



SMART CARD BASED EV PARKING SYSTEM USING DC CHARGING

Prof. Kokate Monali C¹, Sanap Pravin D², Gore Om V³, Khaire Vaibhav S⁴, Bhosale Tejas B⁵

¹Lecturer, Department of Santosh N Darade Polytechnic, Yeola, Maharashtra, India.

^{2, 3, 4, 5} Students, Department of Santosh N Darade Polytechnic, Yeola, Maharashtra, India.

Article Info

Article History:

Published: 11 Oct 2026

Publication Issue:

Volume 03, Issue 10
October 2026

Page Number:

237-242

Corresponding Author:

Prof. Kokate Monali C

Abstract:

The Smart Card Based EV Parking System using DC Charging is an innovative system designed to provide an efficient, secure, and convenient solution for parking and charging Electric Vehicles (EVs). With the increasing use of electric vehicles, proper parking management and fast charging facilities are becoming important. This system combines smart card technology, automatic parking management, and DC charging into a single system.

In this system, a smart card is used to identify and authenticate the EV user. When the vehicle enters the parking area, the user scans the smart card using a card reader. The system verifies the card and allows authorized users to access the parking facility, after authentication, an available parking space is assigned to the vehicle. The user can then connect the EV to the DC charging unit. The charging system supplies direct current to the vehicle battery and provides faster and more efficient charging.

The system can also monitor the charging process and control the charging operation according to the requirements of the vehicle. This reduces manual work and improves the overall management of parking and charging facilities. The smart card provides controlled access and can also be used for recording user and charging information. The proposed system is useful for shopping malls, colleges, offices, residential areas, public parking spaces, and commercial EV charging stations. It helps save time, improves security, reduces human involvement, and provides a systematic method for EV parking and charging. Thus, the Smart Card Based EV Parking System using DC Charging can contribute to the development of smart, efficient, and sustainable transportation infrastructure.

Keywords: charging Electric Vehicles, DC charging unit, EV Parking.

1. Introduction

The increasing use of electric vehicles (EVs) has created a need for efficient, secure, and user-friendly parking and charging facilities. Conventional parking systems generally depend on manual entry, verification, and payment, which can be time-consuming and difficult to manage. At the same time, EV users require convenient access to charging stations with proper control over charging and payment.

The proposed **Smart Card Based EV Parking System Using DC Charging** combines smart-card technology with EV parking and DC charging. A smart card or RFID card is used to identify and authenticate the user before allowing access to the parking and charging facility. After successful authentication, the system controls the parking and charging process using a microcontroller. The charging time and corresponding cost can be monitored, and the user's account or card balance can be updated according to the energy or charging time used.

DC charging is used because it can provide faster charging compared with conventional AC charging, making it suitable for EV charging stations where reduced charging time is important. The integration of smart-card authentication, parking control, charging, and billing helps reduce manual operation and improves the overall efficiency of the system.

The main purpose of this project is to develop a simple and economical automated EV parking and charging system that provides secure user identification, controlled access, efficient DC charging, and convenient payment management. The system can serve as a basic model for future smart EV parking facilities with advanced features such as IoT monitoring, mobile applications, online payment, and intelligent energy management.

2. LITERATURE SURVEY

The increasing adoption of electric vehicles (EVs) has created a growing requirement for efficient parking and charging infrastructure. Conventional parking systems require manual identification, payment, and monitoring, which can result in delays and inefficient utilization of parking spaces. Smart-card and RFID-based systems provide an effective solution by enabling automatic vehicle identification, access control, and payment management.

Prajwal Kumar D. et al. proposed a Smart Card Based EV Parking System using DC Charging that integrates RFID-based authentication with EV parking and charging. The system uses an RFID card to identify authorized users and controls parking access through a microcontroller-based arrangement. Charging is provided after authentication, while the system monitors charging duration and calculates the corresponding cost. This approach reduces manual intervention and provides a simple method for integrating parking and EV charging facilities.

Phadtare et al. studied IoT-based EV charging and parking systems and highlighted the importance of integrating parking management with charging infrastructure. Their work indicates that sensors and communication technologies can be used to identify available parking and charging spaces, thereby improving the utilization of EV charging facilities. Such systems can also provide users with information about charging availability and parking status.

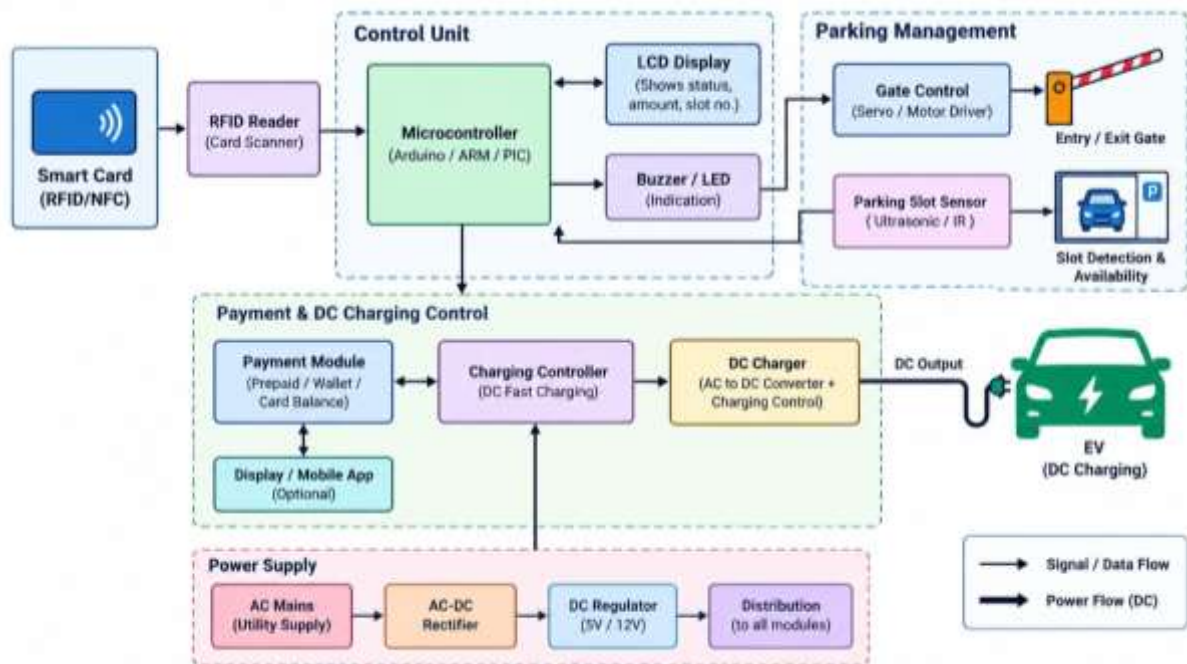
Sawant and Zambare reviewed DC fast-charging stations for electric vehicles and examined different charging technologies, station configurations, charging time, energy requirements, and grid-related issues. Their study shows that DC charging can significantly reduce EV charging time compared with conventional AC charging. However, high-power DC charging introduces challenges such as increased infrastructure cost, power demand, thermal management, and impact on the electrical grid.

Kumar et al. reviewed EV charging standards and charging infrastructure in India. The study discussed different charging methods, charging modes, connectors, and applicable standards. The authors emphasized the importance of standardization and interoperability for the development of reliable EV charging infrastructure. Their work provides a useful foundation for designing charging systems that can be safely integrated into EV infrastructure.

Recent studies on intelligent EV charging infrastructure have focused on combining charging stations with IoT, smart energy management, renewable-energy sources, and automated payment systems. These developments demonstrate that EV charging stations can be transformed from simple charging points into intelligent systems capable of monitoring users, controlling charging, managing energy consumption, and recording transactions.

From the reviewed literature, it is observed that RFID/smart-card technology is suitable for user authentication and access control, while DC charging provides faster charging for EVs. However, many existing systems address parking management and EV charging as separate functions. Therefore, integrating smart-card authentication, parking control, DC charging, and automatic billing into a single system can provide a more convenient and efficient solution.

3. BLOCK DIAGRAM



4. WORKING

The smart card-based EV parking system using DC charging is designed to provide an automated and efficient solution for electric vehicle parking and charging. The system combines smart card authentication, parking slot management, DC charging, energy monitoring, and automatic billing into a single system. When an electric vehicle arrives at the parking entrance, the user places or taps the smart card on the card reader. The card reader reads the information stored on the card and sends it to the microcontroller for verification. The controller checks whether the smart card is valid and whether sufficient balance or authorization is available for using the parking and charging facilities. If the card is valid, the system checks the availability of parking and charging slots.

If a suitable slot is available, the microcontroller assigns the slot to the vehicle and activates the entry gate mechanism. The gate opens automatically, allowing the user to drive the EV into the designated parking and charging area. The vehicle is then connected to the DC charging unit through the appropriate charging connector. The DC charging unit converts and regulates the electrical power as required by the EV battery and supplies controlled DC power for charging. A charging controller is used to control the charging process and provide safe and regulated power to the vehicle.

During the charging process, important parameters such as charging voltage, current, energy consumed, and charging duration are monitored. The microcontroller receives the required information from the sensing and monitoring circuits. This information can be displayed on an LCD or other display unit so that the user can observe the charging status. The controller continuously checks the charging conditions and can stop the charging process when the required charging level is reached or when an abnormal condition is detected. This helps to improve the safety and reliability of the charging system.

After the charging process is completed, the system calculates the total cost based on the amount of electrical energy consumed and the parking duration. The parking and charging charges are deducted from the user's smart card balance. The transaction information can also be stored in the system for future reference. When the user is ready to leave, the smart card is again presented to the exit card reader. The controller verifies the card and confirms that the required payment has been completed. After successful verification, the exit gate is activated and opens automatically, allowing the EV to leave the parking area.

Thus, the smart card-based EV parking system provides a convenient, secure, and automated method for managing EV parking and DC charging. It reduces the need for manual supervision, provides cashless payment, monitors charging parameters, and improves the overall utilization of parking and charging facilities. The system can be further enhanced by adding features such as mobile notifications, multiple charging stations, online monitoring, and a centralized database for maintaining user and charging records.

The smart card-based EV parking system using DC charging is designed to provide an automated and efficient solution for electric vehicle parking and charging. The system combines smart card authentication, parking slot management, DC charging, energy monitoring, and automatic billing into a single system. When an electric vehicle arrives at the parking entrance, the user places or taps the smart card on the card reader. The card reader reads the information stored on the card and sends it to the microcontroller for verification. The controller checks whether the smart card is valid and whether sufficient balance or authorization is available for using the parking and charging facilities. If the card is valid, the system checks the availability of parking and charging slots.

If a suitable slot is available, the microcontroller assigns the slot to the vehicle and activates the entry gate mechanism. The gate opens automatically, allowing the user to drive the EV into the designated parking and charging area. The vehicle is then connected to the DC charging unit through the appropriate charging connector. The DC charging unit converts and regulates the electrical power as required by the EV battery and supplies controlled DC power for charging. A charging controller is used to control the charging process and provide safe and regulated power to the vehicle.

5. ADVANTAGES

- **Automated parking management:** The system automatically manages vehicle entry, parking-slot allocation, charging, and exit.
- **Secure user authentication:** The smart card ensures that only authorized users can access the parking and charging facility.
- **Fast DC charging:** DC charging supplies power directly to the EV battery, allowing faster charging compared with conventional AC charging.
- **Cashless payment:** Charging and parking charges can be automatically deducted from the user's smart card balance.
- **Reduced human intervention:** The complete process can be controlled automatically using a microcontroller, reducing the need for manual supervision.
- **Efficient parking-space utilization:** Parking sensors help identify vacant and occupied slots, preventing unnecessary searching for available spaces.
- **Energy monitoring:** The system can monitor voltage, current, power, and energy consumed during the charging process.
- **Automatic billing:** The system calculates charging and parking charges based on parameters such as energy consumption and parking duration.
- **Improved safety:** The charging process can be monitored continuously, and charging can be stopped when abnormal conditions are detected.
- **Time saving:** Automated entry, slot allocation, charging, payment, and exit reduce the time required for the user.
- **Easy operation:** Users only need to use the smart card for authentication and payment, making the system simple and convenient.
- **Reduced operational cost:** Automation reduces the requirement for continuous manual monitoring and management.
- **Expandable system:** Additional charging points, parking slots, displays, sensors, and online monitoring facilities can be added according to future requirements.
- **Better user experience:** The user can receive information about the parking slot, charging status, energy consumption, and payment through the display system.
- **Environmentally friendly:** By supporting electric vehicles and organized EV charging, the system contributes to the reduction of fuel consumption and vehicle emission.

6. DISADVANTAGES

- **High initial cost:** The installation of DC charging equipment, smart card readers, sensors, controllers, and gate mechanisms requires a significant initial investment.
- **High maintenance requirement:** Charging units, card readers, sensors, and electronic control circuits require regular maintenance to ensure reliable operation.
- **Dependence on electricity:** The system cannot operate normally during a power failure unless a backup power supply is provided.
- **Smart card dependency:** If the smart card is lost, damaged, or not detected by the reader, the user may not be able to access the charging facility.
- **Complex system:** Integration of parking sensors, charging units, payment systems, and microcontrollers makes the overall system more complex than conventional parking systems.
- **Limited charging slots:** If all charging slots are occupied, new EV users may have to wait until a slot becomes available.
- **DC charger cost:** DC charging stations are generally more expensive than basic AC charging stations because they require higher-power equipment and more sophisticated control systems.
- **Technical failures:** Failure of sensors, the microcontroller, card reader, charging unit, or communication circuits can interrupt the operation of the entire system.
- **Battery limitations:** Frequent or improper high-power DC charging may affect battery life depending on the EV battery technology and charging management system.
- **Security risks:** If the smart card or payment system is not properly secured, unauthorized access or misuse may occur.
- **Space requirement:** EV parking and DC charging stations require sufficient space for vehicle parking, charging equipment, cables, and safe vehicle movement.
- **Skilled personnel required:** Installation, troubleshooting, and maintenance of the charging and control system may require trained technicians.
- **Communication dependency:** If the system uses a network or centralized database, communication failure can affect monitoring, billing, or user authentication.
- **Long-term infrastructure cost:** As the number of EV users increases, additional charging stations and electrical infrastructure may be required, increasing the overall cost.

7. APPLICATION

- **Shopping malls:** Provides dedicated EV parking and fast DC charging for customers while automatically managing parking and charging payments.
- **Office and corporate parking:** Employees can use smart cards to access EV parking and charging facilities during working hours.
- **Colleges and universities:** Can be used to provide organized EV parking and charging facilities for students, teachers, and staff.
- **Railway stations:** EV users can park their vehicles and charge them while travelling by train.
- **Airports:** Provides EV charging and parking facilities for passengers, staff, and visitors.
- **Hotels and resorts:** Hotels can offer smart-card-based EV charging and parking as an additional facility for guests.
- **Residential buildings:** Apartment complexes can use the system to manage EV charging slots and track energy consumption for individual users.
- **Public parking areas:** The system can be installed in municipal and commercial parking areas to provide automated EV charging services.
- **Highway charging stations:** DC fast-charging facilities can be integrated with parking management for EVs travelling long distances.
- **Hospitals:** Provides convenient EV parking and charging for doctors, staff, patients, and visitors.
- **Industrial areas:** Companies can use the system for managing EV charging facilities for employees and electric fleet vehicles.

- **Electric vehicle fleet management:** It can be used for electric buses, taxis, delivery vehicles, and other commercial EV fleets to control charging and monitor energy usage.
- **Smart city infrastructure:** The system can be integrated into smart-city projects to provide automated parking, charging, authentication, and payment facilities.
- **Government offices:** Government buildings can use smart-card-based systems to manage authorized EV parking and charging facilities.
- **Commercial EV charging stations:** The system can provide automated user identification, charging control, energy measurement, and billing without continuous manual supervision.

8. CONCLUSION

The Smart Card Based EV Parking System Using DC Charging provides an efficient, secure, and automated solution for managing electric vehicle parking and charging facilities. The system integrates smart card authentication, parking slot management, DC charging, energy monitoring, automatic billing, and gate control into a single system. By using a smart card, users can easily access the parking facility and make cashless payments for charging and parking services. The DC charging unit provides faster charging, while sensors and the microcontroller continuously monitor the charging process and energy consumption. Automatic slot allocation and gate control reduce manual intervention and save time for users. The system also improves the utilization of available parking spaces and provides better control over charging and payment operations. Although the initial installation and maintenance costs are relatively high, the system offers significant benefits in terms of convenience, security, automation, and efficient energy management. Therefore, this system can be effectively implemented in shopping malls, offices, colleges, residential areas, public parking spaces, railway stations, airports, and other locations to support the growing demand for electric vehicle charging infrastructure. With future improvements such as mobile applications, online payment, cloud monitoring, and smart-city integration, the system can become an important part of modern and sustainable transportation infrastructure.

References

1. Bureau of Indian Standards , IS 17017: Electric Vehicle Conductive Charging System, relevant standards for EV charging infrastructure in India.
2. Ministry of Power, Government of India , Guidelines and Standards for Charging Infrastructure for Electric Vehicles, Government of India.
3. Ministry of Heavy Industries , Electric Mobility and EV Charging Infrastructure Guidelines, Government of India.
4. International Electrotechnical Commission , IEC 61851 – Electric Vehicle Conductive Charging System, standards for conductive EV charging.
5. International Organization for Standardization , ISO 15118 – Road Vehicles: Vehicle-to-Grid Communication Interface, standards related to communication between EVs and charging infrastructure.
6. B. K. Bose , Modern Power Electronics and AC Drives, Prentice Hall, for power-electronics and charging-system concepts.
7. R. Krishnan , Electric Motor Drives: Modeling, Analysis, and Control, Prentice Hall, for electric-drive and control-system concepts.
8. Research papers and technical articles on EV charging, smart parking systems, RFID/smart-card authentication, and IoT-based charging infrastructure can also be consulted for project development and implementation.