EV Point (Electric Vehicle Charging Infrastructure Project)

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Abstract:

Increasing numbers of individuals are adopting electric vehicles (EVs) due to climate change and environmental concerns. This has generated a high demand for efficient, easy-to-use, and smart charging stations. This project, **Electric Vehicle Charging Station Point**, provides a web application that helps users in finding nearby EV charging stations and repair stations quickly and accurately. Having electric car charging station infrastructure, or electric vehicle points (EVPs), is necessary for more individuals to adopt electric vehicles. Designing and maintaining electric vehicle points involve numerous challenges, including power quality, security, stability, communication, and interfacing with other systems. To overcome these challenges and gain the maximum benefits from electric vehicle points, various technologies and protocols can be utilized. This project helps in making smart and sustainable transport by providing easy access to EV charging stations and promoting the use of clean transport modes.

Key Words: Electric Vehicle(EVs), Charging Station Locator, Sustainable Transportation, Leaflet.js Map Integration, Admin Panel, Chatbot assistance.

Introduction:

The rapid depletion of fossil fuels, along with growing concerns regarding climate change, air pollution, and environmental degradation, has led to a worldwide transition towards cleaner and greener energy resources. The electric vehicle (EV) has been amongst the most promising and influential technologies in this context. Electric vehicles have become a revolutionary force in the transport industry, providing an effective mechanism to mitigate greenhouse gas emissions, reduce the reliance on non-renewable energy resources, and promote the use of green technology in daily life.

Disadvantages of Conventional energy resources and Need for Adopting Electric Vehicles:

One of the greatest disadvantages of conventional sources of energy is that they cause environmental degradation. Fossil fuel combustion is the main reason for the emission of greenhouse gases, mostly carbon dioxide (CO_2), which is a major cause of global warming and climate change. The second serious issue is that fossil fuels are finite and non-renewable. The resources are being consumed at an unsustainable level, and the process of extraction becomes more complex and expensive as reserves keep decreasing with time.

Conversely, electric vehicle usage provides a useful solution to all the problems relating to conventional modes of transport. Electric vehicles are driven by electricity that can be generated from renewable energy sources like solar, wind, and hydroelectric power, leading to a significant reduction in greenhouse gas emissions and air pollution. Clean electricity powering electric vehicles can provide near-zero emissions, thereby becoming a critical component in ensuring global sustainability goals and national goals under the Paris Agreement.

What is an electric vehicle?

An electric vehicle (EV) is a vehicle powered by electricity, using an electric motor driven by a battery that can be recharged from an external source. This includes battery electric vehicles (BEVs), where the vehicle is

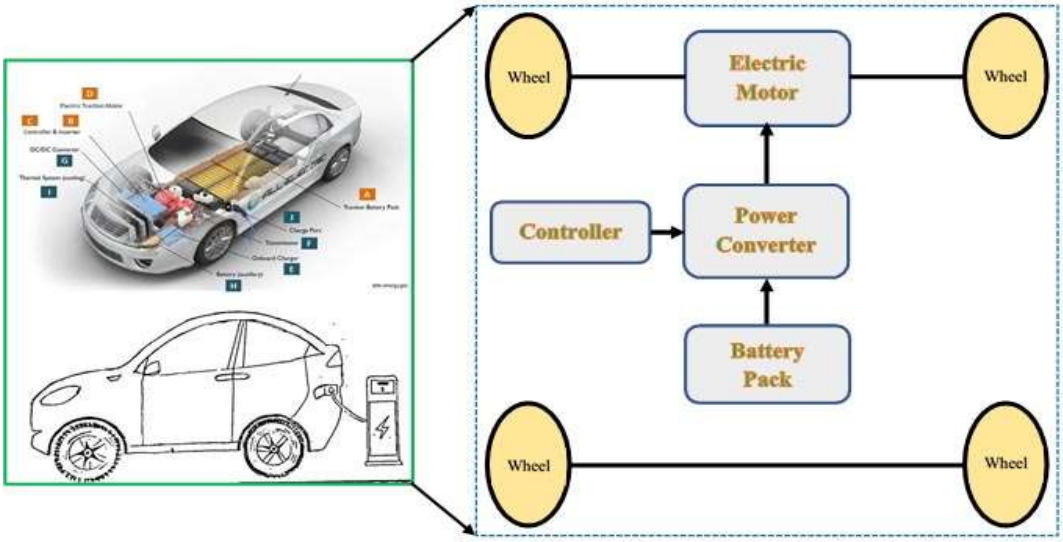
entirely electric, and plug-in hybrid electric vehicles (PHEVs), which can also run on gasoline. EVs include a wide range of transportation modes, including road and rail vehicles to electric boats and electric aircraft. E.g. Tata Nexon EV, Tata Punch EV, Hyundai Creta Electric.

Features and Benefits: EVs produce no tailpipe emissions, so the air stays cleaner and there are fewer greenhouse gas emissions. Electric motors are generally much quieter than gasoline engines, making EVs quieter to drive. Electricity is generally cheaper than gasoline, and EVs require less maintenance than gasoline vehicles. In many countries, incentives are given to promote the use of EV's, including tax credits and subsidies.

Another crucial dimension of this project is the **environmental impact** and **sustainability** of EV charging stations. The project supports a zero-emission, green strategy based on sustainable energy sources such as solar power or wind energy in charging station design that aligns with the global objectives of carbon neutrality and achieving sustainable development.

Fig 1: Example of an electric vehicle

Fig 2: Inside diagram of an electric vehicle



Literature Survey:

The aim of this literature survey is to evaluate past as well as current studies related to electric vehicle infrastructure, i.e., charging systems. This review will decide on technological advancements, identify current problems, and highlight research gaps as compared to this project.

1. *Evolution of Electric Vehicles and Charging Infrastructure:* Electric vehicles have seen rapid technological advancements in the past two decades.

Research by Boulanger et al. (2011) indicated that the initial take-up of electric vehicles (EVs) in developed countries was slowed by inadequate charging infrastructure. Consequently, most countries started placing greater emphasis on financing electric vehicle charging stations (EVCS), leading to the development of Level

1 (120V), Level 2 (240V), and Level 3 (DC fast charging) systems, each with different power output and charging times (Saxena et al., 2015).

2. *Types and Technologies of Charging Stations:* Level 1 chargers are suitable for residential use and offer slow charging times, typically 8–12 hours. Level 2 chargers are more appropriate for commercial and public locations, offering faster charging in 4–6 hours. DC fast chargers (Level 3), as studied by **Liu et al. (2018),** can charge an EV to 80% capacity in less than 30 minutes but they are more expensive and need high-power grid supplies.

Kumar and Zaveri (2020) surveyed the feasibility of wireless EV charging and concluded that it is good but currently limited by low efficiency and high costs.

3. *Integration with Renewable Energy Sources:* Several studies, such as those by **Aliprantis et al. (2013),** have proposed the use of solar-powered charging stations and wind-integrated charging hubs. However, some problems still remain like energy storage, cost of solar panels, and intermittent energy supply.

4. *Smart Charging and Grid Management:* The concept of smart charging has received more attention in recent years. According **to Ghosh et al. (2019),** smart charging systems can minimize peak load pressure on the electrical grid and lower user costs. Studies by **Kempton and Tomić (2005)** demonstrated the potential of vehicle-to-grid (V2G) technology as a decentralized energy storage system, though actual implementation still has some regulatory and technical problems.

5. Research by Sharma et al. (2021) highlights the importance of improved planning, standard connectors, and public-private collaborations to increase charging points in the country.

Despite the vast amount of research, several gaps still remain:

- Lack of uniform charging standards across different manufacturers and regions.
- There is limited information regarding long-term battery wear from repeated fast charging.
- Limited focus on rural EV infrastructure development.
- Integration with renewable sources is underdeveloped in terms of scalability and energy storage.

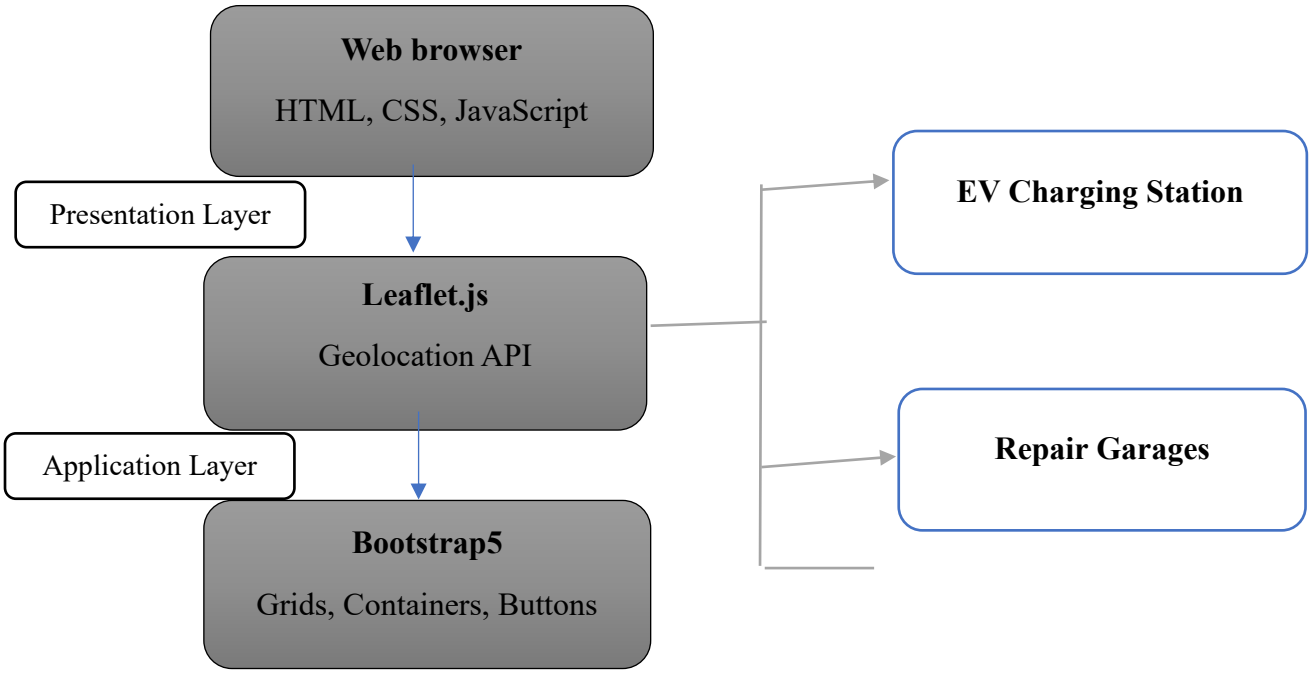
Proposed System:

The development of the project follows a structured, modular approach that makes use of modern web development technologies along with intelligent features to enhance user experience. The main functionality of the system is to allow users to locate nearby electric vehicle charging stations and garage facilities, and to support this goal, front-end technologies have been used .

The front-end of the project is built using **HTML, CSS, JavaScript, Bootstrap, and Leaflet.js**. HTML and CSS are used for the basic structure and styling of the website, while Bootstrap ensures a responsive and user-friendly layout which means it helps the site to work across various gadgets. JavaScript is used to handle

dynamic content rendering and user interaction. Leaflet.js plays a important role in rendering interactive maps and plotting station locations with custom markers, enabling users to visually identify nearby charging stations.

Fig 3: EV charging and repair system flowchart



Methodology:

The aim is to create a user-friendly platform that enables electric vehicle (EV) users to easily locate charging stations and related services like garages. The application also offers functionalities for EV station owners to add their locations to the system. Technologies like **HTML, CSS, Java Scripts, JS leaflet and bootstrap** framework are used to define the methodology of this project. The main goal of our project is to find charging stations for electric vehicles as well as finding a garage to repair electric cars. The user just needs to access our website through the internet and they can get information about the nearest available charging stations for their electric vehicle. For this, the site uses the location of the user to track nearby stations. This industry is growing fast. The demand for efficient and accessible charging solution has increased driving the need to create innovative web based platforms.

- Using **HTML** and **CSS** we create the structure of our web application - Used to structure the web pages, including forms, search fields, maps, and station/garage listings.

- Using Javascript library **Leaflet.js** - allows the project to render a dynamic, zoomable map where EV charging stations and garages are marked with custom icons.

- Using **Bootstrap** - Provides pre-designed components like navigation bars, models, grids, and forms and helps to create websites faster and easily.

- With the help of **Javascript**, we add lots of functionality and access data from the database - Handles user activities like search requests, map interactions, and dynamic content changes.

- Functionalities : Users can **search** for EV charging points and garages by entering a location. This dynamically filters the map and shows matching results.

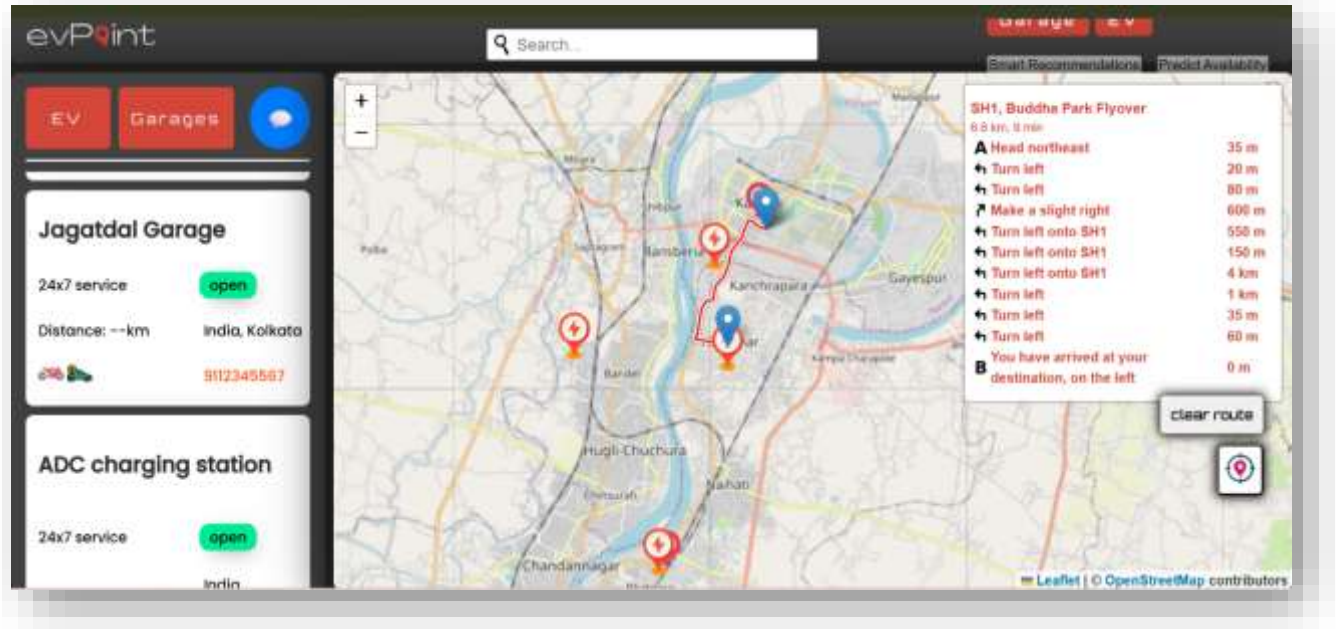
Fig 4: HTML code of the application

```
<body>
    <div class="clear-search btn-nf hide"><button>clear search</button></div>
    <div class="clear-route btn-nf hide"><button>clear route</button></div>
    <div class="locate btn-nf"><button><img src="./img/icon/location.png" width="30px" alt="
    <div id="app">
        <div id="nav" class="section">
            <div class="logo">
                <img src="./img/logo.png" height="70px" alt="">
            </div>
            <div class="buttons">
                <a class="btn create-ev" href="./admin.html">Garage</a>
                <a class="btn create-garage" href="./admin.html">EV</a>
            </div>
        </div>
        <div id="side_bar" class="section">
            <div class="buttons">
                <button class="btn ev-filter">EV</button>
                <button class="btn garage-filter">Garages</button>
            </div>
```

Results and Discussion:

The implementation of the Electric Vehicle Charging Station Point project has led to a functional and interactive web application that fulfills the main objective of the system: enabling users to locate nearby electric vehicle (EV) charging stations and associated facilities such as garages and repair centers easily. The system makes use of several modern web technologies—like HTML, CSS, JavaScript, Bootstrap, and Leaflet.js—to deliver an easy-to-use and user-friendly platform for EV users. The mapping feature, powered by Leaflet and combined with real-time geolocation capabilities, enables users to view nearby stations on an interactive map interface easily and precisely.

Fig 5: Overview of the portal



One key feature is the ability to how it dynamically shows charging points and garage facilities as a function of geographic data queries. This feature has proven particularly useful in modeling how users may look for support

services in real-world situations. The apllication of customizable map markers, pop-ups with detailed information, and filtering functionalities improves the user experience by allowing them to identify not just the nearest stations, but also those that meet specific criteria—such as charging type, availability, or business hours. Moreover, the clean design and layout achieved using Bootstrap ensure that the site remains simple and easy to use.

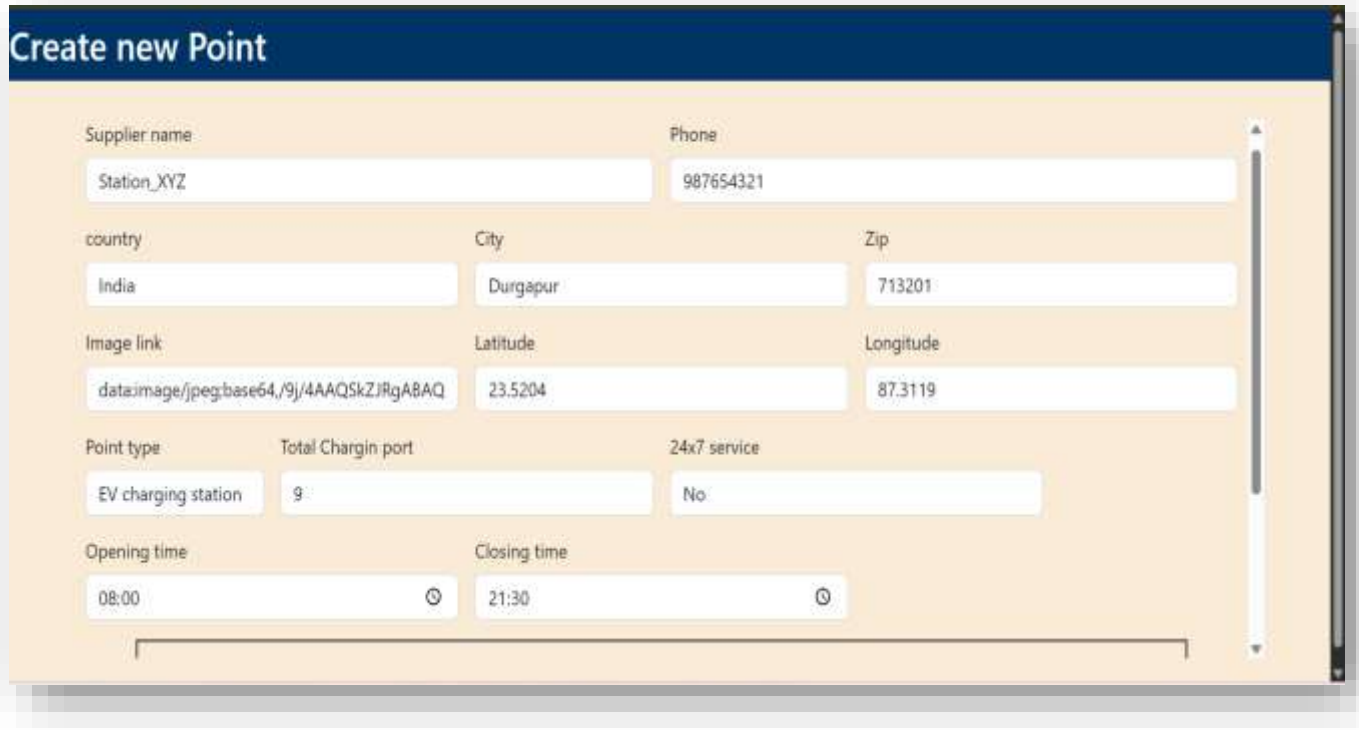


Fig 6: Creating a new charging station point

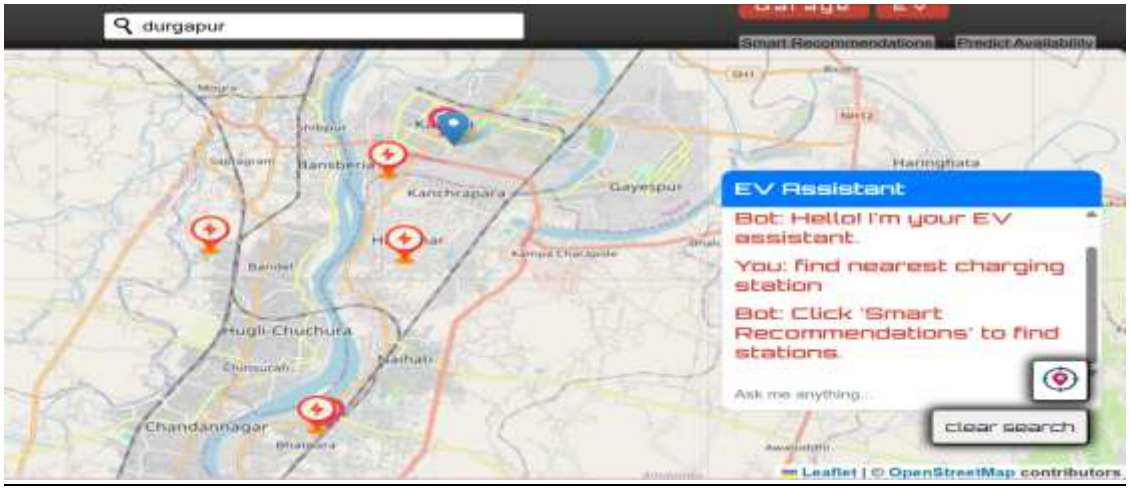
Admin Panel: There is also an admin interface where electric vehicle point owners can log in and submit their station details. This allows the station database to grow through the input of the users.

Search Functionality: Users can search for EV charging points and garages by entering a location. This dynamically filters the map and displays matching results.

Filter Options: Users can apply filters to view only EV stations or only garages, helping them to limit their search to specific needs.

Click-to-Navigate: A click on any of the map markers opens an information popup, which contains navigation options that link to external map services like Google maps for directions.

Fig 7: Simple chatbot for user support



Also, a basic chatbot interface is built into the website. This chatbot serves as a virtual assistant, answering common questions such as how to use the system, where to find nearby stations, what charger types are supported, and what the current availability might be. Although it does not use machine learning at this stage, it provides a basic support system for users and adds a level of interactivity to the site.

So, our EvPoint portal combines **interactive mapping, location-based recommendations** and **conversational assistance** through a chatbot. All of these features provide a practical and efficient solution to help grow the network of electric vehicle users and the infrastructure needed to keep them running. It also allows for future updates with features like real-time APIs, user logins, machine learning, and advanced chatbot platforms for more intelligent assistance.

Conclusion:

The Electric Vehicle Charging Station Point project provides a simple way of identifying EV charging points and garages. It utilizes technologies such as HTML, CSS, JavaScript, and Leaflet.js to assist users in searching for places, viewing charging points on a map, filtering the results, and getting easy access to nearby stations. An admin interface is employed by EV station owners to upload their stations onto the system. Intelligent suggestions, time-based predictions for availability, and an effortless chatbot option make the site more interactive and intelligent and thus improving the user experience.

The project supports green transport, enables access to EV facilities, and has a strong base for further enhancements like real-time data integration, route planning, and mobile app support.

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