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PROTOTYPE DESIGN FOR A MICROCONTROLLER-BASED PARKING INFORMATION SYSTEM

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Abstract

In a parking area, numerous issues exist, such as the lack of information to locate available parking spaces, leading to prolonged search times. To streamline and expedite the search for parking, a parking system can be designed to provide information about full and empty parking spaces. Employing an agile process to address parking challenges, the aim is to shorten queues and provide timely parking information. The envisioned outcome is a system enabling drivers, especially those with specialty vehicles, to identify parking spaces without manual searching. The parking information system prototype incorporates a 16x2 LCD for displaying parking space addresses, LED indicators, and the ability to showcase the number of available parking spaces, enhancing effectiveness and user accessibility. By preventing excessive queues through real-time information on vacant parking spaces, the system reduces congestion and provides smoother parking experiences for drivers. Each parking lot has an infrared sensor to determine occupancy status, while the LCD at the entrance relays information on available spaces. The LED is an indicator light, illuminating when a parking lot is vacant. The microcontroller is the central system, seamlessly connecting and coordinating each component.

Keywords: Information system, Parking.

1. Introduction

Parking is stopping or storing a vehicle in a designated space. It is indisputable that technology is evolving so quickly right now, and information technology is crucial for the community because it may make daily tasks easier. Community mobility is very high, and parking lot issues typically arise when the vehicle parking area is full, which can result in parking lot congestion due to backed-up vehicle lines. The issue with the parking system is that drivers frequently have to search for an empty parking space for a long time due to a lack of knowledge about vacant parking lots and improper car placement [1].

The parking problem is significant and requires a more in-depth study. An adequate number of parking spaces must be available, especially considering the increased traffic coming to and from the hub of activity. Insufficient parking spaces may lead motorists to resort to roadside parking, causing problems [2]. Every driver desires to locate a parking spot quickly. However, during rush hour, parking spaces are often filled, and drivers are unaware of unoccupied spots in the available spaces, forcing them to drive around in search of empty spots [3].

Officers and parking users can easily determine the availability of parking spaces using the parking information system. Information systems are not limited to big or complex tasks; instead, they can be applied to daily tasks that were initially manual. One example of information systems in parking involves significant changes introduced by parking systems adopting information systems. When a parking process is still manual, it changes, leading to automation, where all parking actions are carried out using an application resulting from an information system [4].

Designing a parking system that provides information on the status of parking spaces, whether full or unoccupied, will address this issue. Reducing excess vehicle capacity can be achieved by identifying where parking spaces are empty or occupied. A parking monitoring system is necessary to simplify management oversight of the parking lot [5]. Creating a unique, educational automatic parking system has been considered. In this instance, the Arduino microcontroller will be used as a tool for the automatic parking system [6].

This study aims to create a working prototype of a parking information system that uses an Arduino microcontroller to aid in various aspects of human activity, including parking. Needs analysis, development techniques, and agile are examples of research methodologies. Data are gathered by reading the literature and making observations.

2. Research method

The waterfall method was used to create this prototype to construct a parking information system. The stages of needs analysis, tool design, coding/programming, testing, and report production are the starting points for this method's systematic execution.

2.1. Components of tools

The following information and explanations of the various components used in the design are provided:

i) Microcontroller ESP32

The parking information system uses various sensors and an ESP32 microcontroller for data processing. Espressif System's ESP32 is a potent 32-bit microcontroller with inbuilt WiFi, a complete TCP/IP layer for internet connection, and Bluetooth 4.2 [7]. The Microcontroller ESP32 is shown in Fig. 1.

Fig. 1. Microcontroller ESP32.

An ESP32 microcontroller is seen in Fig. 1. This microcontroller can be used as a substitute for microcontroller interface props and is suitable for usage as the Internet of Things media since it has a comprehensive interface and WiFi built-in [8].

ii) Sensor infrared

The IR sensor is a sensor that can detect obstacles by reflecting infrared light. When the sensor detects an object before it, a reflected light will be received with an intensity adjusted for its sensitivity with a potentiometer. Sensor Infrared is shown in Fig. 2.

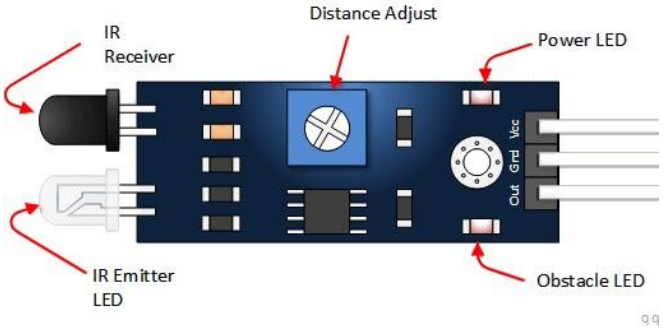

Fig. 2. Sensor infrared.

Figure 2 shows the value produced by the sensor, which depicts that the infrared sensor's physical shape can be HIGH or LOW. If an object is in front of the sensor, the value will be LOW; otherwise, it will be HIGH. The emitter and receiver are

the two primary components of infrared sensors. Infrared is sent from the emitter to the object, reflected, and picked up by the receiver [9]. Medical diagnostics, night vision, remote control, security alarms, and system automation all use infrared (IR) sensors [10].

iii) Liquid crystal display 16×2

An electronic gadget called a liquid crystal display shows numbers or text. Liquid Crystal Display 16x2 is shown in Fig. 3.

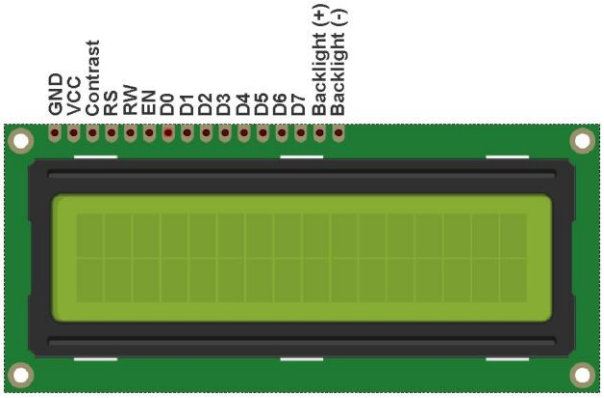

Fig. 3. Liquid crystal display 16×2.

In Fig. 3, the LCD used in the circuit is connected to the I2C module, a two-way serial communication standard using two channels designed to send and receive data [11].

iv) LED Indicator

In this series of tools, the LED is used as a light emitter to mark the parking slot, whether empty or already filled [12]. LED indicator is shown in Fig. 4.

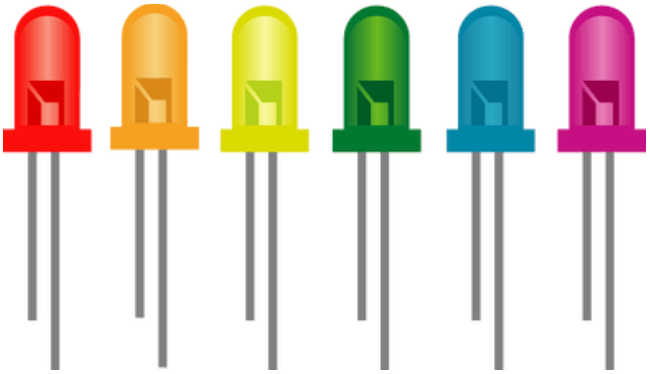

Fig. 4. LED Indicator.

Figure 4 is the physical form of the LED indicator. In this prototype, the colours used are red and green. Red indicates that the parking slot is filled, while green indicates that the parking slot is empty.

2.2. Testing

The parking lot entry bar has an LCD screen showing which spaces are available, and an LED light acts as a signal when the green light indicates the land is vacant. The system is capable of detecting parking lots that are empty or being filled by testing.

Figure 5 shows the input, process, and output produced; an infrared sensor detects the presence of vehicles and detects if the parking lot is empty [13]. Then, after passing the input stage, the next stage is the process stage. The data that the sensor has obtained will be managed by the microcontroller, whose output is in the form of text on the LCD and indicator lights on the LED.

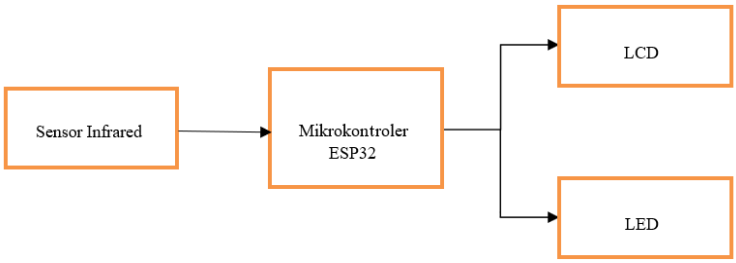

Fig. 5. LED indicator.

To detect an empty parking lot or not, use an infrared sensor by measuring the distance between the sensor and the vehicle (car) [14]. If a condition where the sensor reads a predetermined distance, the parking lot indicates that it is in a state of being filled. The formula for calculating the distance by the sensor is as follows:

$$\text{Distance} = \frac{\text{Time} \times \text{Speed}}{2}$$

A formula to determine the value of a distance may be found in formula 2.1, and the determined distance will be assigned a fixed value. If, for instance, the distance specified is 75 cm and the sensor detects a vehicle farther than that distance, the condition indicates that the parking lot is already full.

3. Results and Discussion

The output produced is in the form of a display on the LCD located at the entrance to the parking lot in the form of information on the location of the empty parking slot. When heading for an empty parking slot, the driver will see a green or red indicator light. When the driver has entered the parking slot, the colour of the indicator light will change to red. The following is a use case diagram of the parking system prototype in Fig. 6.

As the simulation in Fig. 6 shows infrared sensors 1A, 1B, 1C are parking slot locations, where 1A is the 1st floor in block A, 1B is the 1st floor of block B, 1C is the 1st floor of block C. Infrared sensors are used to detect vehicle objects, on infrared sensor 1A has a person symbol indicating that the parking slot has been filled and the data that the sensor has read is sent to the microcontroller for further processing. The output produced by the LCDs is that the 1st floor of block A is filled, and the LED light is red. The status on the 1st floor of block B LCD shows the green LED light is empty; the 1st floor of block C is the same as the 1st floor of block B. This study gives additional information regarding current issues, as reported elsewhere [15-21].

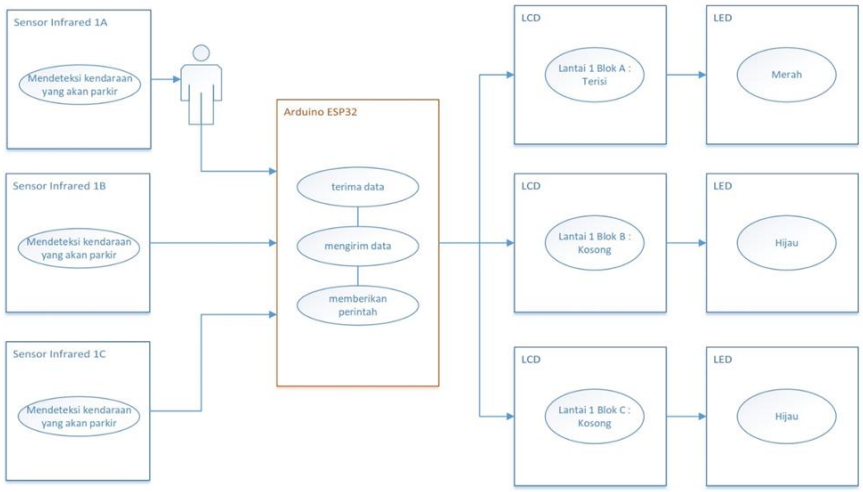

Fig. 6. Use a case diagram of the parking information system.

4. Conclusion

This study covers using a microcontroller to construct a parking information system. With the discussed results, it aims to notify drivers and simplify the parking process, reducing vehicle queues that often arise when the parking lot is congested.

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