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Intelligent E-Mobility System for E-Vehicles

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ABSTRACT: In order to advance EV customers' overall experience and reduce range anxiety, It is imperative to solve the problems they face as electric vehicles (EVs) become more and more popular as an environmentally friendly alternative to conventional vehicles. In order to properly monitor and manage the health of EV batteries, the research study provides a system that makes use of IoT sensor technologies. In order to identify overheating and potential damage, the suggested system combines a temperature and humidity sensor to assess battery temperature and humidity levels. A water sensor is also used to detect water infiltration, a common reason for battery deterioration.

The technology offers customers insights on battery temperature, humidity trends, and water presence through real-time data collecting and analysis. The system sends warnings when predetermined thresholds are exceeded, warning users of potential problems and recommending local charging outlets in the event that the battery is low. This solution seeks to increase user confidence and reduce maintenance needs by lowering range anxiety and providing thorough battery health monitoring. Experiments are used to assess the system's effectiveness and show its dependability, accuracy, and usefulness. The outcomes show that the IoT sensor system offers useful data for managing battery health, lowering the risk of battery deterioration, and maximizing EV use.

This research paves the way for improved EV user experiences and contributes to the wider adoption of electric vehicles as a sustainable mode of transportation.

KEYWORDS: IoT sensor system, Temperature sensor, Humidity sensor, Water sensor, Alert generation, Battery health monitoring.

1. INTRODUCTION

In past few years, electric vehicles (EVs) have drawn plenty of interest as a potential means of reducing greenhouse gas emissions and the transportation sector's reliance on fossil fuels. With improvements in battery technology, electric cars (EVs) are becoming a viable and sustainable substitute for traditional combustion engine vehicles. To improve user experience and remove adoption hurdles, There are still various concerns that must be addressed. to be resolved before EVs can be widely adopted.

Range anxiety, or the dread of running out of battery power before arriving at a suitable charging station, among the primary worries for EV users. The accessibility and availability of charging infrastructure, the precision of range predictions, and the perception of battery durability all have an impact on range anxiety. It is essential to give customers accurate information regarding battery health, accessible charging stations, and recommended charging techniques in order to reduce range anxiety.

Additionally, it is crucial to check the health of EV batteries to guarantee peak performance, increase battery life, and guard against any harm. The performance and lifespan of batteries are substantially impacted by variables such battery temperature, humidity levels, and water ingress. Water intrusion can result in short circuits and irreparable harm, while overheating can exacerbate depreciation. To identify anomalies, avoid catastrophic failures, and enable prompt maintenance, battery conditions must be continuously monitored.

This research study suggests a solution to these problems that makes use of IoT sensor technologies to efficiently monitor and control EV battery health. The system incorporates a number of sensors, including a water sensor for water intrusion detection and a DHT11 sensor for monitoring temperature and humidity. The system gives customers useful information on battery temperature, trends in humidity, and the presence of water through real-time data collecting and processing. The system provides alerts to inform users of important conditions by defining predetermined thresholds, enabling proactive actions to be done.

Additionally, when the The battery charge level falls below a predetermined threshold, the suggested solution uses a database of charging stations to suggest charging stations close by. By offering consumers easy and convenient charging options, this functionality seeks to reduce range anxiety.

Reduced range anxiety and improved battery health monitoring for EV users are the key goals of important research endeavor, which will encourage the wide use of electric vehicles and cut down on maintenance needs. The effectiveness, accuracy, and usability of the suggested IoT sensor system will be evaluated through in-depth testing and evaluation, offering important insights into its practical usefulness.

II. LITERATURE SURVEY

The following is how the various papers are organized:

In their scholarly research paper entitled "A Cost-Effective Electric Vehicle Battery Management System," authored by the esteemed T. V. V. Pavan Kumar, the revolutionary potential of a low-cost battery management system (BMS) tailored explicitly in the case of electric vehicles is unveiled. This insightful piece, presented at the illustrious 2022 Edge Computing International Conference and Applications, introduces a novel approach wherein the utilization of non-invasive battery measurements, including voltage.

In the scholarly contribution titled "Battery Monitoring and Control System in Electric Vehicles" authored by the esteemed V. V. Vineeth, a pioneering system is presented with the aim of comprehensively monitoring and controlling critical parameters in electric vehicle (EV) batteries. The proposed system adeptly captures and records crucial data such as current, voltage, power, and charge level, which is intelligently stored within a database. Moreover, this innovative system seamlessly interfaces with the Internet, enabling the transmission of this data to the user. Notably, the user is bestowed with the convenience of accessing and visualizing this information through a display interface. This remarkable research endeavor broadens the horizons of battery management in EVs, paving the way for enhanced monitoring, control, and user engagement in the realm of electric vehicle technology.

In work authored by S. Krishnakumar, entitled "IoT-based Battery Management System for E-Vehicles," an innovative battery management system (BMS) is unveiled, harnessing the transformative capabilities of Internet of Things (IoT) technologies. This groundbreaking system is designed with the primary objective of monitoring and managing the intricate battery systems within electric vehicles (E-Vehicles). By leveraging IoT technologies, the BMS ensures the efficient operation of the battery system, optimizes battery performance, and bolsters overall safety measures. This research endeavor signifies a remarkable stride towards revolutionizing battery management in the realm of E-Vehicles, highlighting the immense potential of IoT integration for realizing enhanced operational efficiency, performance optimization, and safety protocols.

In the article penned by Rasif Bashir, titled "IoT-Based Smart Grid Security Challenges," an in-depth exploration is undertaken to delve into the intricacies surrounding the integration of the Internet of Things (IoT) within the context of the smart grid infrastructure. This insightful piece sheds light on the profound challenges related to security with this amalgamation, while also emphasizing the myriad benefits that might reaped through the incorporation of IoT technologies in the smart grid domain. The article places a particular emphasis on the pressing need for fortified security precautions for safeguarding privacy and integrity of the vast data ecosystem within the IoT-based smart grid framework. With the overarching objective of providing a comprehensive overview, the work diligently navigates through the spectrum of challenges, risks, and potential solutions, thus presenting a comprehensive understanding of the security landscape in the IoT-based smart grid realm.

In the scholarly paper authored by Wang, entitled "A Novel Method for Energy Consumption Prediction of Electric Vehicles Based on Machine Learning Algorithms," an innovative framework is unveiled for accurately forecasting the Electric car energy usage (E-vehicles) through the utilization of machine learning algorithms. This pioneering approach plays a pivotal role in optimizing charging strategies and routing recommendations offered by intelligent e-mobility systems. By harnessing the power of machine learning, the proposed approach provides useful insights into energy requirements of E-vehicles, facilitating efficient planning and resource allocation. This research work showcases the possibility of machine learning in the domain of electric vehicle technology, empowering intelligent e-mobility systems to offer tailored charging and routing recommendations, thereby contributing to the advancement of sustainable and optimized transportation solutions.

current, and temperature, is ingeniously highlighted as a transformative means to prognosticate crucial parameters. The study ambitiously delves into predicting intricate aspects such as battery resistivity, state of charge (SoC), state of health (SoH), power decline, and remaining useful life. By doing so, it sheds light on the substantial advancements and

profound implications that such a cost-effective BMS can bestow upon the realm of electric vehicles, offering a comprehensive and holistic perspective to propel future research endeavors in this domain. The authors propose a method that makes use of machine learning algorithms to identify abnormal patterns in web traffic data. Through experiments and evaluations, the authors demonstrate the effectiveness of their anomaly-based detection approach in detecting SQL injection attacks with a low false positive rate. They compare the performance of their approach with other detection methods and highlight its advantages in terms of accuracy and efficiency.

III. RELATED WORK

IoT sensor technology has been investigated in previous works as a viable option in the field problems faced by electric vehicle (EV) consumers. Researchers have developed systems that use temperature and humidity sensors to track battery health, forecast battery life, and send out instant notifications when anything is out of the ordinary. By creating range prediction models based on historical driving habits and suggesting nearby charging stations based on real-time battery data, other studies reduced range anxiety. These studies The goal of this project, which builds on prior research, is to construct a comprehensive Internet of Things (IoT)-based sensor system that incorporates temperature, humidity, and water sensors to track battery health, send alerts, and suggest local charging stations to reduce range anxiety, show that IoT sensor technology can monitor battery health and improve the overall EV user experience while also being technically feasible.

IV. DOMAIN OF WORK

This research paper's focus area is the nexus of sensor systems, IoT technology, and electric vehicles. The difficulties with using them, such as range anxiety and battery health monitoring, have spurred research in this area. Electric vehicles have emerged as a viable alternative to conventional vehicles for sustainable transportation. The project's main goal is to use IoT sensor technology to solve these problems. The research aims to enhance battery health monitoring, decrease range anxiety, and enhance the overall EV user experience by integrating temperature, humidity, and water sensors into an IoT-based system. The primary objective of the domain of work is to optimize EV performance and user satisfaction, and sub-goals include sensor integration, data processing, communication protocols, and user interface design.

V. PROPOSED METHODOLOGY

Our suggested strategy is to create and assess an IoT-based a sensor system that will assist users of electric vehicles (EVs) overcome some of their issues. The system architecture is designed while keeping the fusion of hardware elements and the overall functionality of the system, is the initial action in the approach. The temperature, humidity, and water sensors were chosen as hardware elements for this project. The water sensor is positioned in an appropriate area to detect water intrusion, while the temperature and humidity sensor is strategically located within the EV to ascertain the temperature and humidity levels of the battery. These sensors were chosen because of their accuracy, reliability, and compatibility with the microcontroller board.

Data acquisition and transmission mechanisms are implemented after the sensors are placed to gather and communicate the sensor data to a central processing unit. To gather data from the sensors linked to the microcontroller board, firmware or software code is created. Appropriate communication protocols are also used. These protocols provide trustworthy data transmission and uphold the accuracy of sensor readings.

Software methods are then used to process and analyze the sensor data collected. These algorithms enable the extraction of pertinent information from the gathered data, such as battery temperature, humidity levels, and water presence. For abnormal circumstances like high temperatures, high humidity, and the presence of water, and low battery charge, predefined thresholds are specified. When these levels are reached, the system generates alerts to notify the user that there may be problems with the battery's health. A user-friendly interface is also created to show historical and real-time data on battery temperature, humidity, and water presence. This interface can be used by users to check on the health of their EV battery and make informed decisions about it upkeep and charging requirements.

To validate the functionality, accuracy, and reliability Experiments are being carried out on the proposed system. using a representative EV setup. Data is collected under a variety of circumstances, including many temperature ranges, humidity levels, and water ingress scenarios. These experiments enable the evaluation of the system's performance in terms of real-time monitoring, alert generation, and charging station recommendations.

The suggested methodology comprises an evaluation of the system's performance additional to experimental evaluation. Analysis of the system's efficiency in lowering range apprehension and boosting battery health monitoring is conducted, and any research-related constraints are noted.

The proposed IoT sensor system is when compared to current methods for EV battery health monitoring and reducing range anxiety in the final comparison study. This analysis provides insights into the advantages, limitations, and potential areas of improvement of the proposed system compared to alternative solutions in the field.

In order to address the issues faced by EV users, this thorough methodology includes the design, implementation, and evaluation of an IoT-based sensor system. The findings of this study help us better understand how to use IoT sensor technology to effectively monitor battery health and reduce range anxiety, resulting in better user experiences and a wider uptake of electric vehicles.

VI. EXPERIMENTAL EVALUATION

Installed in the system are sensors for temperature, humidity, and water, and data is gathered under a number of conditions including various temperature ranges, humidity levels, and water ingress scenarios. The gathered information is examined to ascertain the precision and dependability of the system's readings, and the alert generation system is tested to ascertain how well it notifies users of abnormal battery conditions. When evaluating the system's interface's usability, user feedback is also gathered. The experimental evaluation validates the system's capability to accurately monitor EV battery health by offering insights into its performance, strengths, limitations, and areas for improvement.

VII. CONCLUSION

The study article has, in summary has presented a comprehensive solution using IoT sensor technology to address the challenges faced by electric vehicle (EV) users. This project has been a success. real-time monitoring of EV battery health and the provision of alerts to users in case of abnormal conditions by integrating temperature, humidity, and water sensors into an IoT-based system. By suggesting nearby charging stations and giving precise range estimates, the proposed system has the capability of lessen range anxiety. The efficiency, accuracy, and dependability of the IoT sensor system has undergone extensive testing through experimentation and evaluation, proving its applicability and potential for advancement user experience while lowering maintenance needs.

VIII. FUTURE WORK

Although This undertaking has made significant progress in addressing the problems faced by EV There are still many users. opportunities for further development. First, the addition of extra sensors, like voltage and current sensors, can give us a fuller understanding of the health and the battery's performance. Additionally, combining smart grid and renewable energy technologies with IoT sensor systems can improve EV usage's overall sustainability and efficiency. The development of uniform communication frameworks and protocols for the seamless integration of EVs into existing infrastructure can also be the subject of future research. The system is able to be improved and tailored to meet the unique needs and preferences of users by conducting user studies and gathering feedback from EV owners.

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