Electric Vehicle Charging Station Monitoring using Open Charge Point Protocol

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Abstract - Electric vehicles (EVs) have gained significant popularity in recent years due to their environmental benefits and potential to reduce dependence on fossil fuels. As the adoption of EVs continues to increase, the efficient management and monitoring of charging stations become crucial to ensure reliable and seamless charging services. This abstract presents a solution for monitoring electric vehicle charging stations using the Open Charge Point Protocol (OCPP) in conjunction with NodeMCU and a web application. The proposed system utilizes the NodeMCU, an open-source IoT platform based on the ESP8266 Wi-Fi module, to connect and communicate with the EV charging stations. NodeMCU acts as a gateway between the charging stations and the web application, enabling real-time data collection and monitoring. OCPP, an open and widely accepted communication protocol for EV charging infrastructure, is employed to establish a standardized and interoperable communication link between the charging stations and the NodeMCU. The web application serves as the user interface for monitoring and managing the charging stations. It provides a comprehensive dashboard that displays real-time information such as charging station status, power consumption, charging history, and availability of charging ports. Users can access the web application from any device with internet connectivity, enabling remote monitoring and control of the charging stations. The system architecture ensures secure and reliable communication between the charging stations, NodeMCU, and the web application. Advanced encryption techniques are employed to protect sensitive data and prevent unauthorized access or tampering. By implementing this solution, electric vehicle charging station operators and administrators can effectively monitor and manage their charging infrastructure. Real-time data collection and visualization help identify operational inefficiencies, plan maintenance activities, optimize charging schedules, and improve overall user experience. Moreover, the standardized OCPP protocol ensures compatibility with a wide range of charging station manufacturers, facilitating scalability and interoperability in a heterogeneous charging infrastructure ecosystem.

Keywords - vehicle; inductive power; resonant frequency; mutual inductance; internet of things

Introduction

Going green is a popular phrase in the car industry these days. The industry attempted to leapfrog in the electric transportation domain due to the substantial need to safeguard our planet from many environmental challenges. This prompted several measures aimed at reducing the fundamental causes of environmental degradation, particularly air pollution. The introduction of electric automobiles has accelerated the development of electric transportation technology. Every industry player has set a goal of creating a positive EV ecosystem. The primary factors that influence EV acceptance in the country are demand and supply. The initiatives that contribute to the purchase of electric vehicles can be classified as a demand factor. The supply side includes the manufacturing industry as well as component suppliers and vendors, promoting additional research in this area.

Through the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) initiative, the government of India has been eager to implement laws to promote the manufacturing of electric and hybrid vehicle technology and its sustainability. FAME phase-II focuses on increasing the deployment of charging stations for electric vehicles in a safe, economical, and accessible manner across the country. India is ranked fourth in the world's car market. It is the world's largest two-wheeler and three-wheeler manufacturer, as well as the fourth largest vehicle manufacturer.

In 2018, India had 1.5 million battery-powered three-wheeled rickshaws on the road, which was more than the entire number of electric passenger cars sold in China since 2011. As a result, when selecting charging station technologies in India, factors such as user groups who are unable to use smart technologies must also be considered. The commercial viability of an electric car necessitates the creation of a charging infrastructure that is easily accessible, simple to use, and reasonably priced.

This proposed activity seeks to improve the supply side component, which helps the establishment of a robust charging infrastructure for EVs. We gathered the need to construct a localized charging station to enable short-distance public transportation systems and a networked charging station for long-distance transportation after analysing requirements from various automotive participants. In a business context, we present two application implementations to fulfil the needs of distinct customers.

Literature Review

The design and production of electric vehicle charging equipment for two-wheelers (eScooters) are the main topics of the study [1]. Considering the impending widespread commercialisation of electric two-wheelers on Indian roadways, the overview investigates product design based on fabricability, affordability, and mass production. The suggested design complies with Level 2 charging specifications (240 volts) and is based on the open charge point protocol (OCPP). System administrators, installers, customers, governmental organisations, and others were all taken into consideration when creating the proposed EVCS. Three industries—equipment manufacturers, software developers, and electric power networks—are involved in the development of EVCS. This article elaborates on the hardware, software,

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and protocols utilised in the creation of the EVCS Level 2 charging standard in order to illustrate design concerns.

Implementing grid-aware electric vehicle charging systems with local load control presents numerous obstacles. The National Electric Code (NEC) was updated to include automated load control requirements for EV charging infrastructure, which created new opportunities for creative load control. Utility companies, site owners and operators, facility managers, and end users (EV drivers) are all involved in the efficient dispatch of EV charging assets. The NEC definition has changed to allow for the "over subscription" of more EV charging stations than can be sustained continuously if the total load is never above the supply system's safe limit. Compact submeters and locally hosted control algorithms that talk to the managed EVSEs directly can be used to implement local load control. Through network connections or meshes of smaller nodes, larger EVSE groups can be managed as a constrained system, with cloud-based control algorithms coordinating local control nodes. In a tiny system that can be enlarged to larger meshes of EV charging stations, this research [2] is restricted to only AC charging from the grid to the vehicle.

This work's [3] development stage was implemented with test scenarios, and the operational stage saw the deployment of interoperability scenarios involving a variety of devices. 2018 saw the purchase of 100 electric vehicles by the Instituto Costarricense de Electricidad (ICE, Costa Rican Electricity Company). In addition to this fleet, 110 chargers were positioned at ICE's own facilities all around the nation. To manage and track the amount of energy used by cars at each charger and to determine the energy efficiency per kilometre travelled, a central Open Charge Point Protocol (OCPP v1.6) system was built. The server's implementation includes the usage of tools like HTML, CSS, JSP, MySQL, JavaScript, and Maven. Since most devices can now communicate with this central system using version 1.6 of the OCPP, that version was chosen.

This study [4] describes the usage of OCPP to transport measured data from onboard metres of AC Level 2 chargers used in a BC Hydro TOU measurement trial for residential EV charging. These chargers are OCPP-enabled. A utility-grade smart metre was used to authenticate the data collected from various chargers. It is shown that the measured data is accurate and is transported and kept without loss of precision in a safe manner. To demonstrate the effect of TOU on total home load and the applicability of optimal scheduling, the obtained EV load data is assessed during a 24-hour period..

System Architecture

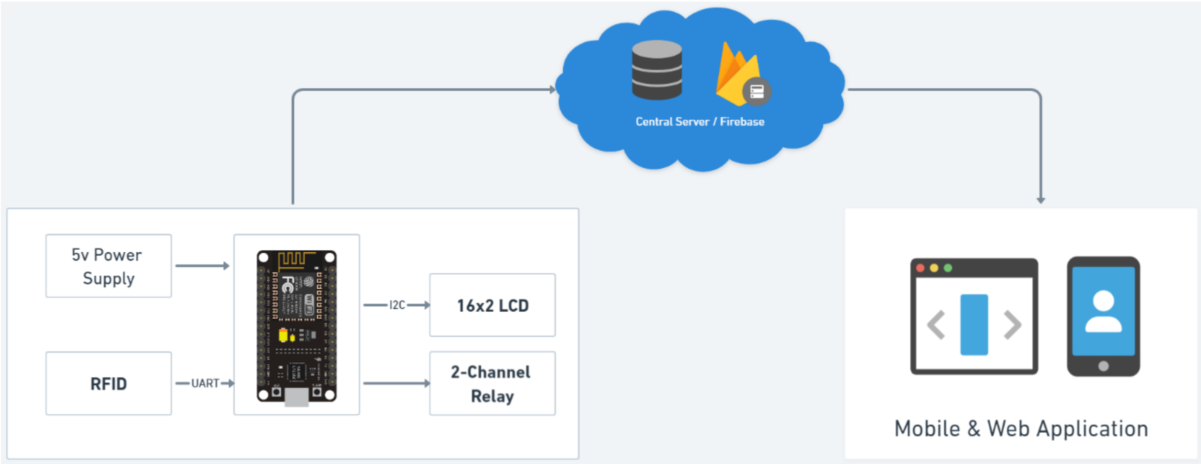

Figure 1 - System Architecture

Our proposed system consists of charging station hardware, a mobile app for vehicle owners (users), and an admin panel for charging station owners. charging stations can provide service to global users because of the central management system. These Networked charging stations are made up of many EVSEs that are managed by a central monitoring system, often known as a Charging Station Management System (CSMS) or Central Management System (CMS). Because multiple users require access to multiple EVSEs in different locations, the system must support networked searching, authentication, monitoring, billing, and payment processes. This involves the creation of a mobile application as well as a web server application. Metering, safety, and fault monitoring will be performed more quickly thanks to an onboard real-time application. The Open Charge Point Protocol (OCPP) is used to assure compatibility and real-time communication with the Central Server.

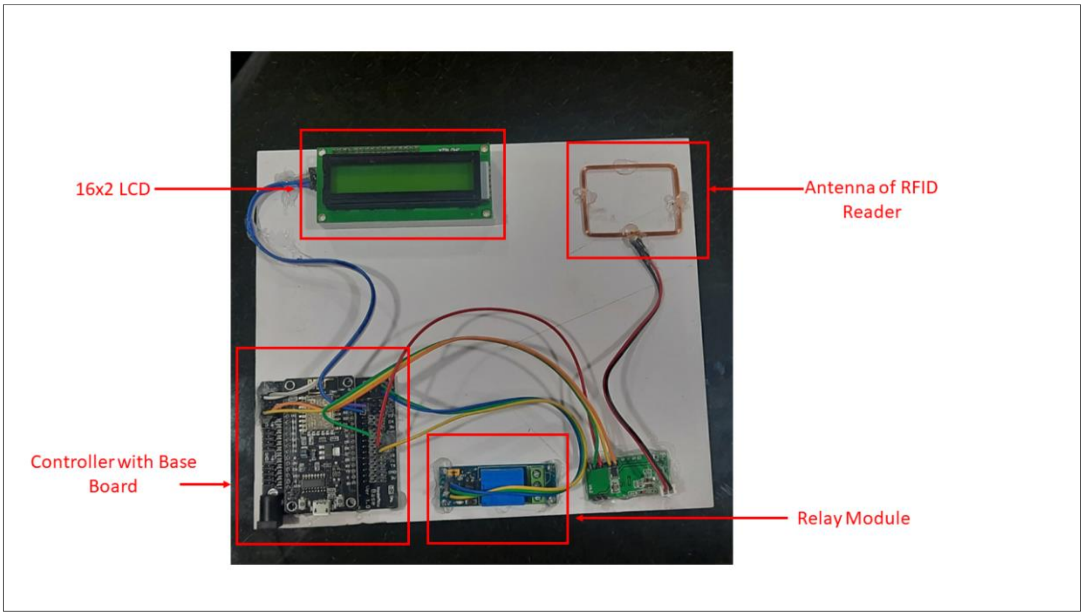

Figure 2 – Hardware Setup

Result

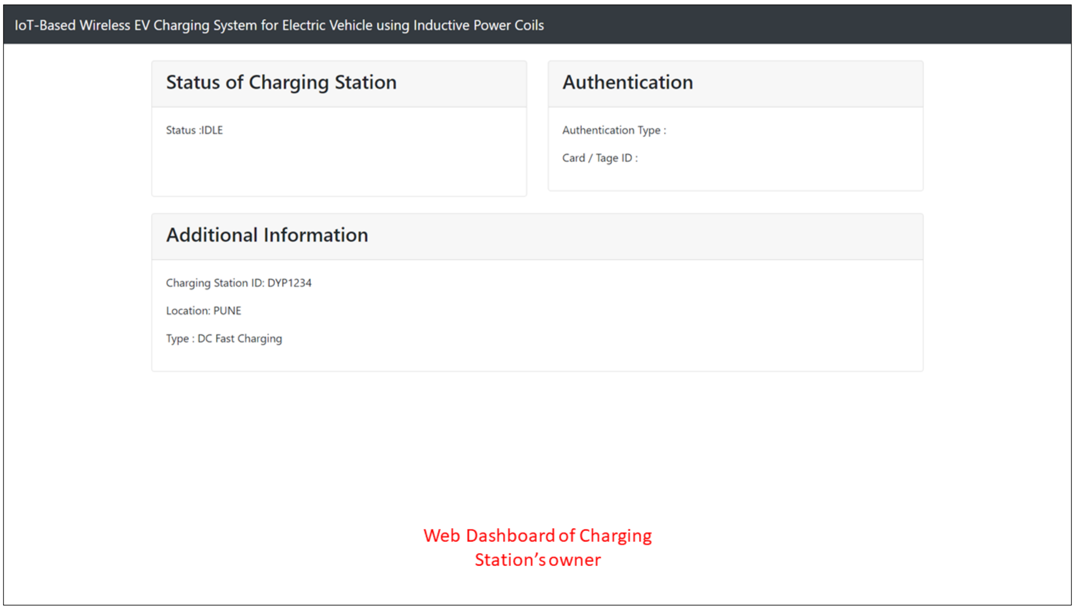

Figure 3 – Web Dashboard

Conclusion

The OCPP protocol connects charging stations to management systems from a variety of suppliers. While this may appear to be a minor issue, the repercussions for charging station customers and operators are enormous. On the surface, this means that owners of charging stations are no longer at the mercy of their service providers. They can mix and match charging stations and management systems as needed, giving them choice and flexibility while allowing manufacturers and network providers to compete on customer-relevant aspects such as price, features, quality, and service.

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