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IOT-BASED-MONITORING-AND-MEASURING- OF-ELECTRIC-VEHICLE-CHARGING

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Abstract – *In the direction of a population of sustainable electric vehicles, the vehicle transportation system is expanding rapidly. Cloud-based monitoring and management of EV smart charger stations for security-driven IoT enabled direct current (DC) fast chargers is the topic of this chapter. The power grid is used to charge energy storage devices in hybrid and plug-in electric vehicles (xEVs). A dedicated interface for predicting and estimating the battery energy consumed at various locations and the bill payment procedure were discussed in the proposed methodology. The details about how long it takes for electric vehicle energy storage devices to charge are discussed in this chapter. Additionally, the technological aspects of conventional DC fast chargers and alternating current (AC) chargers are investigated. In order to analyze the vehicle& 39;s charging cost through the integration of IoT-operated devices, the retrieved data is shared with the original equipment manufacturers via the internet at each charging station. Additionally, DC fast charging stations facilitate the EV users' access to an ideal energy trading solution for all integrated units and associated parameters. The EV metering architecture collects real-time data at each charging location to give current information about how the energy distribution network works and behaves. As a result, the platform provides an optimal method by which the system can serve as an execution framework for EV users to supply energy demand solutions to all entities that are operated at a smart charger infrastructure facility charging station.*

Keywords-IOT, Energy Monitoring, EV charging vehicle

1. INTRODUCTION

Toxic gases from the tailpipe of a conventionally powered internal combustion engine (ICE) contribute to emissions and respiratory system risks. By the year 2030, Norway intends to convert 100% of its passenger cars and 25% of its vehicles in Europe to electric propulsion. Countries on the Asian subcontinent, such as India, have decided to electrify all two- and three-wheel vehicles by 2025.

In addition, the challenges of electrification are being presented by the rising number of vehicles, which is increasing the demand for facilities' energy storage and charging infrastructure. A slow charging station, on the other hand, typically requires 8 to 12 hours to charge 0–100% SOC of the EV's storage devices with the current AC-powered charging stations. During charging, EVs primarily require proper authorization between the vehicle and the charging station, payment security, and load balancing during peak and low usage [1]. Existing AC chargers are the primary obstacle to the implementation and adoption of xEVs. DC charging stations have been introduced by EV manufacturers as a means of overcoming these obstacles.

1.1 Background of the Work

The proliferation of electric vehicles (EVs) has resulted in a significant demand for effective charging infrastructure, which frequently faces difficulties like resource management and real-time monitoring. By enabling real-time data collection, remote charging station management, and improved user interaction through mobile applications, IoT technology can address these issues. Better demand response and predictive maintenance are made possible by combining IoT with smart grid technologies, increasing reliability and customer satisfaction. IoT solutions will play a crucial role in optimizing EV charging processes and reducing the environmental impact of electric vehicle use as governments push for regulations and standards.

1.2 Motivation and Scope of the Proposed Work

The scope of the proposed work on an IoT-based monitoring and measuring system for electric vehicle (EV) charging encompasses the development of a comprehensive platform that integrates real-time data collection, analysis, and visualization of EV charging processes. This project aims to enhance the efficiency and convenience of EV charging stations by implementing IoT sensors to monitor charging status, energy consumption, and user interaction. Additionally, the system will facilitate remote access for users and operators,

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enabling efficient management of charging resources, predictive maintenance, and improved user experience. By leveraging cloud computing and data analytics, the solution will contribute to the optimization of energy distribution and the promotion of sustainable transportation.

2. METHODOLOGY

1. Create a monitoring system based on IoT: Create a sturdy platform for monitoring the charging parameters of electric vehicles in real time.
2. Improve the User Experience: Create a user-friendly interface so that information about charging stations can be easily accessed.
3. Improve Energy Efficiency: Implement algorithms for effective energy distribution and dynamic load balancing.
4. Make predictive maintenance easier: Make use of data analytics to foresee maintenance requirements and reduce downtime

2.1 System Architecture

This stage includes illustrating the framework's general plan, including the construction, parts, and correspondence system. It centers around making a focal energy the executives framework (EMS) that organizes every shrewd gadget and sensors in the home. The engineering configuration will think about network conventions (e.g., Wi-Fi, Zigbee, or Bluetooth) and the framework's versatility for future gadget augmentations. Definite charts and details will show how the different parts interface. This plan gives the establishment to proficient information trade, ongoing checking, and control, guaranteeing that the framework works solidly to accomplish energy streamlining.

2.2 Component Selection and Integration

Putting the developed model and system parts into charging stations that are actually in use. Configuring IoT devices and sensors, establishing communication protocols, and ensuring the safe transfer of data to a cloud platform for centralized management are all part of this procedure. The system can collect and analyze data in real time because of its seamless integration with the existing infrastructure. In order to address any technical issues, improve performance, and incorporate user feedback after deployment, ongoing monitoring and support are essential. This ensures that the system works effectively and enhances the EV charging experience

2.3 Data Preprocessing

An IoT-based monitoring and measuring system for charging electric vehicles (EVs) requires data preprocessing to ensure the accuracy and usability of the collected data. First, missing values and outliers are addressed by cleaning the raw data from various sensors to remove any noise or irrelevant information. Next, methods for data normalization and transformation are used to standardize measurements, making it easier to compare and analyze data in a meaningful way. Data from various sources can be synchronized over time through the use of temporal alignment.

2.4 Model Evaluation

Evaluating the effectiveness of machine learning models with a distinct test dataset. The accuracy, precision, recall, F1-score, and mean absolute error of the model are used in this assessment to figure out how well it can predict charging patterns and energy consumption. Cross-validation and other similar methods are also used to guarantee robustness across various data subsets. This makes it possible to fine-tune and make improvements that improve the system's overall effectiveness in managing EV charging.

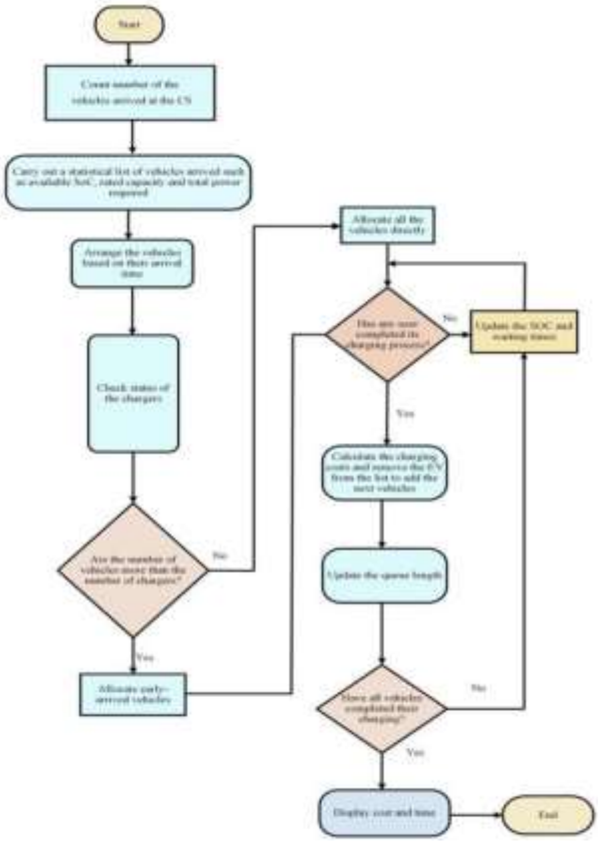

Fig -1- Flowchart

3. CONCLUSIONS

In conclusion, the implementation of IoT-based monitoring and measuring systems for the charging of electric vehicles (EVs) represents a significant advancement in both the improvement of the user experience and the optimization of the charging infrastructure. These systems make use of advanced analytics and real-time data collection to provide useful insights into charging patterns, allowing for more effective energy management and predictive maintenance. By facilitating dynamic load management and peak demand forecasting, this not only helps to cut down on wait times for customers but also contributes to a more environmentally friendly energy ecosystem. However, in order to fully reap the benefits, issues like data security, interoperability among various devices, and the requirement for significant infrastructure investment must be addressed. The incorporation of Internet of Things (IoT) technology into charging solutions will be essential for the development of a dependable and user-friendly ecosystem in light of the growing popularity of electric vehicles. In general, the ongoing advancements in IoT and machine learning will have a significant impact on how EV charging will develop in the future, how greener transportation is promoted, and how sustainable energy practices are supported. The widespread adoption of clean mobility solutions is ultimately driven by the successful implementation of these systems, which not only increases the operational efficiency of charging networks but also boosts consumer confidence in electric vehicles.

4. SUGGESTIONS FOR FUTURE WORK

The implementation of IoT-based monitoring and measuring for the charging of electric vehicles (EVs) has resulted in transformative outcomes, significantly improving the charging process's efficiency, dependability, and overall user experience. The system is able to collect real-time data from various charging stations, including metrics like voltage, current, charging duration, and

user behavior patterns, by utilizing a network of interconnected IoT devices. The system is able to accurately forecast demand for charging and optimize charging schedules thanks to this extensive data collection, which makes it possible for sophisticated predictive analytics. Users benefit from shorter wait times at charging stations and better energy distribution, which is especially important during peak usage times.

Additionally, the application of cutting-edge algorithms for anomaly detection has been crucial in identifying unusual charging patterns. These algorithms can identify potential issues, such as faulty chargers or attempts at unauthorized access, by analyzing previous data. This enables prompt maintenance and intervention. Not only does this proactive approach make the charging infrastructure more reliable, but it also makes security measures better, making sure that users can charge safely in the environment.

The system's load forecasting capabilities contribute significantly to effective grid management. By predicting peak charging loads, utilities can implement strategies to prevent overloads and manage energy resources more sustainably. This is particularly important in the context of increasing EV adoption, as the demand for charging infrastructure grows alongside the need for efficient energy consumption.

User engagement has also seen marked improvements due to the personalization features of the IoT system. By employing machine learning algorithms that analyze individual user preferences and historical charging behaviors, the system can recommend optimal charging times and locations. This tailored approach not only enhances user satisfaction but also encourages more frequent use of EVs by making charging more convenient.

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