A Project Report on

VISUALIZATION TOOL FOR ELECTRIC VEHICLE CHARGE AND RANGE ANALYSIS

BACHELOR OF MATHEMATICS

Submitted by

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Agasteeswaram

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VISUALIZATION TOOLS FOR ELECTRIC VEHICLE CHARGE AND RANGE ANALYSIS

1. INTRODUCTION

1.1 OVERVIEW

A vehicle that can be powered by an electric motor that draws electricity from the battery and is capable of being changed from an external source and have an electric motor instead of an internal combustion engine.

The Electric Vehicle (EV) is not new, but it has been receiving significantly more attention in recent years. Advances in both EV analytics and battery technologies have led to increased automotive market share. However, this growth is not attributed to hardware alone. The modern mechatronic vehicle marries electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer, and data analysis, to form a comprehensive transportation solution. Advances in all these areas have contributed to the overall rise of EVs, but the common thread that runs through all these elements is data analytics.

The new EV's are combined Electrical storage and propulsion systems with electronic sensors, controls, and actuators, integrated closely with software, secure data transfer to form a comprehensive transportation solution

1.2 PURPOSE

Electric vehicles use electricity to charge their batteries instead of using fossil fuel like petrol or diesel.

Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements.

The project has several key objectives Firstly, it aims to create a comprehensive database of electric vehicle models and their corresponding charging and range capabilities. This database will be regularly updated to ensure that it remains¬ current and relevant as new electric vehicle models are released.

Secondly, the project aims to create an interface that allows users to input their own driving parameters, such their daily commute distance and driving style.

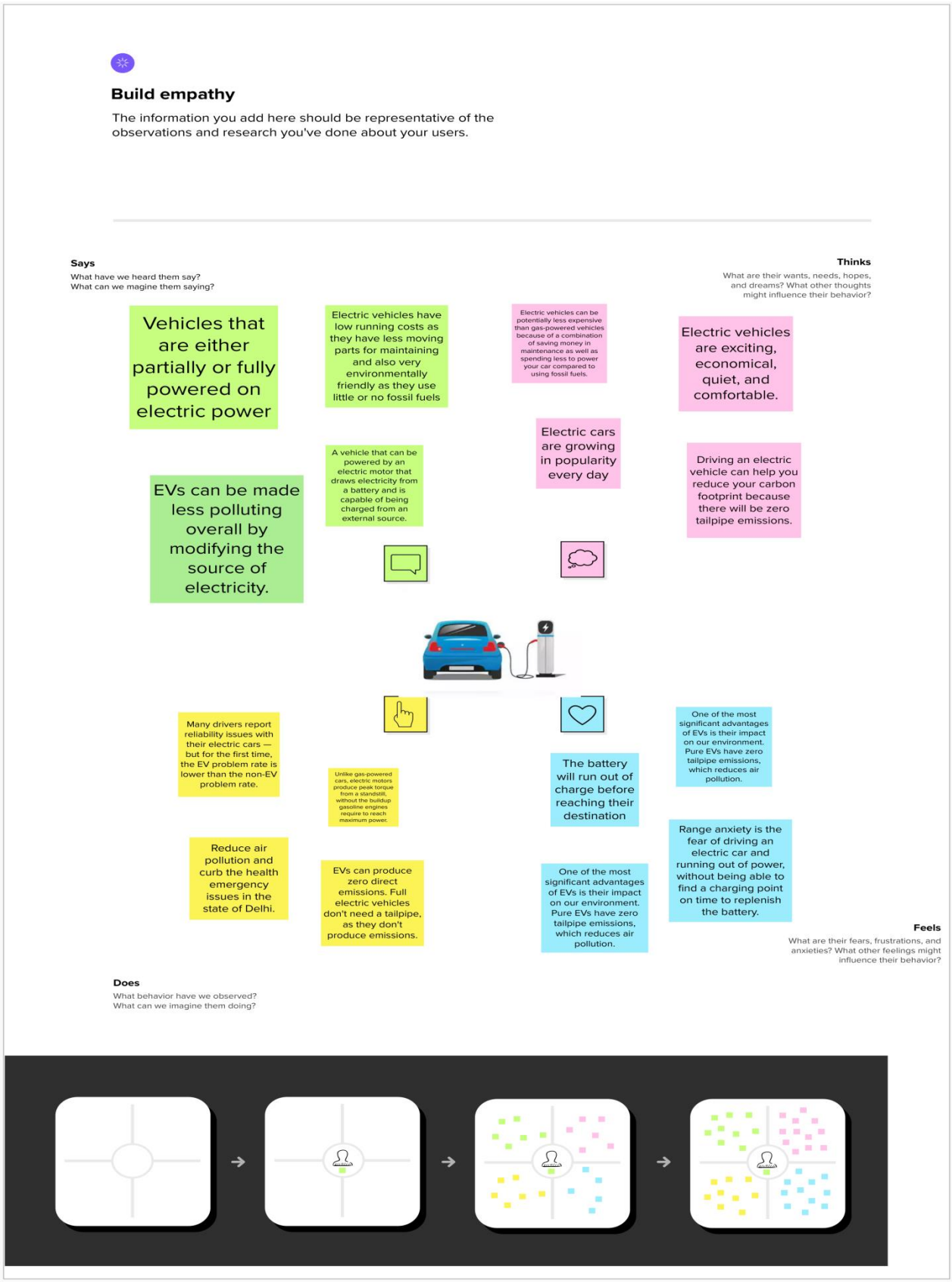
Based on these inputs, the software will simulate the vehicle's¬ performance under these conditions and provide users with insights into how different electric vehicle models may perform in their specific usage scenario.

Thirdly, the project aims to provide users with visualizations of the¬ charging and range capabilities of electric vehicles. These visualizations will enable users to quickly and easily compare different electric vehicle models and understand how their charging and range capabilities may vary under different driving scenarios. In summary , the “Visualization tools for electric vehicle charge and range analysis" project aims to develop software tools that provide users with a comprehensive understanding of the charging and range capabilities of electric vehicles. By doing so, the project aims to promote the adoption of electric vehicles by providing users with useful information and insights to make informed decisions about their transportation choices.

Ultimately, the project thus the potential to play a significant role in accelerating the transition towards a more sustainable and environmentally friendly transportation system.

2. PROBLEM DEFINITION AND DESIGN THINKING

2.1 EMPATHY MAP



2.2 IDEATION AND BRAINSTORMING MAP

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

⏱ 15 minutes

A **Choose your best "How Might We" Questions**

Create 5 HMW statements before the activity to propose them to the team.

B **Set the stage for creativity and inclusivity**

Go over the brainstorming rules and keep them in front of your team while brainstorming to encourage collaboration, optimism, and creativity.

1. **Encourage wild ideas** (If none of the ideas sound a bit ridiculous, then you are filtering yourself too much.)
2. **Defer judgement** (This can be as direct as harsh words or as subtle as a condescending tone or talking over one another.)
3. **Build on the ideas of others** ("I want to build on that idea" or the use of "yes, and...")
4. **Stay focused on the topic at hand**
5. **Have one conversation at a time**
6. **Be visual** (Draw and/or upload to show ideas, whenever possible.)
7. **Go for quantity**

C **Interested in learning more?**

Check out the Meta Think Kit website for additional tools and resources to help your team collaborate, innovate and move ideas forward with confidence.

Open the website →

1 Choose your best "How Might We" Questions

Share the top 5 brainstorm questions that you created and let the group determine where to begin by selecting one question to move forward with based on what seems to be the most promising for idea generation in the areas you are trying to impact.

⏱ 10 minutes

QUESTION

A Vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source and have an electric motor instead of an internal combustion engine.

Key rules of brainstorming

To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

2

Brainstorm solo

Have each participant begin in the "solo brainstorm space" by silently brainstorming ideas and placing them into the template. This "silent-storming" avoids group-think and creates an inclusive environment for introverts and extroverts alike. Set a time limit. Encourage people to go for quantity.

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

10 minutes

SATHYA SHEELA V S

- A vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source and have an electric motor instead of a gasoline or combustion engine
- Renewable sources connected charging station
- Multispeed gearboxes for electric vehicles and feasibility analysis

ASHIKA A K

- Carbon footprint from EV and IC engine vehicles
- Solar charging stations and Conventional charging stations (electricity from coal) comparison.
- Battery electric vehicles are powered by electricity stored in a battery pack.

JENIFER M

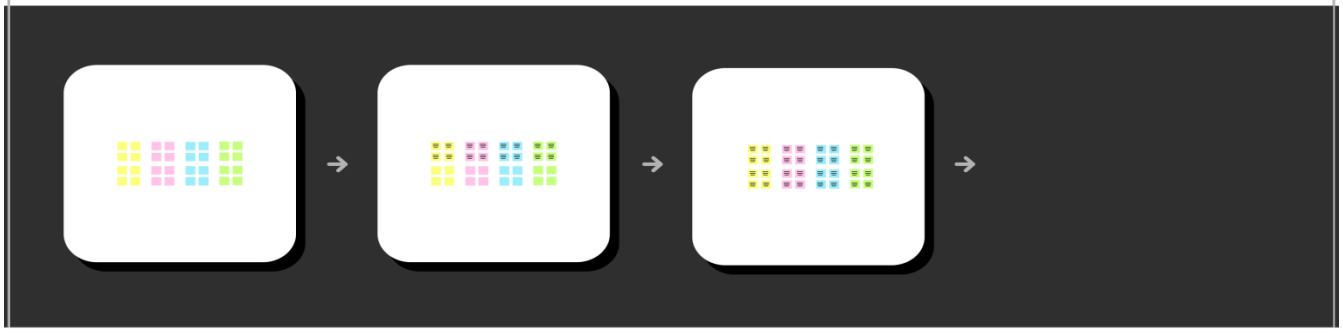
- SVPWM speed control of PMSM
- Electric motor performance analysis in EV for different driving cycles
- Wireless Charging

NIVETHA M

- Vibration analysis of electric motors for electric vehicles
- Simply plug your vehicle into a home or public charger to charge it.
- Electric Vehicle battery modeling in Matlab including self-discharge

SARAN N

- Performance improved battery modeling for EV simulation
- BEVs are powered solely by batteries. They use an electric motor to turn the wheels and produce zero emissions.
- Stability analysis of power utility grid connected with a cluster of charging stations
  V2G at private charging stations



3

Brainstorm as a group

Have everyone move their ideas into the "group sharing space" within the template and have the team silently read through them. As a team, sort and group them by thematic topics or similarities. Discuss and answer any questions that arise. Encourage "Yes, and..." and build on the ideas of other people along the way.

15 minutes

Renewable sources connected charging station

Multispeed gearboxes for electric vehicles and feasibility analysis

There three main types of EV Chargers – rapid, fast, and slow. Measurement of power is in kilowatts (kW).

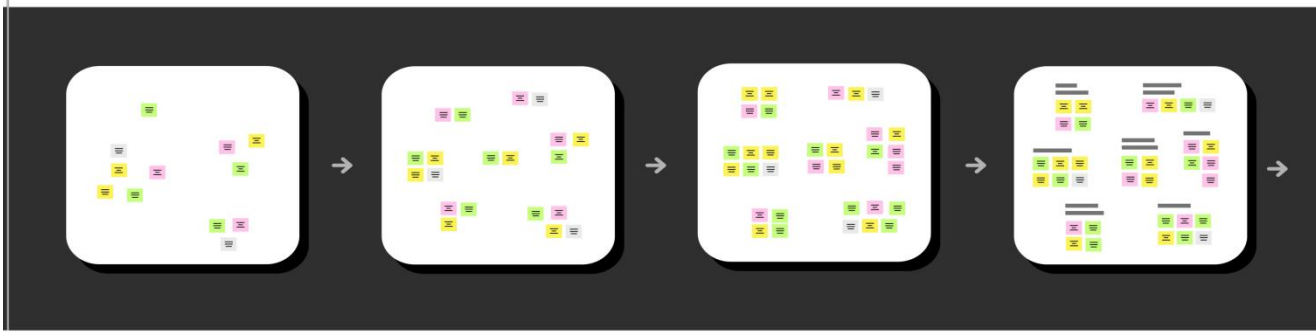
Solar charging stations and Conventional charging stations (electricity from coal) comparison.

The Business requirement for analyzing the performance and efficiently of electric cars include identifying KPIs.

Carbon footprint from EV and IC engine vehicles

TIP

You can use the **Voting session** tool above to focus on the strongest ideas.

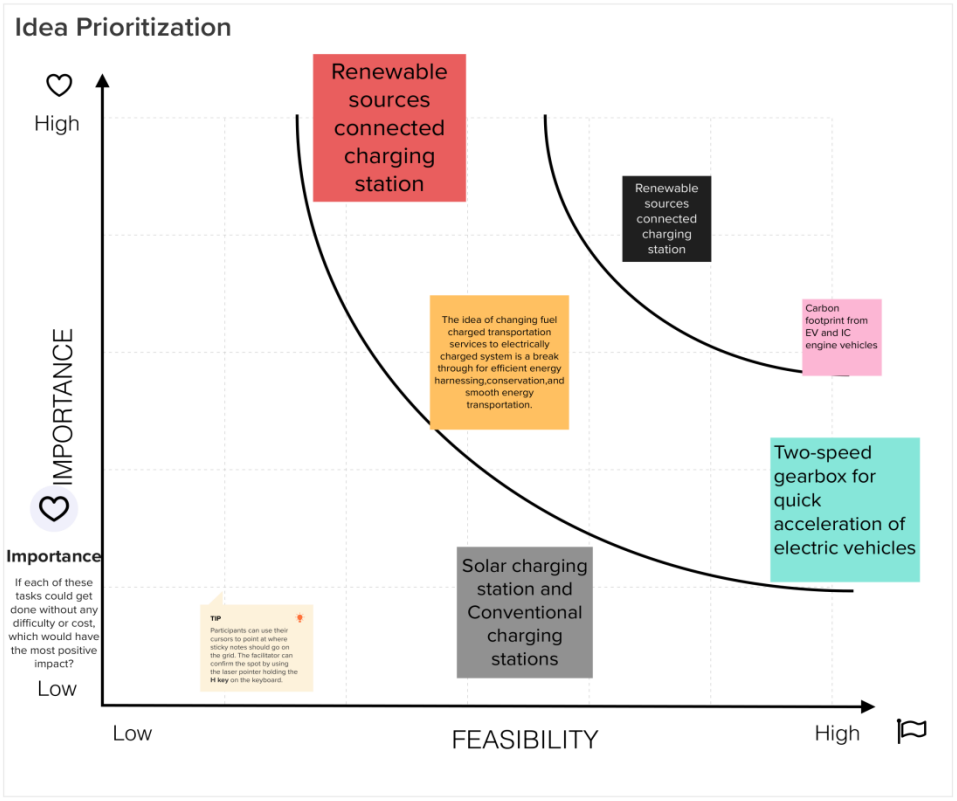


4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

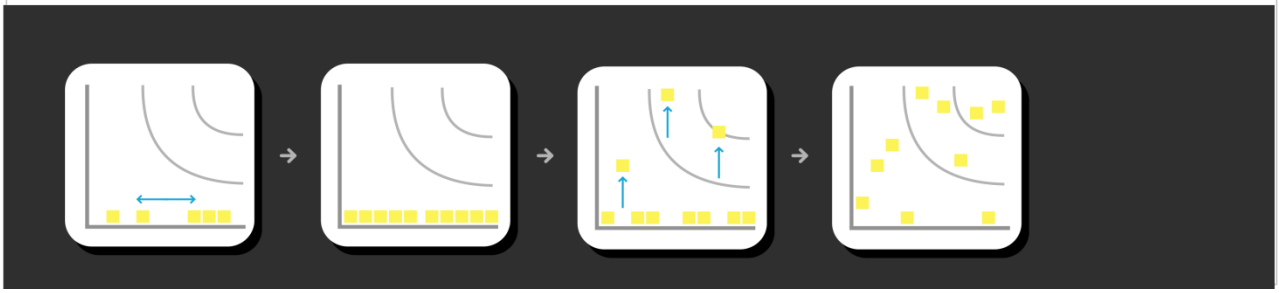


Importance

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)



After you collaborate

A brainstorm like this typically results in a handful of promising ideas that you can carry forward and act upon.

Quick add-ons

A **Cluster related ideas**
Look for patterns or similarities in the standout ideas. Could any be combined together to form a stronger concept? Cluster similar ideas and label each cluster with a theme.

B **Vote on the most promising ideas**
Narrow your focus to only the strongest few ideas by holding a **Voting Session**. Give each person 2 votes

Keep moving forward

2x2 Prioritization matrix
Build shared understanding and make collective decisions for moving ideas forward.
Open the template →

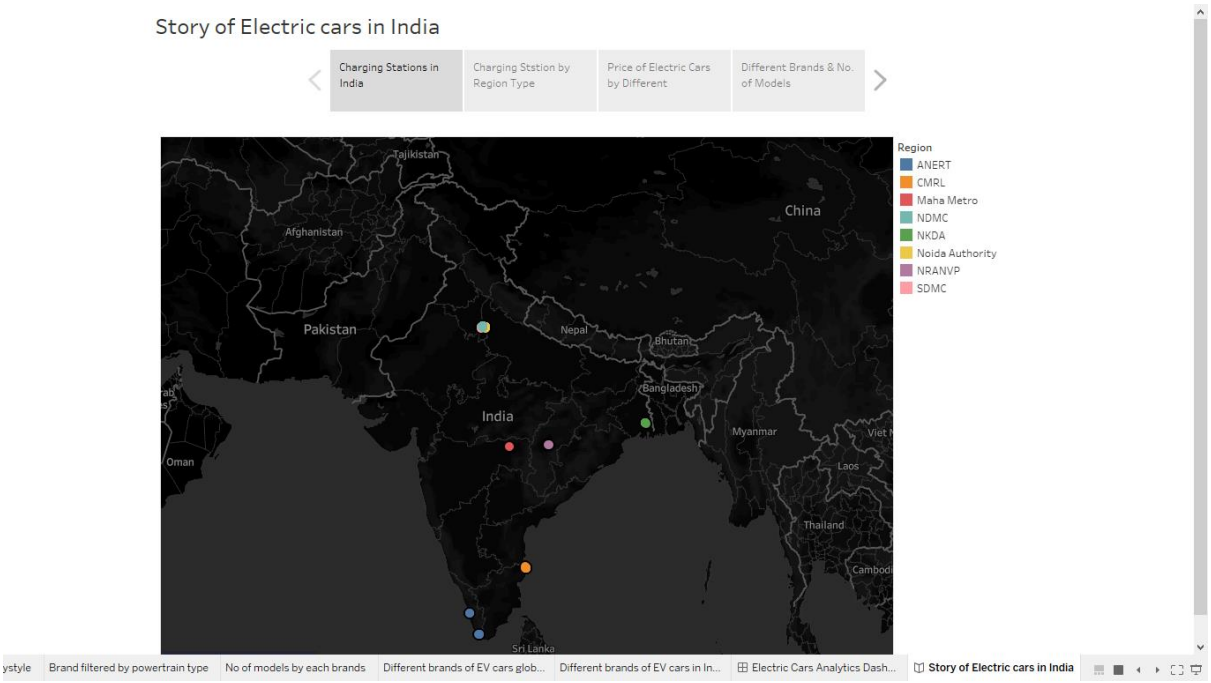
Storyboarding
Show existing and/or future consumer experiences through the act of sketching.
Open the template →

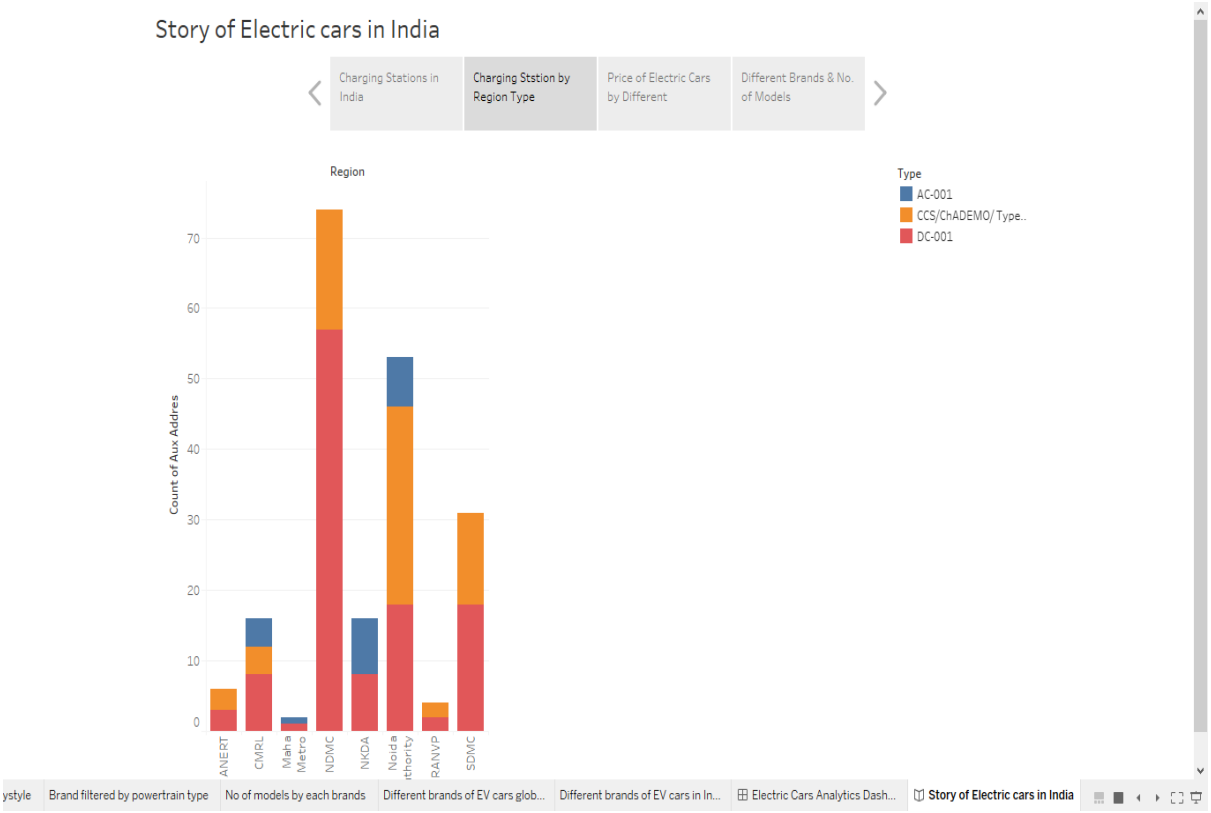
Pre-mortem
Harness the collective experience and wisdom of the team, before the project even starts.
Open the template →

Share template feedback

3. RESULT

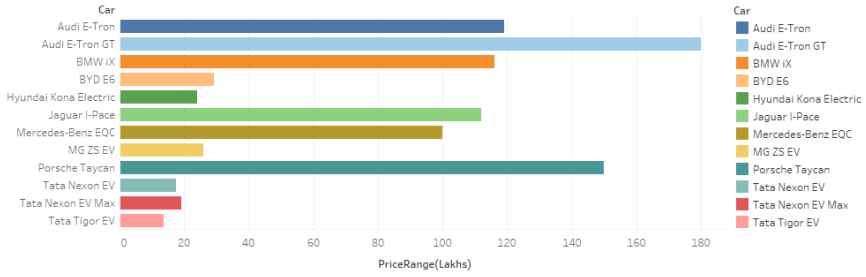
STORY





Story of Electric cars in India

Charging Stations in India | Charging Ststion by Region Type | Price of Electric Cars by Different | Different Brands & No. of Models



ystyle | Brand filtered by powertrain type | No of models by each brands | Different brands of EV cars glob... | Different brands of EV cars in In... | Electric Cars Analytics Dash... | Story of Electric cars in India

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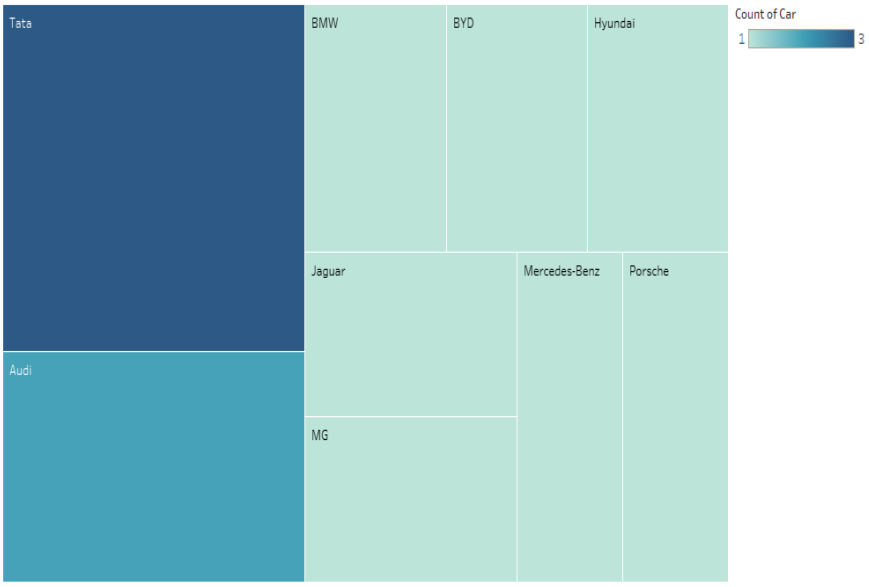

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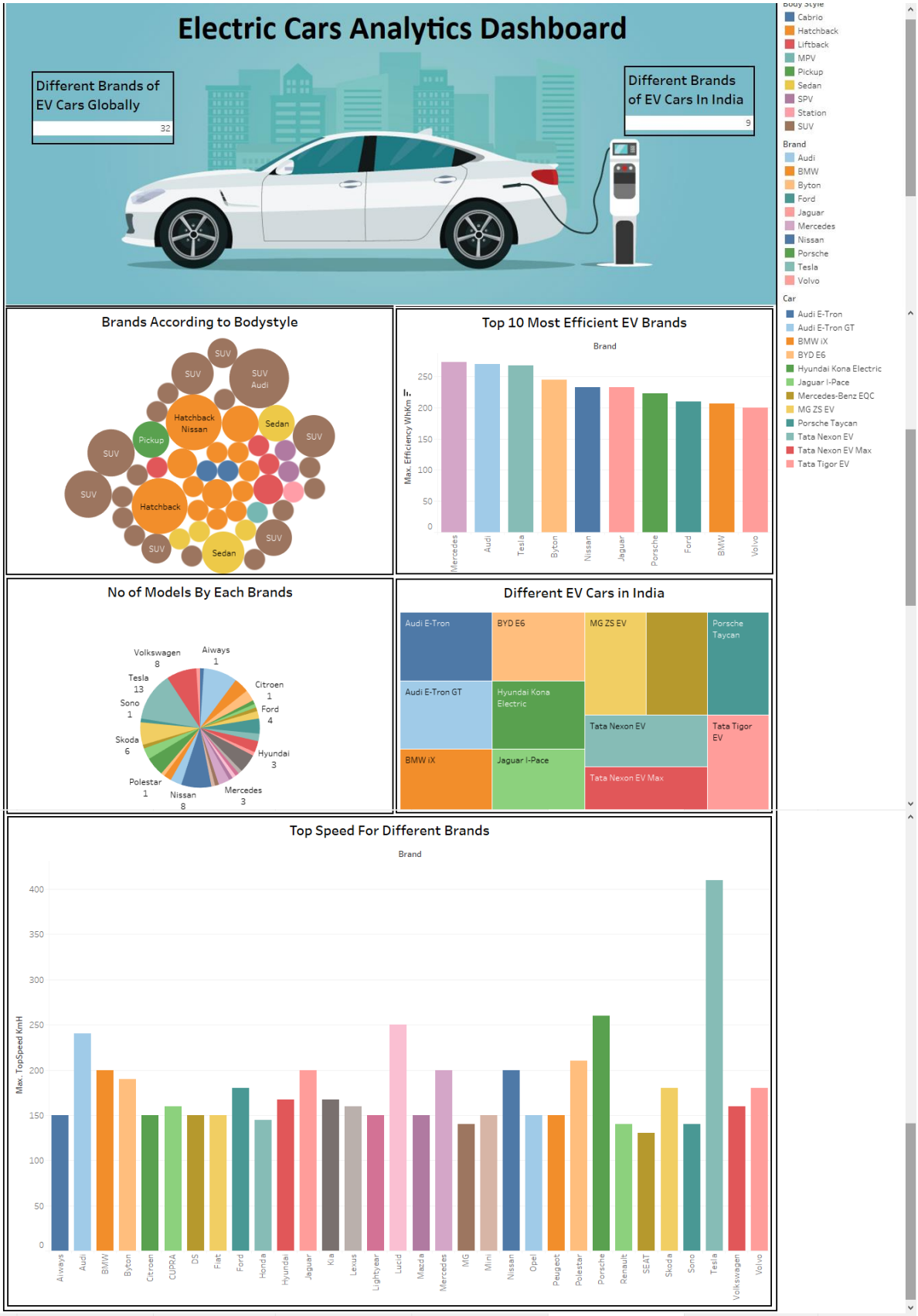
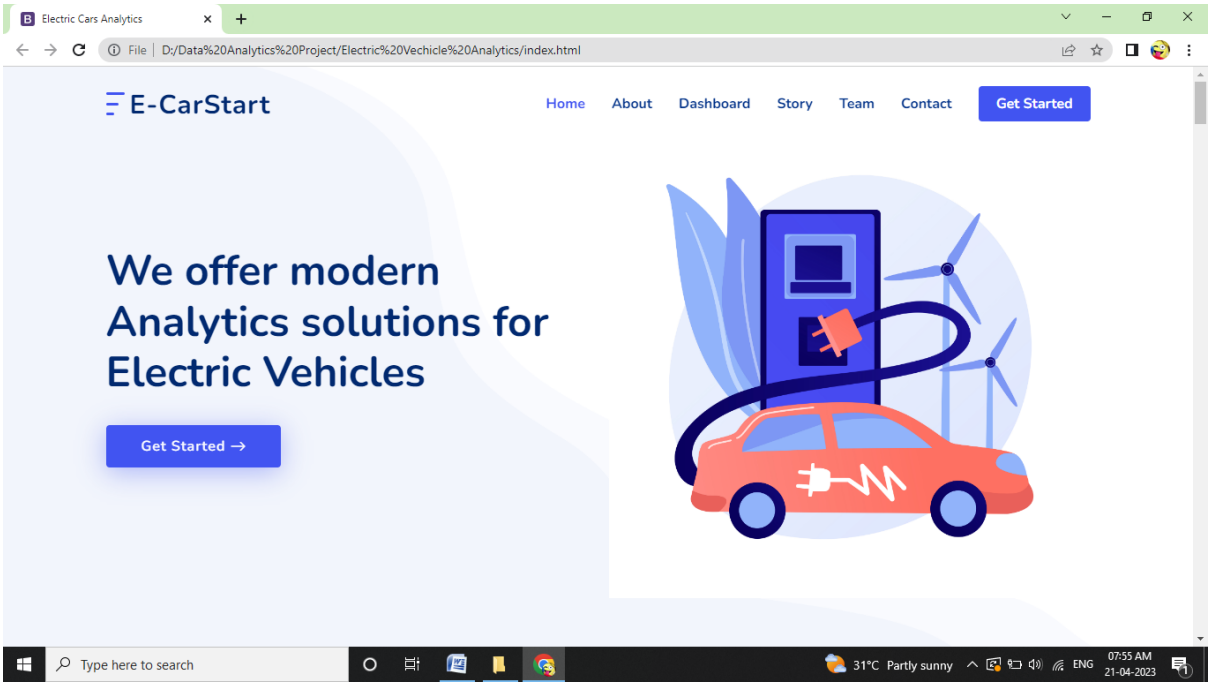
DASHBOARD



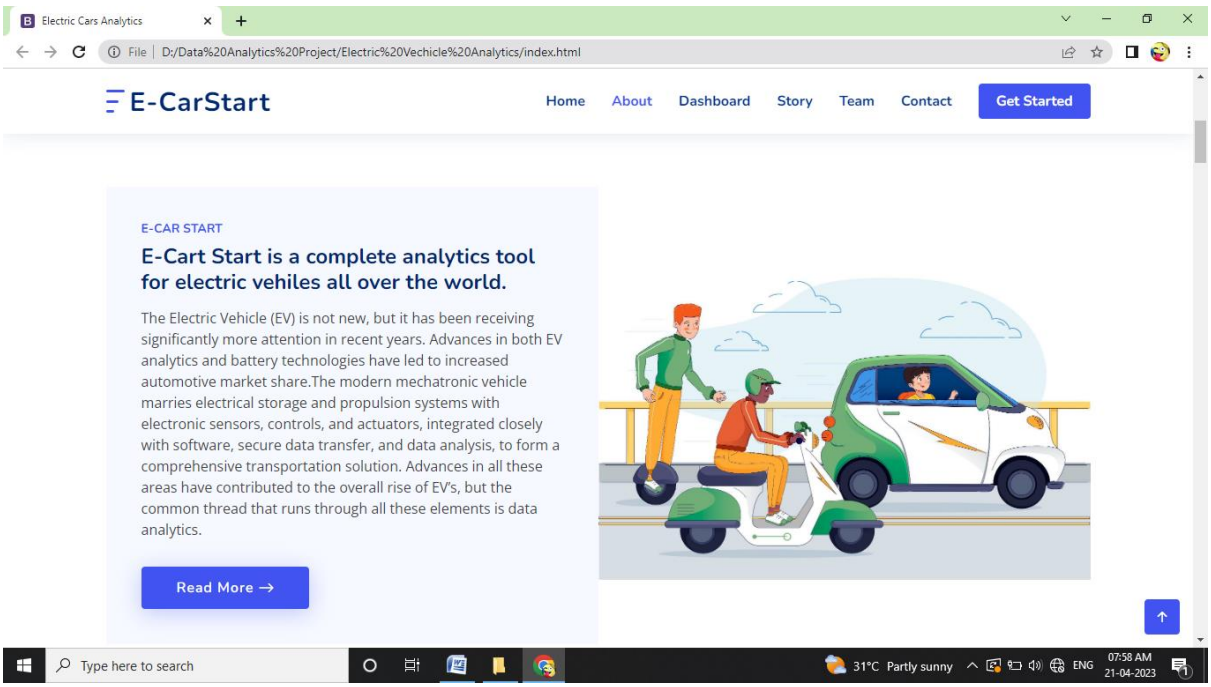
ystyle | Brand filtered by powertrain type | No of models by each brands | Different brands of EV cars glob... | Different brands of EV cars in In... | Electric Cars Analytics Das... | Story of Electric cars in India

WEB APPLICATION

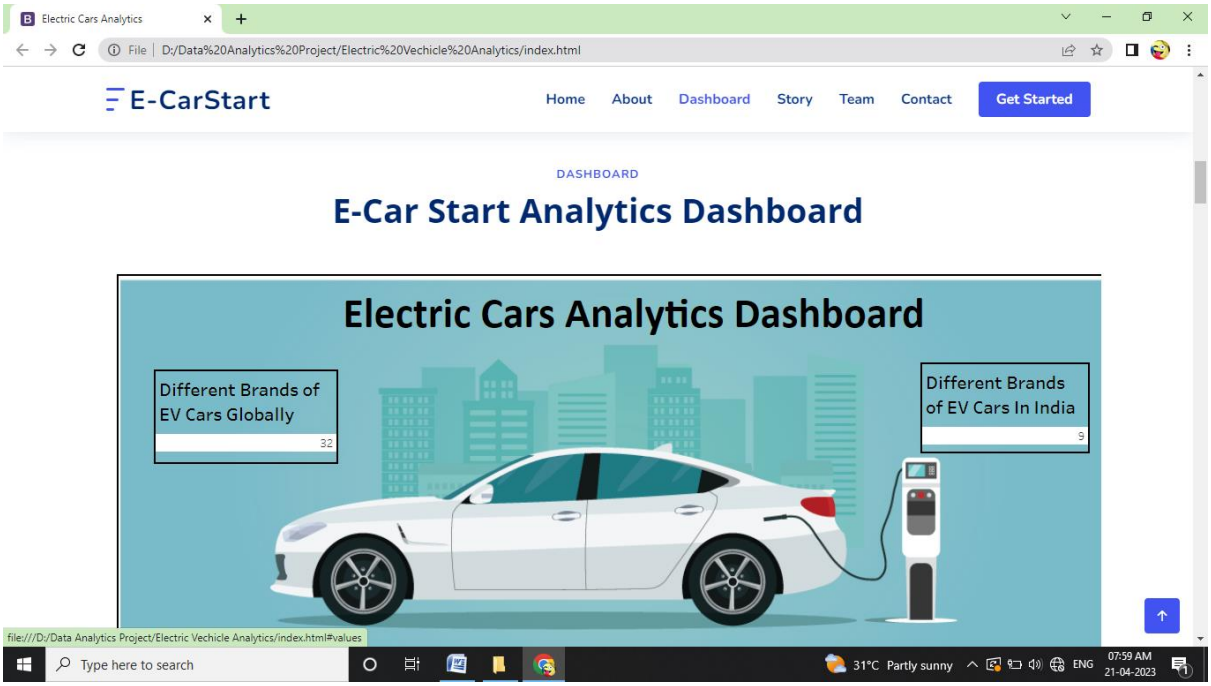
HOME



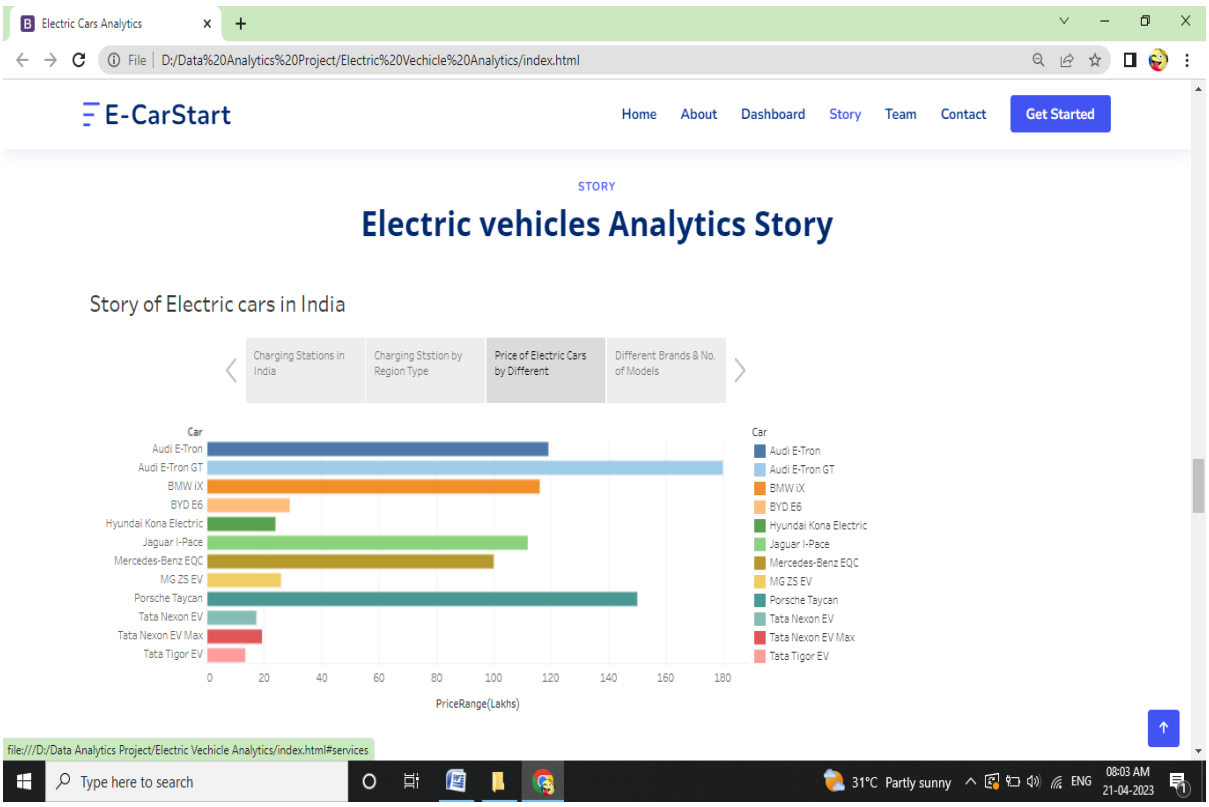
ABOUT



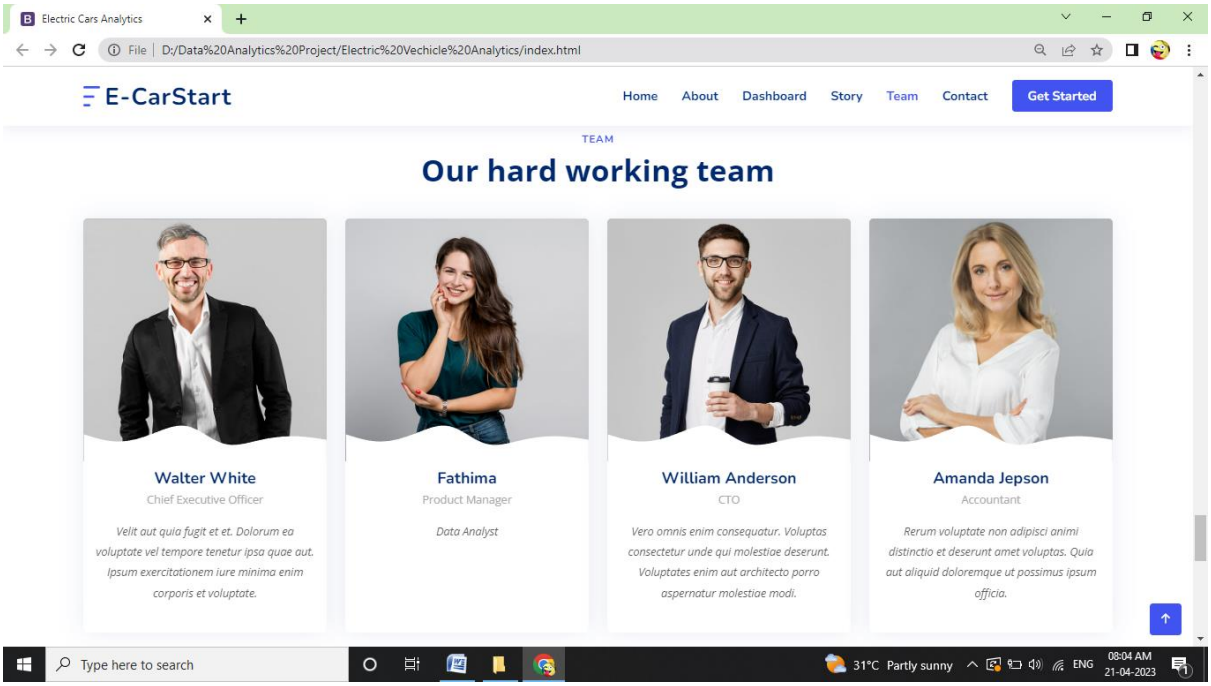
DASHBOARD



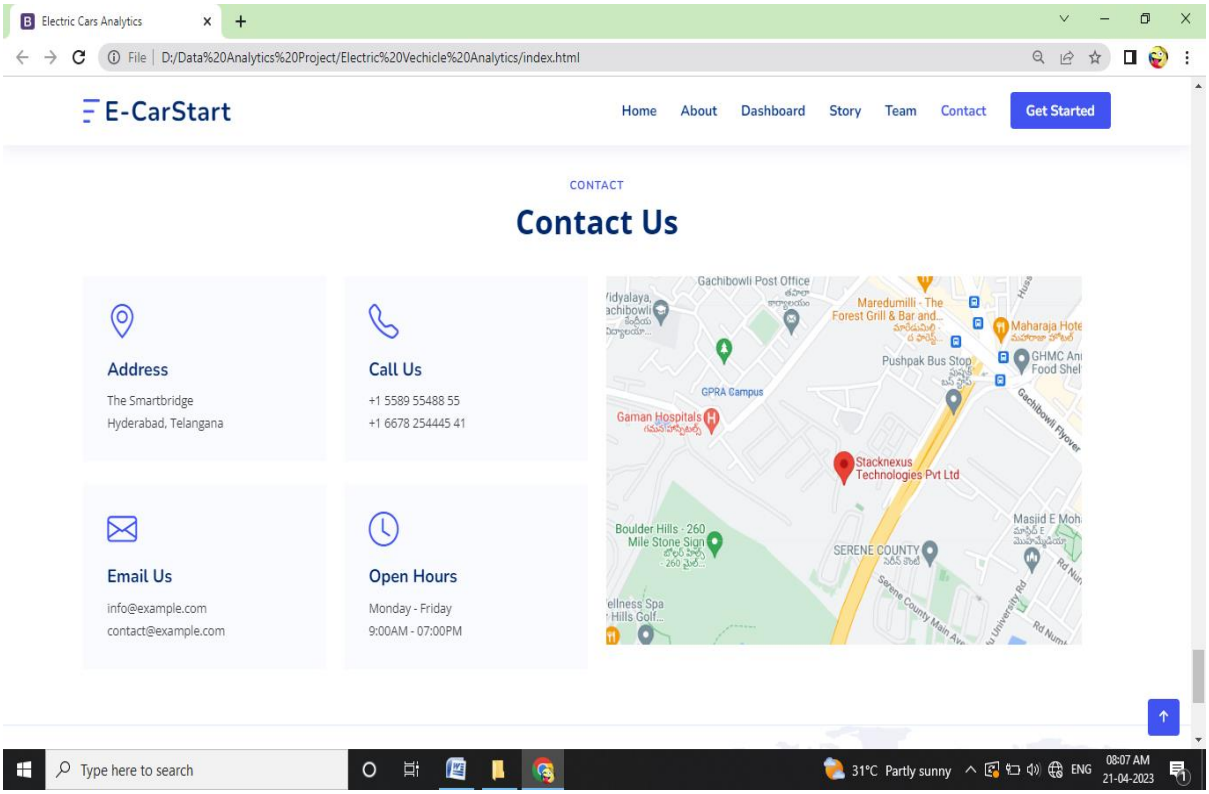
STORY



TEAM



CONTACT



4. ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

Improved understanding of battery health: By visualizing charge and range data, it is possible to gain a better understanding of battery health and performance. This can help to identify potential issues early on, allowing for timely intervention and preventing more serious problems from occurring

Increased understanding of charging patterns: By visualizing charging patterns, it is possible to better understand how and when a vehicle is being charged for optimal performance. This can help to identify times when charging may be necessary, and to optimize the charging process.

Better understanding of range behaviour: By visualizing range data, it is possible to better understand the behavior of a vehicle's range under different driving conditions. This can help to identify areas that could potentially reduce range, and to optimize charging and route planning to maximize efficiency.

Enhanced decision-making: By visualizing charge and range data, it is possible to gain a more holistic understanding of a vehicle's performance. This can help to make informed decisions about charging, maintenance, and route planning, resulting in improved overall efficiency.

Improved communication and education: By visualizing charge and range data, it is possible to communicate and educate others about the performance and behavior of electric vehicles. This can help to raise awareness about the benefits of electric vehicles, and to: encourage the adoption of sustainable transportation.

Electric vehicles offer a number of benefits, including:

Reduced emissions – electric vehicles produce zero emissions, helping to reduce the impact of climate change.

Lower running costs – electric vehicles are cheaper to run than petrol or diesel cars.

Improved performance – electric vehicles can accelerate faster than petrol or diesel cars.

Better safety – electric vehicles are safer than petrol or diesel cars, as they have fewer moving parts.

1. Lower running costs

2. Low maintenance costs

3. Tax and financial benefits

4. Better performance

5. Zero tailpipe emission

6. Easy to drive and quiet

7. Covenience of charging at home

8. No fuel, no emission

9. Spacious cabin and more storage

10. EVs are considered a sustainable alternative.

DISADVANTAGES

Project visualization tools are an essential part of any project management process. They provide a visual representation of the project, making it easier for stakeholders to understand the progress and status of the project.

However, when it comes to electric vehicle charging projects, there are some disadvantages associated with using project visualization tools.

- One major disadvantage is that these tools can be expensive. The cost of purchasing and maintaining these tools can add up quickly, especially for smaller businesses or organizations with limited budgets.

Additionally, the complexity of these tools can make them difficult to use for those who not familiar with them. Another disadvantage: is that project visualization tools may not always accurately represent the reality of the project

This can lead to misunderstandings and miscommunications between stakeholders, which can ultimately impact the success of the project. Finally, relying too heavily on project visualization tools can lead to a lack of personal interaction and communication between team members.

This can result in a breakdown in teamwork and collaboration, which is essential for any successful project

1. Limited Battery Range

2. Battery Lifespan Concerns

3. Charging Infrastructure Worries

4. Long Charging Times

5. Low Top Speeds

6. More Expensive to Buy

7. Environmental Impact

8. Climate Controls

9. Silence

10. Fewer Users

5. APPLICATION

Predicting Range: Visualization tools can estimate the vehicle's range based on factors like weather conditions, driving behavior, and battery life. By making use of GPS data, they can also calculate the optimal route to increase range

Charging Infrastructure Planning: Tools can identify the location and availability of charging stations along a planned route, enabling drivers to analyse which stations to stop at for charging and how long they will take to reach their destination.

Driving Behavior Analysis: Visualization tools can analyse the driver's behavior, such as acceleration, deceleration, and speed, and provide recommendations for improving range and efficiency.

Comparison Analysis: By comparing different electric vehicles' energy efficiency and range, drivers may choose the best electric vehicle for their needs

Real-time Charge Monitoring: Some tools provide real-time charge monitoring to track the state of charge of your vehicle's battery, and can predict the remaining charge time or estimate how long it will take to finish charging

Electric vehicles (EVs) are a type of vehicle that is powered by an electric motor instead of an internal combustion engine. They are used for a variety of transportation purposes, including personal and public transportation, as well as for commercial and industrial purposes.

Some common applications of EVs include:

Personal transportation: Many people use EVs as their primary mode of transportation for commuting, running errands, and other daily activities. EVs can be particularly well-suited for urban and suburban driving, where they can take advantage of their quick acceleration and relatively short driving range.

Public transportation: Some cities and transit agencies have started to adopt EVs for use in their public transportation systems. This can include buses, shuttles, and other types of shared-ride vehicles. EVs can provide a more sustainable and cost-effective alternative to traditional fuel-powered buses and other vehicles.

Commercial transportation: EVs are also used in a variety of commercial applications, including delivery vehicles, utility vehicles, and fleet vehicles. Companies are increasingly adopting EVs as a way to reduce their environmental impact and operating costs.

Industrial uses: EVs are also used in industrial settings for tasks such as material handling, ground support equipment, and other specialized applications. They can offer a cleaner and more efficient alternative to gasoline- or diesel-powered vehicles in these types of environments.

Overall, the use of EVs is increasing as a way to reduce reliance on fossil fuels and improve sustainability in transportation.

6. CONCLUSION

In conclusion, the development of visualization tools for electric vehicle charge and range analysis can greatly improve the usability and adoption of EVE by providing users with more transparent and actionable information about their vehicles Through the use of various data visualization techniques such as graphs, charts, and maps, users can gain insights into their vehicle's charge status and range, helping them make more informed decisions about when and where to charge their vehicles. These tools can also help fleet managers optimize their EV operations by identifying patterns and trends in charging behavior and range usage. As EV adoption continues to grow, the need for effective visualization tools will only become more critical, and the development of these tools represents an important step forward in making EVs more accessible and user-friendly for both individual and commercial users.

7.FUTURE SCOPE

Electric car manufacturing is getting increasingly popular, and its market share is likely to grow significantly. By 2022, India's GDP is predicted to increase by a staggering 25%.

The best aspect is that, in addition to decreasing pollution, EVs can reduce oil imports by $60 billion by 2030. Currently, imports account for 82 per cent of India's oil requirement. As a result, it is clear how helpful it will be for the Indian economy if the import cost is decreased

There are no emissions:

Electric automobiles are being developed primarily because they do not emit any pollution when driving. An electric vehicle is propelled by a battery-powered electric motor. There is no burning of fuel. An electric vehicle does not have an exhaust system. It's the best road transportation solution at a time when global CO2 emissions and air pollution must be drastically cut.

Access to city centres is unrestricted:

Aside from the fact that more cities are implementing LEZs, these zones are also growing in size and strictness with time. With an electric car, you have limitless access to low-emission zones, now and in the future, wherever and whenever you want.

Electricity is less expensive than gasoline:

Electricity is less expensive than gasoline and fuel. In this regard, an electric automobile is less expensive than a car with a combustion engine. The most cost-effective solution is to charge at home.

Comfortable and quiet:

Unlike a combustion engine, an electric motor produces very little noise. As a result, the silence inside an electric vehicle is unmistakable. Additionally, unlike a

combustion engine, an electric motor does not produce any vibrations or resonance. The vibration-free and silent drive train adds to the relaxation.

There's no need to switch gears:

An electric automobile does not have a traditional gearbox, which is another key distinction from a car with a combustion engine. An electric car always works like a car with an automatic transmission, which eliminates the need to shift gears. You also don't have to pay more for it. Driving in busy start-stop traffic in the city or traffic congestion has never been more comfortable, thanks to the quietness of an electric motor.

Torque on the fly:

The incredibly high torque of an electric motor is a distinct feature. Much more powerful than a typical internal combustion engine. Furthermore, an electric motor responds rapidly to throttle motions and generates peak torque right from a standstill. Internal combustion engines have an unavoidable response time and can only generate maximum torque in a specific speed range. All of this assures enticing performance thanks to the smooth and powerful acceleration, as well as a great deal of driving pleasure.

Extremely effective:

At the moment, the most efficient combustion engines have an efficiency of around 40%. That means they only put 40% of the energy in the fuel into motion. Heat and friction account for the remaining 60%.

An electric motor has a 90 per cent efficiency, which means it uses the battery's energy far more efficiently. Furthermore, because an electric motor can be transformed into a generator in the blink of an eye, an electric car can swiftly recover kinetic energy.

Requires less maintenance:

Electric drive train technology is much simpler than that of a combustion engine. Because only a few sections need to be lubricated, it has far fewer (spinning) parts and fluids. So, as you may have guessed, an electric vehicle requires less maintenance.

Generate your power:

Having your oil refinery in your garden to make your auto fuel is impossible. It's hardly unexpected, though, that you can create your electricity. For example, solar panels on the top of your home or office building can provide energy. You may further lower your kilometre cost by charging your battery with this renewable energy.

Overall, the future scope of the project is likely to focus on enhancing the accuracy and usefulness of the data provided, as well as on integrating the tool with other systems and applications to improve its functionality and usability.

8. APPENDIX

SOURCE CODE

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