Intelligent Parking with Arduino & Bluetooth Control

Mr. K.Rakesh Yadav
Assistant Professor-ECE
Sanskrithi School Of Engineering
Puttaparthi-515134

P.Rani, O.Shamshad,
D.R.Samatha, K.Bhavitha.
UG STUDENTS OF ECE
Sanskrithi School Of Engineering Puttaparthi-515134

ABSTRACT:

In the era of urbanization and increasing vehicle density, efficient parking management has become a significant challenge. This paper presents an intelligent parking system using Arduino and Bluetooth technology to simplify and automate the vehicle parking process. The proposed system allows users to control and monitor parking slots through a mobile application via Bluetooth communication. Equipped with sensors and an Arduino microcontroller, the system detects the availability of parking spaces and provides real-time updates to users. This solution minimizes manual intervention, reduces parking time, and enhances user convenience. Designed to be cost-effective and easy to implement, the system offers a scalable approach for smart city infrastructure and private parking management.

Keywords: Arduino, Bluetooth, Intelligent Parking, Automation, Smart City, Mobile Control, Sensor-Based System

INTRODUCTION

With the growing number of vehicles in urban areas, efficient parking has become a critical aspect of modern infrastructure. Traditional parking systems often lead to congestion, time wastage, and increased fuel consumption, prompting the need for smarter, more efficient solutions. As the world moves towards automation and intelligent systems, the integration of microcontrollers and wireless communication technologies has opened new avenues in parking management..

This project, *Intelligent Parking with Arduino & Bluetooth Control*, aims to address the common issues of manual parking by implementing an automated parking assistant. By utilizing Arduino microcontrollers in conjunction with Bluetooth connectivity, the system allows users to monitor and control parking slot availability in real-time through a mobile application. This reduces the effort involved in finding available spaces and enhances user convenience..

The system employs ultrasonic sensors to detect the presence of vehicles, relays for gate operation, and Bluetooth modules for wireless communication. The primary objective is to offer a cost-effective, scalable, and user-friendly solution that aligns with the evolving needs of smart city development. Through this project, we contribute to the ongoing transformation of urban mobility by introducing a reliable and accessible intelligent parking solution.

METHODOLOGY

The proposed intelligent parking system is designed using a microcontroller-based architecture integrated with Bluetooth communication to enable real-time monitoring and control of parking slots. The core components of the system include the Arduino Uno microcontroller, HC-05 Bluetooth module, ultrasonic sensors, servo motors (or relays), and a mobile application interface.. The Arduino Uno acts as the central processing unit, responsible for collecting data from sensors, processing it, and triggering the appropriate hardware responses.

Ultrasonic sensors are strategically placed at each parking slot to detect the presence or absence of a vehicle. These sensors continuously send distance data to the Arduino, which interprets the readings to determine the slot occupancy status

The communication between the user and the parking system is facilitated through the HC-05 Bluetooth module. This module is paired with a mobile device, allowing users to interact with the system using a custom-built Android application. When a user opens the app, they can view real-time parking slot availability and control entry or exit operations through a simple graphical interface

With the rapid urbanization and continuous increase in vehicle ownership, parking has become a major concern in both commercial and residential areas. Inefficient and unorganized parking systems not only waste time and fuel but also contribute to traffic congestion and environmental pollution. In response to these challenges, the development of intelligent parking systems has emerged as a promising solution to optimize space usage, improve convenience, and enhance urban mobility..

The evolution of embedded systems and wireless communication technologies, particularly through microcontrollers like Arduino and modules such as Bluetooth HC-05, has enabled the creation of low-cost and reliable smart parking systems. These systems offer real-time information about parking space availability and allow users to interact with the system through their smartphones or other Bluetooth-enabled devices.

This project, titled *Intelligent Parking with Arduino & Bluetooth Control*, introduces an automated parking management system designed to simplify the process of locating and utilizing parking spaces. It employs ultrasonic sensors to detect the presence of vehicles in each slot, with the sensor data processed by an Arduino microcontroller. Based on this data, the system controls entry and exit gates using servo motors or relays and communicates the status to users via a Bluetooth module connected to a mobile application interface..

Unlike traditional systems that rely on manual inspection or costly infrastructure, this solution is focused on affordability, ease of deployment, and scalability. It can be implemented in small-scale residential buildings, commercial complexes, educational institutions, and other environments where efficient parking management is necessary. The user-friendly interface and wireless connectivity make the system highly accessible, even to those with limited technical knowledge. Moreover, the system can be further extended to integrate with cloud platforms or IoT protocols to enable remote access, data logging, and advanced analytics. As cities continue to adopt smart technologies, intelligent parking solutions like this play a crucial role in building sustainable and efficient urban infrastructures.

The methodology also includes feedback and monitoring features. The Arduino updates the slot occupancy dynamically, and the mobile app refreshes in real-time to reflect the current availability. The system logic ensures that access is granted only when at least one parking slot is free, thereby preventing congestion at the entry point.

SYSTEM ARCHITECTURE

Hardware Layer

1. Sensor Integration: Connect parking sensors to Arduino board for real-time data collection.
2. Arduino Processing: Process sensor data and control LED displays and other system components**.**
3. Bluetooth Communication: Use Bluetooth module to transmit parking slot availability data to user's .

Software Layer

1. Arduino Code: Write code to process sensor data, control LED displays, and communicate with Bluetooth module.
2. Mobile App Development: Develop user-friendly mobile app for parking guidance, slot booking, and payment.
3. Data Storage: Store parking slot availability data and user information in a database.

.

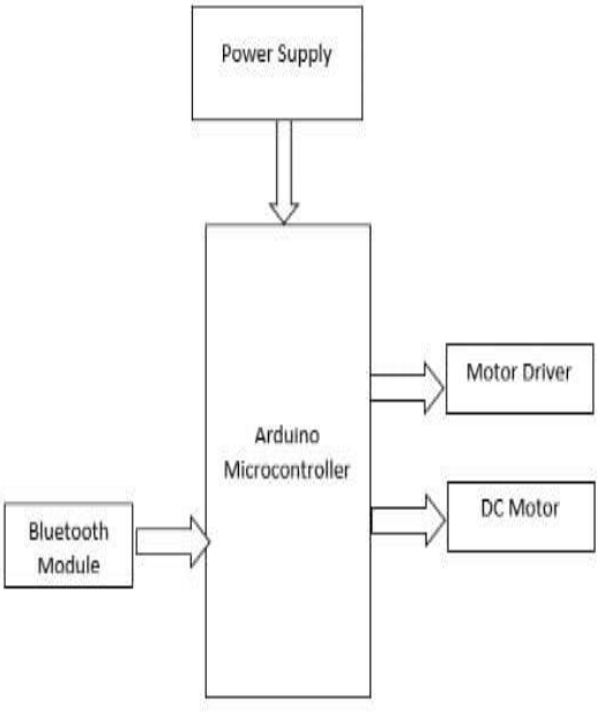

Fig1: General Block Diagram of the Intelligent Parking with Arduino& Bluetooth Control

FLOW CHART

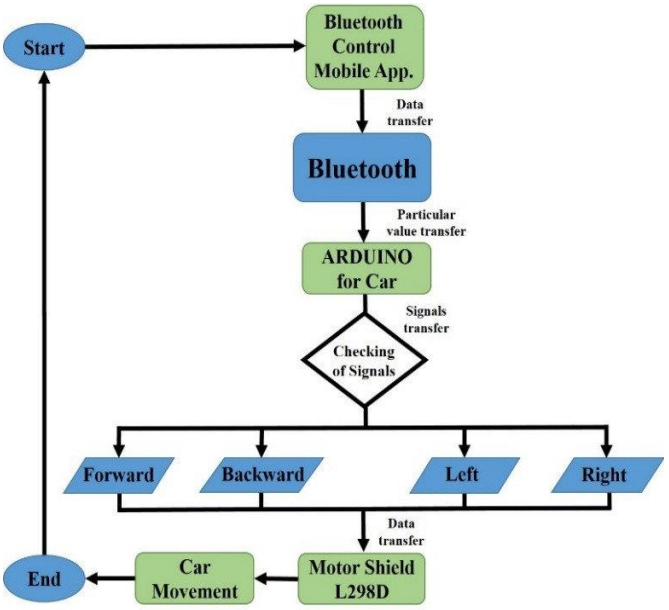

Fig2: Fow chart Flow Chart for Intelligent Parking with Arduino& Bluetooth Control

The steps of proposed work as given below

Step 1: The user opens the Bluetooth-based mobile application and connects to the Arduino system.

Step 2: Ultrasonic sensors detect and send parking slot availability data to the Arduino.

Step 3. The Arduino processes the sensor data and updates the mobile app with real-time slot status.

Step 4: The user sends a command via the app to open the gate if a slot is available.

Step 5: Arduino triggers the gate mechanism (servo motor or relay) to allow vehicle entry.

Step 6: Once parked, the slot is marked as occupied, and the app is updated accordingly.

RESULTS AND DISCUSSION

The intelligent parking system is implemented using an Arduino microcontroller interfaced with ultrasonic sensors, a Bluetooth module (HC-05), and a mobile application. The system effectively detects the presence or absence of vehicles in real-time using ultrasonic sensors and updates the parking slot status through Bluetooth communication to the user's smartphone

When a vehicle approaches, the system checks for available slots. Upon confirmation, the user can trigger the entry gate using the mobile app. The Arduino responds instantly by activating the gate mechanism via a servo motor or relay. After parking, the occupied slot is automatically marked, preventing further allocation.

Table1 :Comparison of Proposed Model with existing NFC based models

Parameter	Proposed Bluetooth Model	Existing NFC-Based Models
Control Range	5–10 meters (line of sight)	< 10 cm (very short range)
Response Time	100–300 ms	~50–100 ms
User Control Flexibility	High – real-time manual control via Smartphone	Low – limited to preset NFC tag actions
Cost Effectiveness	Affordable and widely accessible components	Slightly lower hardware cost, but limited functionality

CONCLUSION:

The intelligent parking system is developed using Arduino, ultrasonic sensors, and Bluetooth technology to provide a smart, user-friendly solution for managing parking spaces. The system enables real-time monitoring of slot availability and allows users to control entry through a mobile application. It is cost-effective, easy to deploy, and suitable for small to medium parking facilities This solution aligns with the goals of smart infrastructure and can be effectively implemented in residential complexes, schools, offices, and public parking areas to improve convenience and space utilization.

REFERENCES:

1. A. Z. Kougianos, S. P. Mohanty and M. E. Zervakis, "Smart Parking Systems Using Internet of Things (IoT) and Wireless Sensor Networks (WSN): A Survey," *IEEE Consumer Electronics Magazine*, vol. 7, no. 5, pp. 26–34, Sept. 2018.

2. N. B. Pundir and A. Shukla, "Bluetooth Based Smart Parking System Using Arduino," *2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU)*, Ghaziabad, India, 2019, pp. 1–5..

3. P. Chawla and R. Jain, "Automated Smart Car Parking System Using Arduino," *International Journal of Computer Applications*, vol. 113, no. 1, pp. 6–10, March 2015.

4. S. Sharma, R. Goyal, and A. Verma, "Design and Implementation of Smart Parking System Using Arduino and RFID," *International Research Journal of Engineering and Technology (IRJET)*, vol. 6, no. 4, pp. 2150–2154, Apr. 2019..

5. M. I. Syed, M. Usman, and F. Qadir, "IoT Based Smart Parking System Using Bluetooth Low Energy," *2020 International Conference on Emerging Trends in Smart Technologies (ICETST)*, Karachi, 2020, pp. 1–6..

6. . D. S. Tuteja and H. S. Sedha, "Parking Management System Using IoT," *International Journal of Engineering Research & Technology (IJERT)*, vol. 6, no. 11, pp. 320–323, Nov. 2017.

7. V. M. Mane and P. P. Kulkarni, "Smart Parking Using IoT," *2018 International Conference on Communication and Signal Processing (ICCSP)*, Chennai, 2018, pp. 1216–1219.