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Design and Implementation of an Intelligent Car Parking System Using Arduino Uno

Karigar Sabir[1], S. I. Anand[2], Patel Aryan[3], Bihola Harshraj[4], Chamapat Jayrajsinh[5]
Students, Department of Electrical Engineering[1,3,4,5]
Professor, Department of Electrical Engineering[2]
Government Polytechnic, Gandhinagar, Gandhinagar, India

Abstract: *The rapid growth of electric vehicles (EVs) and urban population has increased the demand for smart and efficient parking management systems. The Intelligent Parking System with Wireless Charging Station integrates advanced technologies such as sensors, and wireless power transfer to provide a seamless parking and charging experience for electric vehicles. In this system, sensors are used to detect the availability of parking spaces and guide drivers to vacant spots through a mobile or display interface, thereby reducing time spent searching for parking. Once the vehicle is parked, the wireless charging module automatically initiates charging using inductive coupling technology, eliminating the need for physical plugs or human intervention. The system can also monitor parameters such as charging status, energy consumption, and parking duration in real-time. This intelligent solution promotes energy efficiency, convenience, and sustainability by combining smart parking management with automated wireless charging. It reduces traffic congestion, enhances user comfort, and supports the growing infrastructure needs for electric vehicles in smart cities.*

Keywords: Intelligent Parking System, Arduino Uno, IR Sensor, Smart Parking, Automation

I. INTRODUCTION

Rapid urbanization has led to increased vehicle usage, resulting in severe parking management issues in cities, campuses, and public infrastructures. This paper presents the design and implementation of an intelligent car parking system using Arduino Uno to efficiently monitor and manage parking slots. The proposed system utilizes ultrasonic sensors installed at each parking slot to detect vehicle presence, an Arduino Uno microcontroller for data processing, an LCD for real-time status display, and a servo motor to automate the entry gate. The system identifies vacant and occupied parking spaces, displays availability information to users, and controls gate access based on space availability. Experimental implementation demonstrates that the system is cost-effective, reliable, and suitable for small to medium-scale parking areas such as educational institutions, offices, and residential complexes

II. SYSTEM ARCHITECTURE AND METHODOLOGY

The proposed system consists of an Arduino Uno microcontroller, multiple IR sensors, a 16×2 LCD display, a servo motor for gate control, and a regulated power supply. IR sensors are placed at individual parking slots to measure distance and detect vehicle presence. Sensor data is continuously sent to the Arduino Uno, which processes the information to determine slot availability. The LCD displays the number of vacant and occupied slots, while the servo motor automatically opens or closes the entry gate based on availability.

III. HARDWARE IMPLEMENTATION

The hardware implementation of the Intelligent Parking System with EV Charging Station is based on an Arduino Uno as the main controller. Infrared (IR) sensors are installed at each parking slot to detect vehicle presence and additional IR sensors are placed at the entry and exit points for vehicle detection. A servo motor is connected to the Arduino to control the automatic opening and closing of the parking gate. An I2C-based LCD display is used to show real-time parking slot availability and system messages, reducing wiring complexity. The EV charging section consists of a controlled power

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output connected through a timer-based circuit and keypad, allowing users to set the required charging duration. All components are powered using a regulated 5V power supply, and the Arduino processes sensor inputs to control the display, gate operation, and charging system, ensuring smooth and automated hardware operation of the entire system.

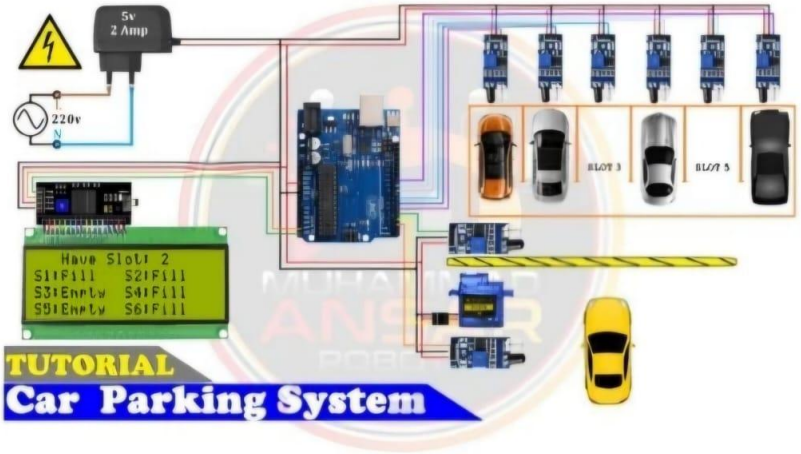

Fig. 1. Circuit Diagram of Car Parking System

In this project, a charging station is developed as an important part of the intelligent parking system. The charging station operates on a timer-based control mechanism, where the user sets the required charging time using a keypad. After the time is entered, the Arduino activates a relay to supply power to the charging point and start the charging process. The controller continuously monitors the charging duration and automatically disconnects the power supply once the set time is completed. The charging status and remaining time are displayed on the LCD screen. This system ensures safe operation, prevents overcharging, and allows accurate charging based on the actual usage time.

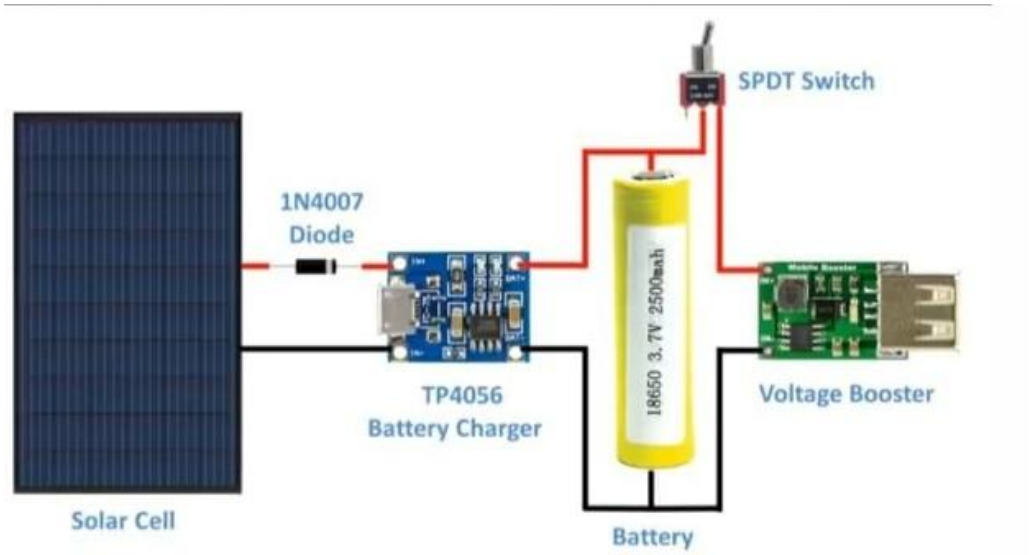

Fig. 2. Charging Station Diagram

The charging station section of the project uses components such as an Arduino Uno for control and timing, a relay module to switch the charging power supply ON and OFF, and a keypad to allow the user to set the required charging time. An LCD display is used to show charging status, remaining time, and messages. A regulated power supply provides stable power to the control circuit, and connecting wires and terminals are used to safely connect the charging output to the EV or charging load.

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This image shows the hardware model of an Intelligent Parking System with an integrated EV Charging Station developed as a mini project. The setup includes a scaled parking layout with multiple slots, IR sensors for vehicle detection, and an automatic gate mechanism controlled by a servo motor. An Arduino-based control unit processes sensor inputs and updates the parking status on an LCD display. The model also features a dedicated EV charging station with a keypad and display for setting and monitoring charging time. Overall, the project demonstrates a smart, automated parking solution combined with a time-controlled charging system suitable for smart city applications.

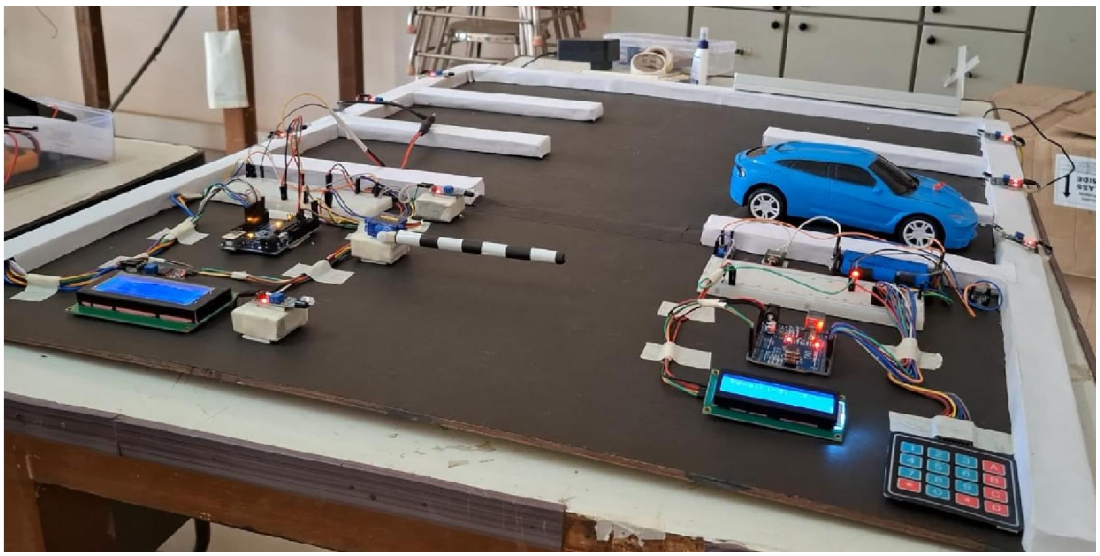

Fig 3 Overview

IV. CONCLUSION

A smart parking system with a wireless charging station enhances convenience, efficiency, and safety for drivers while promoting the adoption of electric vehicles. It optimizes parking space, reduces energy wastage, and provides a sustainable, eco-friendly solution for modern urban transportation. With future advancements like AI integration, autonomous vehicles, and renewable energy, such systems are poised to make parking and EV charging more intelligent, seamless, and environmentally responsible.

V. ACKNOWLEDGMENT

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