JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

IOT BASED PREPAID ELECTRIC VEHICAL CHARGING STATION

C Umadevi [1], Jamuna SG [2], Janhavi R [3], Manaswini KM [4], Saleem S Tevaramani[5]
[1,2,3,4]*ECE, KSIT, Bangalore, India*
[5]*ASSISTANT PROFESSER, ECE, KSIT, Bangalore, India*

Abstract: ***The increasing ubiquity of grid-connected electric vehicles (EVs) poses challenges for controlling operational expenses and scheduling EV charging. Prepaid electric vehicle (EV) charging requires customers to prepay for the electricity they wish to use. This technique allows for better control over invoicing charges and cost control. The charging stations subtract the amount that a user deposits into their account ahead of time from the vehicle's charge. It can help with budgeting, and there may be incentives or discounts for early payments. When charging an electric vehicle, a sensor measures the voltage and current; this process is controlled by a mobile application.***

INTRODUCTION

Charging is an essential part of using an electric vehicle (EV), whether you presently own one or are considering buying one.
When electric vehicles gain widespread acceptance in the near future, brilliant electric car charging will become crucial for network administrators of charging stations as well as the public power matrix. When first entering the electric vehicle (EV) market, the charging system presents one of the major obstacles. The primary issues here stem from private buildings' inadequate infrastructure (high rises), as these structures are ill-prepared to deal with this new reality. The standard power issue on the left does not meet the needs of EV owners. Taking into account recent advancements in the mechanisms, sensors, and communication phases related to the Internet of Things (IoT)might be able to offer fresh answers to these issues. Renting lodging and the potential requirement for assistance with electric vehicle charging in these situations are further aspects of this challenge. Though some condo owners may use them, there is still a widespread reluctance to install EV charging stations. Since the electrical networks aren't built to accommodate EV charging stations, there is also an issue with their security. Not only would changing the electrical basis of the loft require approval from the majority of owners, which may provide challenges, but obtaining permission from government building health specialists may also prove to be challenging. An analysis of the way in which Buildings, sensors, and communication stages may all be able to provide innovative solutions to these problems. Additional components of this problem include renting accommodation and possibly needing help with electric vehicle charging under these circumstances. Despite the fact that some condo owners might utilize them, installing EV charging stations is still largely opposed. Additionally, there is a security risk with EV charging stations because the electrical networks aren't designed to support them. Not only would it be difficult to get consent from the majority of owners to change the electrical basis of the loft, but it might also be difficult to get approval from government building health specialists.

LITERATURE SURVEY

As the number of EVs on the roads increases, charging stations in both parking structures and private garages will become more prevalent. These stations will be responsible for meeting the requirements of the distribution grid, EV owners, and parking structure operators. For security and financial reasons, among the many functions these charging stations will perform are user authorization, authentication, and billing. Basic, networked, charging stations such as Leviton [1] and Clipper creek [2] require a point of sale (POS) device to authorize and enable charging. Other commercial charging stations, such as Coulomb [3] and Blink [4] require a shortrange RFID card for the same purpose. In both cases, extra steps on the part of the user must be taken to authorize charging. The authors in [5] propose using conventional RFID tags inside EVs and RFID readers on parking garage access gates together with middleware and an aggregate charging controller to authorize, assign, and enable charging. However, this system still requires action from the user and is not as flexible as may be desired. The UCLA SmartGrid Energy Research Center (SMERC) has developed a software-based EV monitoring, control, and management system that employs multiplexed charging stations capable of providing varying power to several EVs from one circuit, called WINSmartEVTM[6]. This system centers on a server-based aggregated charging controller and utilizes a user database together with a smart-phone interface for charging authorization. In order to simplify the charging authorization process and make it more convenient for users, an authentication system based on an RFID mesh network is proposed as an additional capability for the existing WINSmartEVTM framework. The proposed improvements allow charging authorization to take place seamlessly at multiple charging stations in a single geographic location without any action on the part of the user. Vehicle Monitoring/Identification Modules (VMMs), located in EVs, act as RFID tags for vehicle identification and charging authorization. Unlike the layered architecture for managing a

variety of automatic identification hardware proposed in [9], the VMMs communicate directly with a network coordinator and charging control server through a ZigBee mesh network, thus simplifying the architecture. The paper is structured in the following way: first, the existing WINSmartEVTM architecture is outlined. Then the architecture of new Zigbee-based RFID charging authentication system is presented and each component of the system is described in detail. Last, the results of the implementation are presented and discussed. With an increased number of Electric Vehicles (EVs) on the roads, charging infrastructure is gaining an ever-more important role in simultaneously meeting the needs of the local distribution grid and of EV users. This paper proposes a mesh network RFID system for user identification and charging authorization as part of a smart charging
infrastructure providing charge monitoring and control. The Zigbee-based mesh network RFID provides a cost-efficient solution to identify and authorize vehicles for charging and would allow EV charging to be conducted effectively while observing grid constraints and meeting the needs of EV drivers. The Internet of Things, also known as things-linked internet, is a network that connects any object to the internet via RFID (radio frequency identification), infrared sensors, and other sensing devices, allowing data exchange and communication. This paper discusses the technical advantages of RFID technology for identifying electric vehicles and managing the entire battery charging compartment, as well as how RFID technology is used in battery charging stations. Because of these advantages, RFID technology can better serve the electric vehicle industry and support effective battery charging compartment management. Electric vehicle charging stations have begun to be installed in many areas, but they are not yet complete.

Jagnyashini Debadarshin, Sudipta Saha Indian Institute of Technology, Bhubaneswar entitled "Efficient Coordination among Electrical Vehicles: An IoT-Assisted Approach" on 20 June 2022 Higher refueling time of the Electric-Vehicles (EVs) is one of the major concerns in their wide-spread use for transportation. A well-planned charge scheduling of the EVs, hence, is extremely important for proper utilization of the limited charging infrastructure and also limit the size of the waiting queue in the Charging Stations (CSs). Almost all the existing works on this topic are theoretical and assume the availability of global data of the EVs and the CSs. In this work, we take an endeavor to derive a practically useful solution to this problem through efficient EV-CS coordination.

N. Sankar Department of Electrical and Electronics Engineering, National Institute of Technology Puducherry, Karaikal, India M. M. Rajan Singaravel Department of Electrical and Electronics Engineering, National Institute of Technology Puducherry, Karaikal, India entitled "Solar Powered Off-board Electric Vehicle Charger with Reconfigurable Power Electronic Interface" on 21-22 January 2022 the growth and usage of the electric vehicle is on the rise over the past few years. Demerits of conventional IC engine vehicles like depletion of fossil fuel, increase in fuel price and negative impacts on the environment made us to shift to electric vehicles. The fuel for electric vehicle is electrical energy which is extracted from the power grid through charging station. In the power grid, the energy share from conventional energy sources are high, that too coal, which again leads to the same negative impacts as like IC engine vehicles.

Sangeetha R.G, Hemanth. C School of Electronics Engineering, Vellore Institute of Technology-Chennai, Chennai, India Naveen Kumar Marati Wipro Limited, Bengaluru, India entitled "Remote Electric Vehicle Battery Monitoring & Life Cycle Management System" on 10 October 2022, the Internet of things (IoT) is one of the most revolutionary technologies leading experts have created today. The ever-increasing number of devices and embedded systems has made it a necessity for IoT to be implemented in every corner of the world. The latest technology for electric vehicles uses IoT monitoring and life cycle management. Even though there is a sophisticated battery management system in the present Electric Vehicles, there is always a chance of battery damage due to numerous instances caused by battery overcharge and exposure to high/low temperatures.

Manoj Basnet, Subash Poudyal, Mohd. Hasan Ali, Dipankar Dasgupta Department of Computer Science, University of Memphis, Memphis, TN, USA The Supervisory control and data acquisition (SCADA) systems have been continuously leveraging the evolution of network architecture, communication protocols, next-generation communication techniques (5G, 6G, Wi-Fi 6), and the internet of things (IoT). However, SCADA system has become the most profitable and alluring target for ransomware attackers. This paper proposes the deep learning-based novel ransomware detection framework in the SCADA controlled electric vehicle charging station (EVCS) with the performance analysis of three deep learning algorithms, namely deep neural network (DNN), 1D convolution neural network (CNN), and long short-term memory (LSTM) recurrent neural network.

Lucas Zenichi Terada , Juan Camilo López ,Cindy P. Guzmán ,Marcos J. Rider ,Luiz C. P. Da Silva Department of Energy Systems (DSE), State University of Campinas (UNICAMP), Campinas, SP, Brazilentitled "An IoT-based Smart Charging Algorithm Considering Local Distributed Energy Resources and V2G Technology"on 28 September 2022International Journal of Research Publication and Reviews, Vol 4, no 1, pp 1479-1484, January 2023 1484 The integration of distributed energy resources (DERs), such as electric vehicle charging stations (EVCSs), photovoltaic units (PVs), and battery energy storage systems (BESSs) is a key component towards decarbonization. In this context, the development of smart charging control strategies to encourage the usage of renewable energy sources (RESs) for EV charging has become a topical research subject. This paper proposes a smart charging algorithm executed through an internet of things (IoT) platform to control DERs, locally integrated through an aggregated system.

Ankita Nagpal (2020) attempts to uncover consumer perceptions of electric vehicles in the Indian setting in her study. The study's goal is to look at the elements that influence consumer purchasing intent. Low carbon levels, lower maintenance costs, and government measures to incentivize consumers all contribute to higher purchase intent. Other components that have an impact on the consumer are television advertisements, after-sales service, and the wealth of knowledge and information available on the internet.
Increased disposable money, as well as the availability of charging stations and systems, are variables that impact people's decisions to acquire electric vehicles. Beena and Rakesh (2020) investigated current and future trends in electric vehicle production and sales in India, as well as emission standards for India, vehicle standards based on light duty vehicle energy consumption, emission reduction based on global warming for light duty vehicles, and an examination of the EV market. According to the survey, there are numerous
barriers to overcome for EV adoption, and customers are eager to reduce pollution and accept the possibilities, but the various costs are significant, so a cost-effective car is expected in India.

Consumer purchasing intentions of battery electric vehicles in China are identified by Jiang Q WeiW. (2021) and others. Their research aims to investigate the elements that impact consumers' decision to purchase electric vehicles and to construct a theoretical model of these aspects. Brand identity, brand image, and perceived risk are all factors that influence consumer purchase intentions for electric automobiles. Brand image is influenced by brand recognition, brand awareness, and perceived risk. Brand awareness and

identification will have an effect on risk perception. Brand awareness will be influenced by brand identity, but purchasing decisions will not be influenced directly by brand awareness. Essential hurdles and insufficient charging facilities are addressed for a growing country like India, according to a research article published by Goel and colleagues (2021). They discuss the market penetration rates for electric vehicles, hybrid electric vehicles, plug-in hybrid electric vehicles, and battery electric vehicles. When compared to regular automobiles, hybrid, plug-in hybrid, and electric automobiles can improve fuel economy while significantly increasing the cost of ownership. Purchasers, society, automakers, and governments all profit from their lower petroleum use and increased productivity in the long run. When conventional energy sources are unavailable, the new vehicle-to-grid concept can be used to either deliver power to the grid or charge the battery.

Krishna (2021) attempted to find impediments to EV adoption and consumer perception in his research. According to the study, the following factors influence consumer perception: 1. inability to convert sales: i. vehicle supply and choice, and ii. dealer role. 2. lack of trust in technology: i. autonomous driving, ii. unsafe, iii. unfriendly to the environment, iv. unreliability, v. technological immaturity; 3. adapting to technology: i. purchase and ownership costs, ii. infrastructure, iii. range, and iv. recharge time; 4. wantability: i. the vehicle's soul and personality, ii. repair, iii. culture, iv. a lack of fun, v. the vehicle's appearance and futuristic concept, vi. presentation, vii. sound, viii. emotional attachment, ix. negative image

In his study, Saiful Hasan (2021) attempted to predict consumer intent to repurchase electric vehicles. Consumer satisfaction with EV benefits, such as cost, range, recharge, policy measure, environmental qualities, symbolic attributes, and model availability motivate consumers to repurchase EVs, according to the study. In their paper "Customer Perception of Electric Vehicles," researchers Parmar and Pradhan (2021) identify consumer knowledge and decision criteria for purchasing an electric vehicle. According to their research, the majority of customers are aware of the internet as a key source of information in addition to television and newspapers. Consumers are motivated by a variety of considerations, including environmental awareness, minimal noise, pricing, and new trends. Electric vehicles should be provided at a lower cost to consumers. Because consumers are less aware of government subsidies, they must be advertised more.

Singh, Sharma (2021) and others list the benefits and drawbacks of marketing electric vehicles in India. The following are some of the benefits: When compared to internal combustion engines, electric vehicles are more environmentally friendly. Electricity is less expensive than fuel. In comparison to internal combustion engines, electric vehicles require less maintenance. Electric car challenges include electricity supply, electric vehicle cost is higher than regular vehicles, unavailability of charging stations,and shorter range after charging causes consumers to be afraid of long driving. The high cost of electric vehicles is one issue that deters consumers from purchasing them. To address this, the government has promoted the use of electric vehicles in commercial vehicles by offering incentives. However, electric automobiles are still at least 30% more expensive due to imported batteries.

Monica and Mifzala (2019) investigated customer perceptions in Banglore by learning about their attitudes, feelings, and perceptions. The researchers discovered the level of EV knowledge and the elements that influence client purchase decisions. The majority of buyers are aware of the environmental benefits of electric vehicles. As a result, half of the customers were environmentally sensitive and may like to adopt it. They believe that installing charging stations will aid in the growth of EV sales. In their study, researchers Helmus and van den Hoed (2019) focused on charging infrastructure with the goal of better understanding important performance indicators for public charging infrastructure. Stakeholder concerns about public charging are considered, using objective and result indicators in their study for charging infrastructure. Over the course of various specified goals, result indicators, performance indicators, and various possibilities are assessed. The formulation of key result indicators and key performance indicators, which provide ideas for communicating with stakeholders and implementing, are required for charging infrastructure performance monitoring.
Based on consumer behavior and consumption trends, this article examines a market research study on consumers' understanding of and buying intentions for electric automobiles. Consumers are less aware of most electric autos, according to researchers Yuhang Shang and Yi Feng (2019), and their purchase intents are rather plain. When it comes to purchasing an electric vehicle, the most significant factors they examine are design, price, and dependability, and in the changing circumstances, they also anticipate good
design, a fashionable look, and high-quality service.

The problems for electric vehicles in India were investigated by authors Rakesh Kumar and Dr. Sanjeevikumar (2019). Customers will have range anxiety as a result of a lack of charging infrastructures at regular intervals on the streets, as the vehicle may not be able to run for long. The battery cell is the most fundamental component of an electric vehicle's battery pack. A battery pack is made up of numerous modules, while a module is made up of several battery cells. The batteries are the most expensive component in electric vehicles. They cost around half of electric vehicles. The electronics that tie the cells of a battery pack together and constantly check the status of each cell is known as the battery management system (BMS). A BMS monitors each cell's temperature, charge-discharge state, and short circuit protection.

Selva and Arunmozhi (2020) set out to determine customer perceptions of electric vehicles and the global market, as well as the effectiveness of electric vehicles and their global market. Currently, BEVs (all-electric vehicles) account for 66% of the global EV market. Sales of BEVs are growing faster than those of plug-in hybrids (PHEV). Organizations are working on electric autos to improve consumer awareness and develop new goods. Customers trust their friends and family more than corporation marketing; therefore, this strategy is low-cost and has a greater impact on customers.

Garling and Thogersen'sessay (2020), "Marketing of Electric Vehicles," discusses how substituting electric vehicles for traditional ones could reduce local pollutants and greenhouse emissions from the transportation system. They contend that the user of an electric vehicle pays a hefty price for these societal benefits in terms of pricing, availability, speed, and acceleration. The authors believe that to finish the diffusion process, supportive national policies and skilled marketing are required. Based on a consideration of current and future expected qualities of electric vehicles, as well as a review of data on early adopters, the article outlines a two-phrase strategy for marketing electric automobiles. Afroz (2015) and his colleagues published a study to investigate how individual values and attitudes influence consumers' purchasing intentions for electric vehicles. Customers from Malaysia are the focus of the study. Individual consequences (ICNs), such as measures of convenience, product size range, and perceived utility, were found to be adversely connected to green purchasing intention in the study (PIN). While consumers consider fuel efficiency, consumption, and comfort of a car when

making a purchasing decision, they may choose an electric vehicle if the manufacturer offers a battery recycling facility. PIN has no statistically meaningful link with ECN's environmental impacts.

Craig Morton (2016) and co-authors observed the impact of consumer innovation as well as perceptions of electric vehicle functional capabilities on customer demand for electric vehicles in their study on consumer preferences for electric vehicles. The study proposes a framework for analyzing the impact of consumer innovation and attitudes on electric car functional qualities.

DRAWBACKS OF THE EXISTING SYSTEMS

1.It requires man power
2.More time consuming
3.Transaction delays
4.Uncertain Costs

OBJECTIVES OF THE PROPOSED METHOD

1.Cost Control
2.Convenience
3.accessibility
4.Efficiency
5.User-Friendly Experience

I. PROPOSED METHOD

This is the procedure that needs to be followed at the charging station. The Arduino and Node MCU are the main components in the suggested system that facilitate communication between the charging station of the OEM (Original Equipment Manufacturer) and the consumer. Switches between the ports allow Arduino to tell the Arduino UNO when a port is available so that it can show the information on an LCD (liquid crystal display). The servo motor will open and close the port gates once those switches create the relay module. The 12C (Inter Integrated Circuit) Serial Communication Node MCU (Micro Controller Unit) will take over and interact with the cloud data to enable prepaid car charging. Radio Frequency Identification, or RFID,

The RFID card is with the consumer, and the reader module is in the charging station. This RFID module will assist in the prompt, prepaid charge of the car. Based on the location of the charging station and the closest power grid, the Node MCU component will determine the overall cost after accounting for the time needed to charge the car. Prepaid charging station technology can be implemented because of different grid connection tariff pricing.

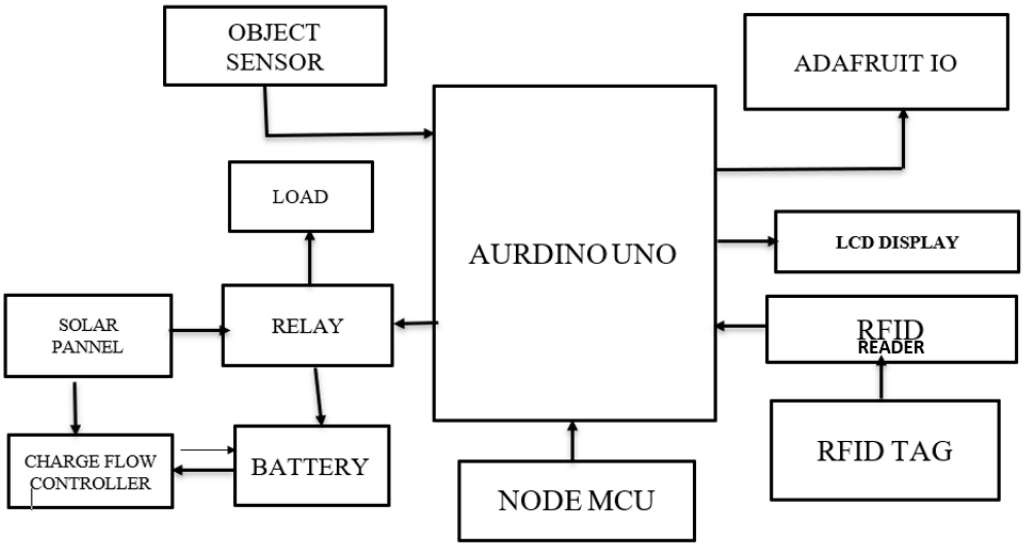
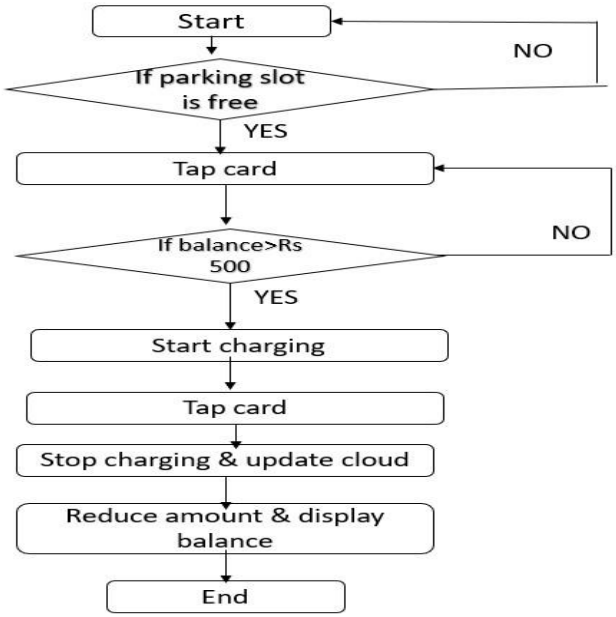


Figure1: Block diagram

FLOWCHART:

In this, first it will check whether the slot is empty or not. If slot is empty then it will ask to tap card on lcd if it is not free then we may go to next slot if it shows free or else we have to wait until it will be free. After tapping the card if the details of the customer matches it will reduce the amount and start charging as per the recharged balanced. We can stop the charge by tapping the card again then it will update the details in to the cloud and displays the remaining balance and the reduced amount. If the details of the customer doesn't matched it will shows the card is invalid. The flow chart is shown below:

Flowchart



V1: APPLICATIONS

1.Urban Mobility Hubs
2.Corporate Campus Charging
3.retail and shopping center
4.Public infrastructure

V11: RESULT

Prepaid electric vehicle charging stations with Internet of Things connectivity provide better billing efficiency and user management. Encouraging a seamless experience, users can remotely monitor and manage charging sessions, check real-time availability, and pay for services in advance. It also facilitates improved cost optimization, data-driven insights, and load control for operators, resulting in an infrastructure for electric vehicles that is both economical and sustainable.

V111: CONCLUSION

Prepaid electric vehicle charging stations with Internet of Things connectivity provide better billing efficiency and user management. Encouraging a seamless experience, users can remotely monitor and manage charging sessions, check real-time availability, and pay for services in advance. It also facilitates improved cost optimization, data-driven insights, and load control for operators, resulting in an infrastructure for electric vehicles that is both economical and sustainable.

II. REFERENCES

[1] Patel, MD, Aush, MG, Mahadik, YV, Kamble, SG, Patil, SV, Kharade, JM. Energy management between electric vehicle charging stations and electric distribution system considering quality of service using IACSO-MPA approach. Int Trans Electra Energy Syst. 2021

[2] Manoj D. Patel , Rutuja V. Nerlekar , Ankita S. Patel , Namrata M. Raut, Ankita M. Virbhakt, "Wireless Charging of Battery in Electrical Vehicle using Solar Energy," International Journal of Engineering Research & Technology (IJERT), Volume 09, Issue 03, pp. 394-397, March 2020

[3] 2022 TEMPOS: QoS Management Middleware for Edge Cloud Computing FaaS in the Internet of Things IEEE Access

[4] 2022 Cloud of Things (COT): Cloud-Fog-IoT Task Offloading for Sustainable Internet of Things IEEE Transactions on Sustainable Computing

[5] Connected and Autonomous Electric Vehicles Charging Reservation and Trip Planning System 2021 International Wireless Communications and Mobile Computing (IWCMC)

[6] 2020 Collaborate Edge and Cloud Computing with Distributed Deep Learning for Smart City Internet of Things IEEE Internet of Things Journal

[7] Internet of Things Experiment Platform Based on OpenSource Ecosystem 2023 International Conference on Smart Grid and Electrical Automation