space identification, improper parking detection, display of parking areas, dimensional markers for parking spaces, payment facilities, and identification of different types of parking spaces. The study provides a comprehensive overview of how the SPS technology can be used from the time a vehicle enters a parking area until an empty space is found. The system architecture specifies key design elements such as sensor placement, the number of sensors required for each level, and notice boards for indoor and outdoor use.

Keywords Smart parking · Arduino mega · Infrared sensor

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1 Introduction

The search for available parking spaces in metropolitan areas is a daily struggle for many drivers, and it often leads to time wastage. In addition, cruising around certain areas to find a vacant spot results in increased traffic congestion and air pollution. A survey conducted recently [1] indicates that during rush hours in most big cities, up to 40% of total traffic is generated by cars looking for parking spaces. To address this issue and improve convenience for drivers, various smart parking systems have been implemented with the aim of meeting the needs of parking service providers and drivers.

Existing smart parking or parking guidance systems solely rely on sensor networks to collect data on available parking spaces and then share this information with drivers for guidance [2].

Although existing parking guidance systems can provide information on available parking spaces, they often fail to direct drivers to their desired destinations, resulting in congestion and frustration. As a result, these systems fall short of being truly "smart." In situations where parking is limited, providing drivers with only the number of available spaces can actually exacerbate congestion. Therefore, there is a need for a more effective approach to address these challenges [3].

Our project proposes a smart parking system with an LED display at the parking entrance to inform drivers about available parking spaces and the closest available space to them. The system incorporates a light sensor-based detection system, where each parking space is equipped with a sensor that measures reflected light when a car is parked in the space. The sensor sends the information to the display, indicating that the space is occupied. This approach ensures efficient parking management and assists drivers in finding an available space quickly.

The primary goal of this project is to develop a new smart parking system that aids cars in finding parking spots in a given parking district. Furthermore, one essential purpose of the system is to decrease traffic while looking for parking, hence reducing energy use and air pollution. Improper parking occurs when a vehicle is parked in such a way that it takes up two parking spaces rather than one. Improper parking can occur when a motorist is not mindful of the rights of other drivers. If a driver parks on or slightly beyond the borders of a carpark, this is considered inappropriate parking.

After exiting his car, the driver may realize his poor parking but may be unwilling to unlock his car, restart it, and modify it to be inside the lines. This irritates other vehicles, and most of the time, a driver who tries to park in a little vacant position will give up.

The development of smart parking systems presents a range of alternative approaches, one of which is the IR sensor-based smart parking system architecture that was utilized in our project.

2 IR Sensor-Based Smart Parking System Architecture

The IR sensor-based smart parking system architecture includes a network of infrared sensors installed at strategic locations in a parking lot. These sensors detect the presence of vehicles and transmit the data to a central computer system. The central computer system processes the data and determines the availability of parking spaces. This information is then displayed on a digital board, allowing drivers to quickly and easily locate an available parking space.

The system can also detect inappropriate parking behavior, such as parking in a reserved spot or a handicap space without proper authorization. This data is also transmitted to the central computer system, which can then issue a warning or penalty to the offending vehicle.

The architecture also includes payment facilities for drivers to pay for their parking. The system can differentiate between different types of parking spaces, such as reserved or handicap spaces, and charge accordingly. The use of LED indicators can also guide drivers to the correct parking spaces. The diagram below depicts how the IR sensor works (Fig. 1).

At the parking facility, an LED display board is available for drivers to view the number and type of vacant spots on each floor in real-time. After arriving at the correct parking level, drivers can look at internal indicators that hang from the ceiling at the top of each row. The internal indicators consist of two parts: the number of vacant spots and the direction (left, right, or forward) of the aisle with an unoccupied spot. Each parking space has LED lights located above it that can be green or red. The light color indicates the status of the spot: green means it is available, while red means it is occupied. When a driver parks their car, the green light turns red (Fig. 2). The system is illustrated (Fig. 2) [4].

The system uses infrared (IR) sensors to detect parking lot occupancy. Data obtained from the IR sensors are sent to the cloud platform. Using a LCD, the

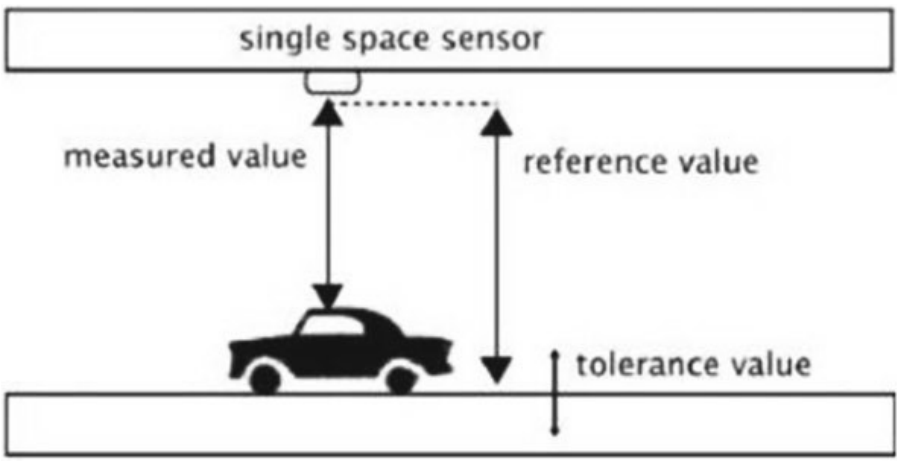

Fig. 1 IR sensor principle of operation

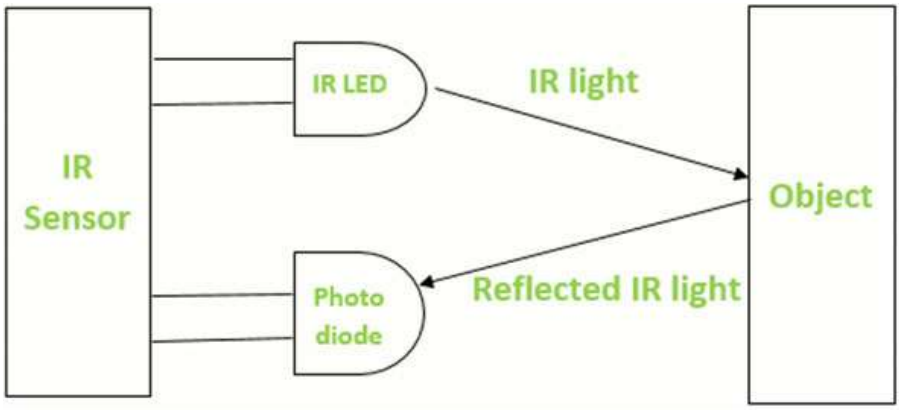

Fig. 2 IR system working principle

user can access the data. Besides, SPS enables the user to get to the nearest available parking lot location [5].

3 Methodology

We utilized the IR sensor to determine the accessibility of the automobile in the parking places, and we'll use the LCD show where your car, while it in an available spaces. In the parking lot, the LCD will display entering cars the nearest level and available space, directing them to the appropriate level.

The operation and function of a smart parking system is essential to comprehending the concept of smart parking monitors. A smart parking system uses technology to improve the parking experience for users. Users would be able to identify nearby parking spaces and reserve their parking spots in advance thanks to these smart parking technologies. The LCD panel is used to display the driver's parking spot, showing him exactly where his car is parked.

IR sensor is considered one of the most important kinetic sensors used because of the speed of its reaction in receiving movement or obstacles, as it works to send infrared rays and then receive them after colliding with the body. When the signal 1 returns, it means that there is a car in the parking lot, and when the signal 0 returns, it means that the garage is empty of cars. Where there are 2 PINs on the sensor, one for sending the signal and the other for receiving it. It is located on the sensor potentiometer, where it measures the distance of the reflection of the rays, and we chose the distance to be short. It distinguishes up to 1 m.

The project utilizes a circuit that includes a regulator to convert 5–12 V, an Arduino Mega 2560 microcontroller that connects all the electronic components to initiate the project, stepper motors to control the lifting, lowering, and movement of the car in any direction, a DC motor to move the slide on which the car is situated forward or backward, servo motors to control the gate's opening and closing, IR sensors with

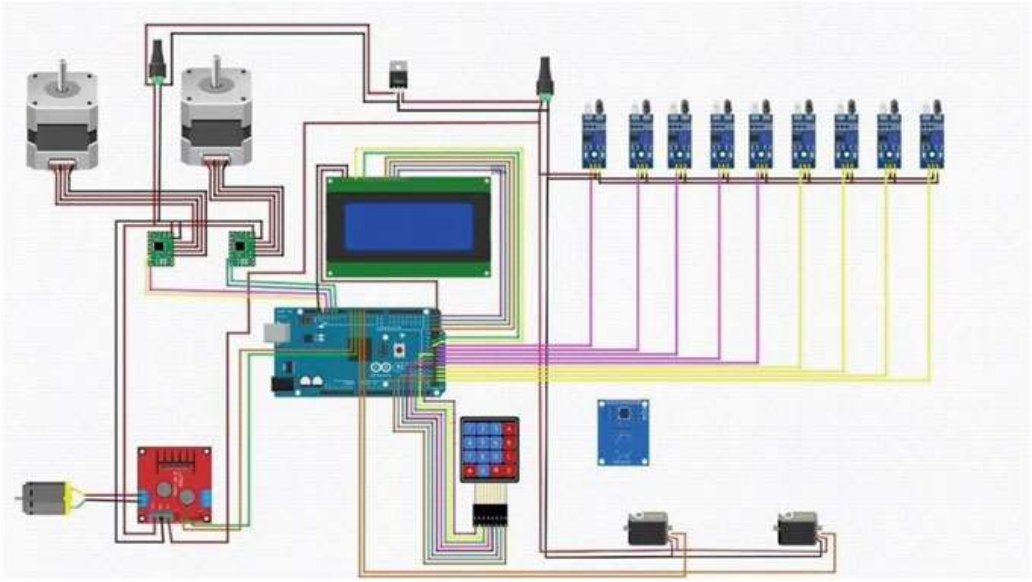

Fig. 3 Project's circuit

senders and receivers to detect the presence of a car in a parking spot, a 4*4 keypad, an LCD display to show the location of the car in detail, and a servo motor driver to amplify the signal and control the motor's movement at the appropriate speed. The IR sensor detects the presence of a car and sends a signal to the microcontroller, where 1 represents a car present and 0 represents no car. The LCD display shows the car's exact floor and location in detail (Fig. 3).

The scope and methodology of this project is illustrated in Fig. 4.

4 Results

Our results depends on the output of the LCD screen, the following figures show the output of it in many cases:

In LCD display we can find our car (Fig. 5).

The final design is shown in Figure 6:

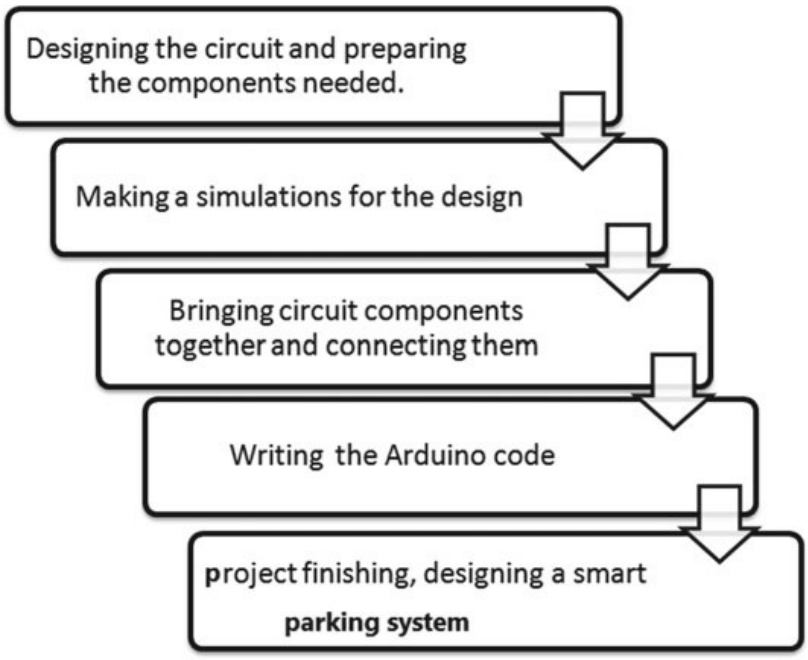

Fig. 4 Flowchart of the methodology

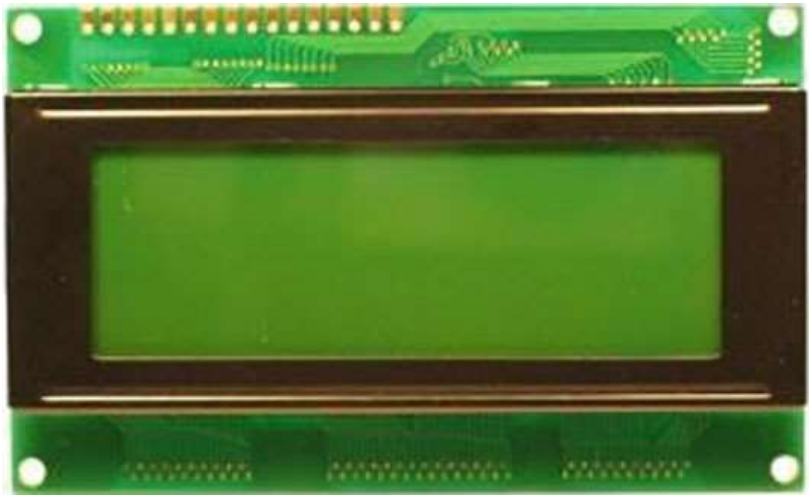

Fig. 5 LCD

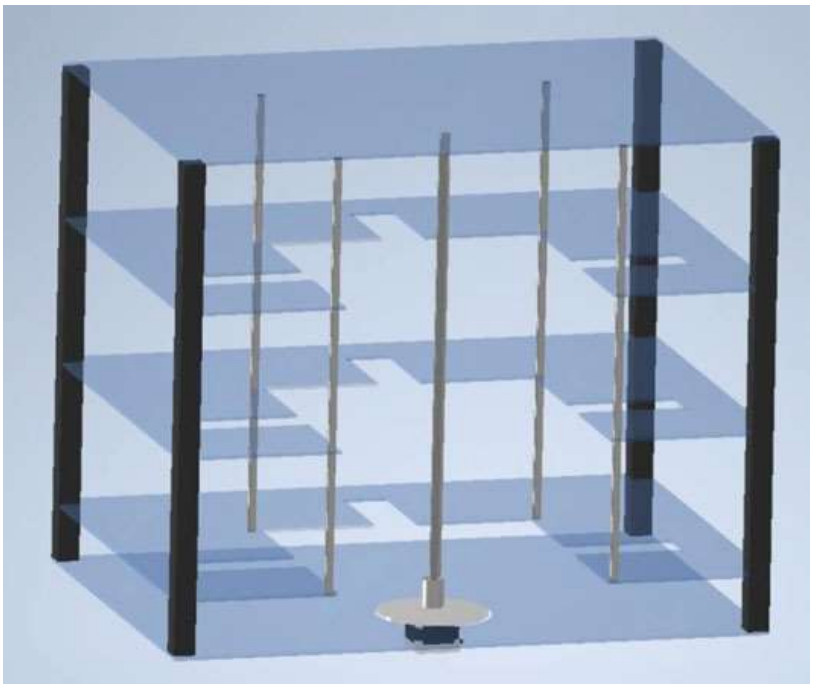

Fig. 6 Final design of the project

5 Conclusion

The smart parking system implemented in this project provides a user-friendly solution to address the ongoing car crisis and parking problem. The system not only saves time, energy, and effort for the driver but also reduces gasoline consumption. By utilizing sensors, the system automatically opens and closes the gate when the driver enters and exits the parking lot. The LCD display shows the driver the exact floor and parking number where the car is located. When the driver returns, the system allows for easy and automated exit. Overall, the implemented smart parking system provides an efficient and convenient solution to the parking problem, benefiting both drivers and society as a whole.

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