Second Year Mini Project Report

Submitted in partial fulfillment of the requirements of the degree

BACHELOR OF ENGINEERING IN COMPUTER ENGINEERING

By

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CERTIFICATE

This is to certify that the Mini Project entitled **" Carbon Footprint of Tourism Industry "** is a bonafide work of **Dipeshbhai Patel(D7B 42), Advay Somani(D7B 53), Parth Takale(D7B 56), Parth Udole(D7B 58)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"Bachelor of Engineering"** in **"Computer Engineering" .**

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Mini Project Approval

This Mini Project entitled "Carbon Footprint due to Tourism Industry" by **Dipeshbhai Patel(D7B 42), Advay Somani(D7B 53), Parth Takale(D7B 56), Parth Udole(D7B 58)** is approved for the degree of **Bachelor of Engineering** in **Computer Engineering.**

Examiners

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Place:

Contents

Abstract

The growing concern over environmental sustainability has prompted the need for accurate prediction models to assess carbon footprints, particularly in the tourism sector where travel-related emissions contribute significantly. This study proposes the development of a machine learning model for predicting carbon footprints attributable to tourism activities. The model incorporates parameters such as distance traveled, number of stops, fuel efficiency, and length of stay of tourists. Three distinct regression models, namely Linear Regression, Random Forest Regression, and Decision Tree Regression, are compared to identify the most accurate predictor. The methodology involves collecting data on tourism-related variables and corresponding carbon footprints. The dataset is preprocessed to handle missing values. Feature engineering techniques are employed to extract relevant information from the input parameters. Each regression model is trained using the training dataset and fine-tuned using cross-validation techniques to optimize performance. The trained models are then evaluated based on metrics such as Mean Squared Error (MSE), and Root Mean Squared Error (RMSE) to assess predictive accuracy. The aim is to develop a user-friendly calculator catered to tourists, providing an estimate of their carbon emissions during trips. Also suggest general sustainable travel practices to minimize their environmental impact. Experimental results demonstrate the effectiveness of the proposed machine learning models in predicting carbon footprints associated with tourism activities. Comparative analysis reveals the model with the highest accuracy, providing valuable insights for decision-making in sustainable tourism management which in this case is a random forest regressor.

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Lastly, we would like to acknowledge our classmates, who have also provided us with every possible support and learning to execute our project efficiently.

List Of abbreviations :

Sr No.	Short Form	Abbreviated form
1.	CF	Carbon footprint
2.	LR	Linear regression
3.	DTR	Decision Tree Regression
4.	RFR	Random Forest Regression
5.	TI	Tourism industry
6.	CO2	Carbon dioxide
7.	GHG	Greenhouse gas

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Chapter 1: Introduction

1.1 Introduction

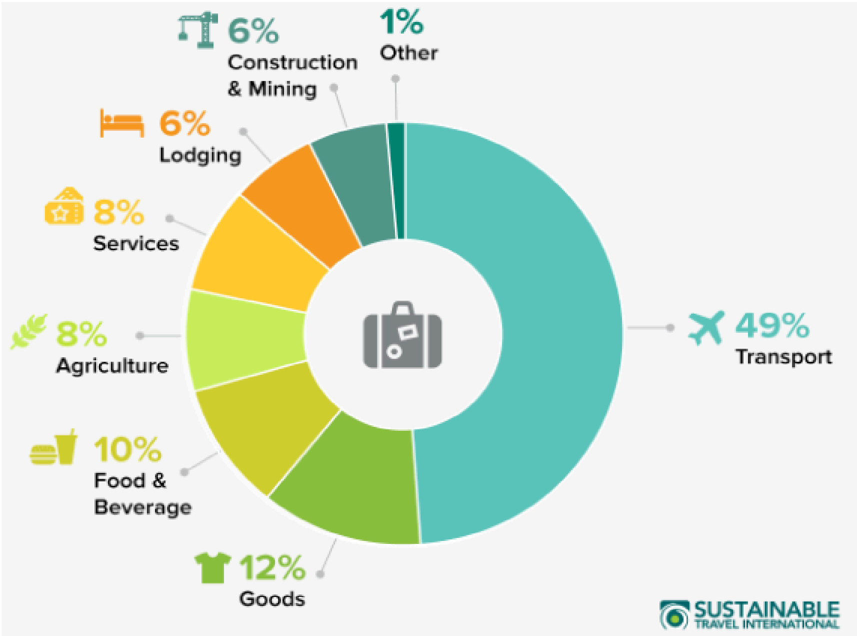

Fig 1.1 : Carbon Footprint of Global Tourism

The tourism industry is a global economic sector that encompasses various activities related to travel and leisure. It includes businesses and services that cater to tourists, travelers, and visitors.

The tourism industry is a significant contributor to the global economy and plays a vital role in many countries' economic development. It generates over 10% of the global GDP and contributes to the creation of one in ten new jobs.

However, tourism is also a major contributor to global greenhouse gas emissions. According to the World Tourism Organization (UNWTO), tourism accounts for about 8% of global carbon emissions.

From plane flights and boat rides to souvenirs and lodging, various activities contribute to tourism's carbon footprint. The majority of this footprint is emitted by visitors from high-income countries, with U.S. travelers at the top of the list. As the number of people who can afford to travel grows, so will tourism's environmental footprint.

1.2 Motivation:

In today's world, the tourism industry has become a global powerhouse, contributing significantly to economies and offering travelers diverse experiences. However, this rapid growth in tourism has also raised significant environmental concerns, particularly in relation to carbon emissions and their impact on our planet. This is where the motivation for creating a machine learning model for predicting carbon footprints in the tourism industry comes into play.

- **Environmental Preservation:** Tourism, while offering incredible benefits, can also lead to overdevelopment, habitat destruction, and increased pollution. By developing a machine learning model, we can better understand the carbon emissions generated by tourism activities, which will enable us to take informed actions towards preserving our environment and reducing the negative impact of the industry.

- **Sustainability:** A machine learning model can assist in identifying which tourism activities have the most substantial carbon footprints, allowing us to focus our efforts on reducing emissions where they matter the most.

- **Economic Benefits**: Implementing sustainable tourism practices can lead to cost savings and economic benefits for the industry. By using machine learning to predict carbon footprints, tourism businesses can identify opportunities to reduce energy consumption, decrease operational costs, and enhance their long-term competitiveness.

- **Traveler Awareness:** Today's travelers are becoming more conscious of their environmental impact. By providing them with information about the carbon footprint of their travel choices, we empower them to make eco-conscious decisions, ultimately leading to a more responsible tourism industry.

Fig 1.2 : Measuring Carbon Footprint

1.3. Problem Statement & Objectives

Climate change is a global problem, and it requires a global solution. The ultimate goal is to make the planet 'climate neutral' by 2050. India has also taken upon itself to become carbon neutral by 2070.

By analyzing and predicting Carbon Footprints due to the Tourism Industry, we would be able to take steps towards decreasing the carbon footprint generated by the industry.

1.4. Organization of the report

In this report, we further discuss the following points:

□ Literature survey of existing systems

□ Limitations of existing systems

□ Mini project contribution

□ The proposed system

□ Details of hardware and software used

□ Progress

□ Conclusion

Fig. 1.3: The Carbon Footprint

Chapter 2 : Literature Survey

2.1 Survey of existing System

Paper 1 : Predicting the Environmental Change of Carbon Emission Patterns in South Asia

- ❖ This paper presents a pioneering approach by introducing a CO_2 emission prediction model built upon Bidirectional Long Short-Term Memory (Bi-LSTM) architecture, an advanced deep learning technique. The model's development represents a crucial step forward in our ability to forecast carbon dioxide (CO_2) emissions accurately.
- ❖ To validate and test the efficacy of this model, the study utilizes a comprehensive dataset spanning from 2001 to 2020, encompassing data from South Asian countries and China. This dataset offers a diverse and extensive sample of emissions data, allowing for robust empirical testing of the prediction model.
- ❖ The study goes beyond historical data analysis and ventures into the realm of future predictions. It takes a forward-looking approach by predicting China's CO_2 emissions for the years 2022 to 2030. Notably, the research extends its scope beyond China and also forecasts CO_2 emissions for other countries. By focusing on a collective examination of scientific and technological progress, industrial structures, and energy structure factors, the study aims to unveil the combined effects of these critical determinants on CO_2 emissions.
- ❖ **This innovative approach promises several advancements:**
- ❖ **Accurate Prediction:** The CO_2 emission prediction model based on Bi-LSTM holds the potential to provide more precise predictions, thereby aiding decision-makers understanding and addressing environmental challenges.
- ❖ **Regional Insights:** The inclusion of data from South Asian countries and China broadens the regional perspective and fosters a more comprehensive understanding of emission patterns and dynamics.
- ❖ **Forward-Looking Analysis:** By forecasting CO_2 emissions for the coming years, the study equips governments, industries, and policymakers with the insights needed to plan for a sustainable and eco-friendly future.
- ❖ **Holistic Understanding:** The research's focus on multiple factors influencing CO_2 emissions ensures a holistic perspective that can assist in formulating targeted strategies to mitigate emissions, such as promoting clean energy and optimizing industrial structures.
- ❖ **Global Relevance:** As climate change remains a global concern, this study's findings extend beyond the geographical boundaries of South Asia and China, offering insights and methodologies that can be adapted and applied globally.

Advantage:

When compared with the LSTM and GRU methods, the Bi-LSTM model’s results produced lower MAE, MSE, and MAPE values, indicating that it performs better.

Limitation:

Free bus policies and the promotion of electric vehicles have the potential to reduce the country’s overall fuel consumption and carbon footprint;

Paper 2 : Carbon Footprint Evaluation Based on Tourist Consumption toward Sustainable Tourism

- This study represents a pioneering effort to assess and quantify the carbon footprint (CFP) associated with the Japanese tourism industry. It relies on a meticulous approach that takes into account tourist consumption, drawing on the rich data available within the Japanese input-output table and the extensive framework of the Japanese tourism industry. The research stands as a groundbreaking contribution to the ongoing efforts to measure and address the environmental impact of tourism
- **Key elements of this study encompass:**
- **Tourist Consumption-Based Assessment:** By centering the analysis on tourist consumption, this study aligns with a fundamental aspect of the tourism industry - the impact that visitors have on the environment. The focus on consumer behavior provides a nuanced understanding of how tourism choices influence the carbon footprint.
- **Input-Output Analysis:** The use of the Japanese input-output table and the Japanese tourism industry framework underlines the depth of this research. These data sources facilitate a comprehensive examination of the carbon emissions embedded in the entire tourism supply chain, from transportation and accommodation to dining and leisure activities.
- **Practical Significance:** Beyond its academic importance, this study offers practical and actionable insights. It serves as a valuable resource not only for academics and researchers but also for policymakers, industry leaders, and tourists. The findings have the potential to reshape policies, strategies, and individual behaviors related to tourism and environmental sustainability.
- **Sustainability Roadmap:** The study, by virtue of its findings, effectively provides a roadmap toward a more sustainable and ecologically responsible future for Japanese tourism. Policymakers can leverage the results to craft and implement policies that reduce the CFP, while industry leaders can explore eco-friendly practices and services. For tourists, the study acts as an informative guide to make choices that minimize their environmental impact during their visits.
- **Global Relevance:** The implications of this research extend well beyond Japan. In a world increasingly concerned with the environmental repercussions of tourism, the methodology and insights derived from this study can serve as a model for similar studies in other nations, providing a standardized approach to assess and mitigate the carbon footprint of tourism.

Advantage :

It provides a comprehensive understanding of the carbon footprint by examining various aspects, including transportation, accommodation, dining, and recreational activities, giving readers a holistic view of the issue.

Limitation:

This article does not include procurement, direct energy, waste, etc.

It may have a limited scope in addressing broader global tourism issues.

<u>Paper 3 : Behavior of tourism industry under the situation of environmental threats and carbon emission.</u>

- This study delves into the critical analysis of the environmental impact on Thailand's flourishing tourism industry over the period spanning from 2000 to 2014. The research aims to shed light on the intricate relationship between tourism, a cornerstone of Thailand's economy, and the growing environmental challenge of carbon emissions, which has far-reaching consequences on the global climate.
- The findings of this investigation unveil the palpable influence of carbon emissions originating from diverse sectors, including manufacturing and construction, on the sustainability and vitality of Thailand's tourism sector. As one of the world's most popular tourist destinations, Thailand's tourism industry is intrinsically linked to its natural beauty, making it susceptible to environmental threats. This study scrutinizes how carbon emissions pose a direct threat to the very attractions that draw millions of tourists each year, including pristine beaches, lush jungles, and vibrant coral reefs.
- Data for this research has been meticulously collected from the official World Development Indicators (WDI) webpage, a widely recognized and trusted source for comprehensive and up-to-date global data. Employing a regression-type algorithm, this study analyzes the datasets to unravel the intricate dynamics between carbon emissions and their adverse effects on Thailand's tourism industry.
- The implications of this research extend far beyond Thailand's borders, offering valuable insights into the broader tourism and environmental landscape. By scrutinizing this case study, policymakers, environmentalists, and industry stakeholders can gain a deeper understanding of the interconnectedness between tourism and environmental sustainability. The study underscores the urgency of adopting eco-friendly measures to preserve the natural beauty that drives tourism while mitigating the carbon footprint that poses an existential threat to these very attractions.
- The results of this study offer a compelling call to action, emphasizing the need for concerted efforts to reduce carbon emissions and promote responsible tourism practices. As the global community grapples with the escalating challenges of climate change, this research underscores the vital role that the tourism industry plays in these discussions and the imperative of adopting sustainable strategies to safeguard both the environment and the economic interests of nations heavily reliant on tourism.

<u>Advantage :</u>

This study can also extend to ASEAN economies like Malaysia and Indonesia.

The study addresses main issues i.e. the impact of environmental threats and carbon emissions on the tourism industry.

<u>Limitation :</u>

The study appears to focus specifically on Thailand's tourism industry, thus limiting findings to the other region

Paper 4 : Estimation of tourism carbon footprint and carbon capacity

- This comprehensive study provides invaluable insights into the evolving landscape of tourism carbon footprints (TCF) in Heilongjiang province, China, spanning a decade from 2009 to 2018. Utilizing a multi-method approach, including the innovative "bottom-top" approach and Kaya's method, the research rigorously estimates the carbon emissions associated with tourism activities, shedding light on the province's environmental sustainability trends.
- The study's primary focus is on tracking the carbon footprint trajectory, and the compelling findings reveal a noteworthy 2.97 percent increase in TCF during the examined period. This percentage underscores the challenges that arise as tourism continues to thrive, potentially impacting the province's environmental equilibrium.
- Furthermore, this research delves into the understanding of various models integral to this study, particularly the Tourism Capacity Model (TCC) and the Tourism Carbon Footprints (TCF). The investigation unveils a pivotal revelation: that the primary contributor to the escalating tourism carbon footprint is the domestic tourism sector. This revelation underscores the significance of examining not only international but also domestic tourism in the quest for mitigating carbon emissions in Heilongjiang.
- Amid these findings, the study also identifies a positive trend, with the Tourism Carbon Capacity (TCC) of Heilongjiang Province steadily increasing throughout the decade under consideration. This underscores the region's capacity to absorb tourism-related carbon emissions, showcasing its potential for sustainability and environmental conservation.

Advantage :

Helping out to identify places with black carbon footprint so that we can take measures to avoid CO2 consumptions.

Limitation :

Older method of input collection.

2.2 Limitations of existing system and research gap:

- **Data Availability and Consistency:** Many studies on carbon footprints in the tourism industry rely on data that may be inconsistent or unavailable for certain regions or time periods. This creates limitations in accurately assessing the carbon footprints of specific destinations or in making meaningful year-to-year comparisons.
- **Scope and Coverage:** Existing research often focuses on popular tourist destinations and may not adequately represent a diverse range of tourism environments, including less-visited or emerging destinations. This can lead to gaps in our understanding of carbon footprints in the broader tourism landscape.
- **Lack of Standardized Methodology:** The absence of a standardized methodology for calculating and reporting carbon footprints in tourism hinders comparability between studies. A lack of consistency makes it challenging to aggregate findings and derive overarching conclusions.
- **Behavioral Factors:** While some studies assess the carbon footprints of different

tourism components (e.g., transportation, accommodation), there is often a gap in understanding the influence of tourists' behavior and choices on emissions. Research that delves deeper into consumer behavior and its impact is needed.

- **Limited Focus on Mitigation Strategies:** While studies often identify carbon emissions sources, there is often a research gap in the evaluation of the effectiveness of various mitigation strategies and policies in reducing carbon footprints in the tourism industry.
- **Regional Specificity:** Tourism is highly context-dependent, and the carbon footprint can vary significantly depending on the geographical, cultural, and economic context. Research gaps exist in understanding these nuances in different regions and their implications for policy and practice.
- **Underrepresented Tourism Sectors:** Some segments of the tourism industry, such as cruise tourism or adventure tourism, may receive less attention in carbon footprint research. Expanding the scope to include these sectors is essential for a comprehensive understanding.
- **Economic Considerations:**There is often limited research on the economic implications of carbon reduction strategies in the tourism industry. Understanding the cost-benefit analysis of carbon reduction initiatives is crucial for informed decision-making.
- **Policy Evaluation:** Evaluating the impact of existing environmental policies and regulations on the tourism industry's carbon footprint is an area that needs more attention. Determining whether such policies are effective and how they can be improved is crucial.

Addressing these limitations and research gaps is essential to advance our knowledge and develop effective strategies for mitigating the carbon footprint in the tourism industry. Future research should strive for greater data accuracy, consistency, and a holistic aim to be more regionally specific and consider the economic and behavioral dimensions of carbon reduction in this industry.

2.3 Mini Project Contributions :

- **Raising awareness of the environmental impact of tourism:** The model can be used to raise awareness of the carbon footprint of tourism among both travelers and businesses. This can help to promote more sustainable travel practices and encourage businesses to reduce their environmental impact.
- **Guiding decision-making:** The model can be used to guide decision-making at both the individual and industry level. For example, travelers can use the model to choose more sustainable travel options, while businesses can use the model to identify areas where they can reduce their carbon footprint
- **Supporting policy development:** The model can be used to support the development of policies that promote sustainable tourism. For example, governments can use the model to design policies that incentivize businesses to adopt sustainable practices or that encourage travelers to choose more sustainable travel options.

Chapter-3: Proposed System

3.1 Introduction

➢ This project aims to develop a regression model to predict the carbon footprint of the tourism industry. The model will be used to identify the key factors that contribute to the carbon footprint of the tourism industry, and to develop strategies for reducing this footprint.

➢ The project will begin by collecting and preparing data on the carbon footprint of the tourism industry, as well as on other factors that may contribute to this footprint, such as tourism passenger arrivals, tourism turnover ratio, and GDP. The data will then be cleaned and transformed into a format that is compatible with the regression model.

➢ Once the data is prepared, a regression model will be developed to predict the carbon footprint of the tourism industry. The model will be evaluated using a variety of metrics, such as accuracy, precision, and recall.

3. 2. Architecture / Framework

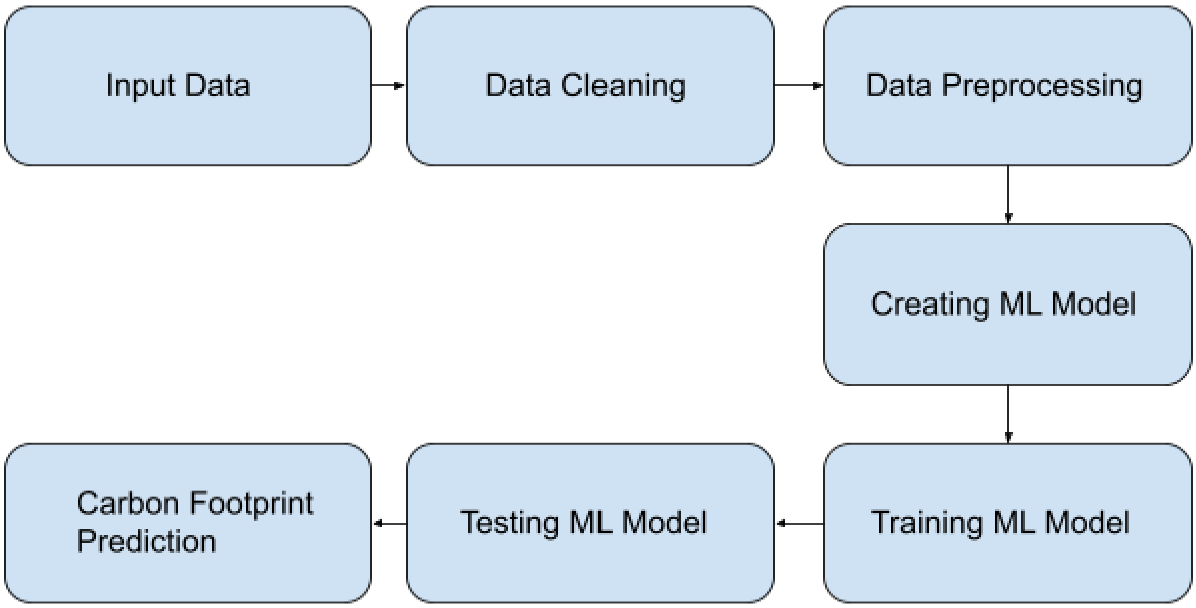

Fig. 3.1: Methodology

We will be developing a machine learning model for analysis and prediction of carbon footprint due to the tourism industry. Predicting carbon emissions or carbon-related metrics from input datasets typically involves applying machine learning or statistical modeling techniques. Here's a general methodology we can follow:

1.Input Data:
Information fed to a process or model, like ingredients for a recipe, used by computers to learn or make predictions.
2.Data Preprocessing:
Cleaning and organizing data, preparing it for analysis, similar to cleaning and chopping ingredients before cooking.
3.Training ML Model:
Teaching a machine patterns in data to learn tasks, like teaching tricks to a pet by repeating actions.
4.Testing ML Model:
Evaluating the machine's learned abilities with new data, like seeing if a pet can perform tricks without hints.
5.Carbon Footprint Prediction:
Estimating environmental impact, like predicting pollution from activities, using data to foresee greenhouse gas emissions for informed decisions.

3.3: Algorithm and process design

1.Data Collection:

- Gather data on various aspects of the tourism industry, such as transportation methods (flights, car rentals), accommodation types (hotels, eco-lodges), and popular tourist destinations.
- Collect data related to carbon emissions associated with each aspect of the tourism industry. This data can include information on fuel consumption, energy usage, and emissions factors.

2.Data Preprocessing:

- Clean and preprocess the data. Handle missing values and outliers appropriately.
- Merge and aggregate data from different sources to create a comprehensive dataset.

3.Feature Engineering:

- Create meaningful features that may affect carbon footprints, such as distance traveled, accommodation ratings, and mode of transportation.
- Consider adding geographical data, such as the proximity to natural reserves or landmarks, which might affect carbon emissions.

4.Machine Learning Model:

- Choose an appropriate machine learning algorithm for regression. You could consider using regression algorithms like Linear Regression, Random Forest, or Gradient Boosting.
- Split the data into training and testing sets for model evaluation.

5.Training and Evaluation:

- Train the machine learning model on the training data.
- Evaluate the model's performance using metrics like Mean Absolute Error (MAE), Mean Squared Error (MSE), or Root Mean Squared Error (RMSE).

Simple Linear Regression:

In simple linear regression, there is one independent variable (predictor) and one dependent variable. The relationship is modeled as a straight line, represented by the equation:

y = b0 + b1 * x

- y is the dependent variable.
- x is the independent variable.
- b0 is the intercept (the value of y when x is 0).
- b1 is the slope (the change in y for a one-unit change in x)

Mean Squared Error: It represents the average of the squared difference between the original and predicted values in the data set. It measures the variance of the residuals.

Root Mean Squared Error: It is the square root of Mean Squared error. It measures the standard deviation of residuals.

$$MSE = \frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y})^2 \qquad RMSE = \sqrt{MSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y})^2}$$

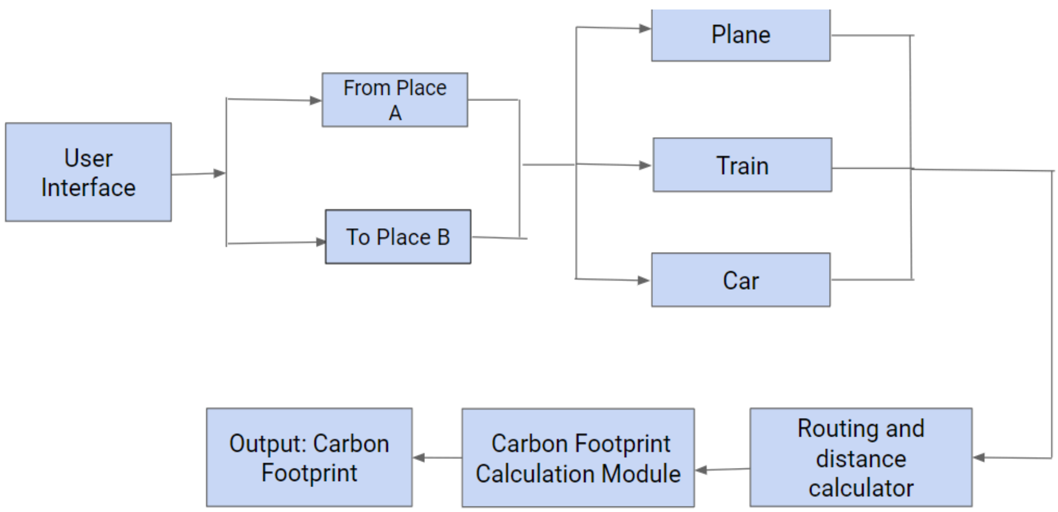

Fig.3.2 : Block Diagram of Footprint Calculator

1. User Enters the Source and Destination of the trip.
2. User then enters mode of Transportation: Car, Train, or Plane
3. The distance is obtained through user input.
4. User fills the other necessary fields that are required in the form.
5. Calculation Module: The data is transferred to the part of the system that calculates the carbon footprint
6. Output Carbon Footprint: The carbon footprint is calculated based on the distance traveled and mode of transportation
7. The carbon footprint is then displayed.

3.4. Details of hardware & software

Hardware requirement is a computer system with the following specifications:

1. Processor: Intel Core (i5 or above) :

The Intel Core i5 is an all-purpose processor that offers solid performance for gaming, web browsing, and doing basic work.

2. RAM. , 8GB or above :

RAM (random access memory) is a computer's short-term memory, where the data that the processor is currently using is stored. RAM memory is much faster than data on a hard disk, SSD, or other long-term storage device, which is why RAM capacity is critical for system performance.

3. Internet Connection :

The minimum requirement for our software to be running is data speed > 1MBPS.

Software Requirements :

1. Operating System: Windows 7 or higher :

The minimum OS requirement for our project is Windows 7. Using a system higher than Windows 7 can help increase performance.

Fig.3.3: Windows

Fig.3.4 : Python

2. Python IDLE:

The Python IDLE is an integrated development environment for Python, which has been bundled with the default implementation of the language.

3.Python Libraries :

We will use libraries like scikit-learn, pandas, numpy and matplotlib.

4.Web Development :

Languages like HTML, CSS, Javascript

Fig.3.5 HTML, CSS and Javascript

Tools Requirements : Data Visualization Tools: Matplotlib and Seaborn are commonly used for creating data visualizations.

3.5 Experiment and Results

<u>Comparative Analysis :</u>

Comparative analysis of the three regression models: Linear Regression, Random Forest Regression, and Decision Tree Regression—reveals valuable insights into their performance in predicting carbon footprints associated with tourism activities.

<u>Linear Regression:</u>

Linear Regression is a simple yet widely used regression technique that assumes a linear relationship between the independent and dependent variables. In the context of predicting carbon footprints, linear regression models may struggle to capture the complexity of the relationships between various input parameters and carbon emissions. The LR model might perform adequately if the relationships are indeed linear, but it may struggle when dealing with non-linear relationships or interactions between features.

<u>Decision Tree Regression:</u>

Decision Tree Regression is a non-linear regression technique that partitions the feature space into distinct regions and predicts the target variable based on the average of the training data within each region. DTRs can handle non-linear relationships and interactions between features effectively. However, decision trees are prone to overfitting, especially when the tree depth is not controlled. This can lead to poor generalization performance on unseen data.

<u>Random Forest Regression:</u>

Random Forest Regression is an ensemble learning technique that builds multiple decision trees and combines their predictions to improve generalization performance. By aggregating the predictions of multiple trees, random forests reduce overfitting and provide robust predictions. RFRs are highly flexible and can capture complex relationships between input parameters and carbon footprints. They are less sensitive to outliers and noise in the data compared to individual decision trees.

Comparative Analysis:

Prediction Accuracy: The comparative analysis likely indicates that the Random Forest Regression model outperforms both Linear Regression and Decision Tree Regression in terms of predictive accuracy. This superior performance can be attributed to the ensemble nature of random forests, which reduces overfitting and captures complex patterns in the data more effectively.

Robustness: Random Forest Regression tends to be more robust to outliers and noise compared to Linear Regression and Decision Tree Regression. This robustness ensures that the model maintains good performance even when the data contains irregularities.

Interpretability: While Linear Regression and Decision Tree Regression models are relatively straightforward to interpret, Random Forest Regression models are more complex due to the aggregation of multiple decision trees. However, the focus here might be on predictive accuracy rather than interpretability, given the application in estimating carbon footprints.

In conclusion, the comparative analysis suggests that Random Forest Regression is the most suitable model for predicting carbon footprints in the tourism sector due to its superior accuracy and robustness. So, it was decided to integrate the Random Forest Regression model with the web application being developed.

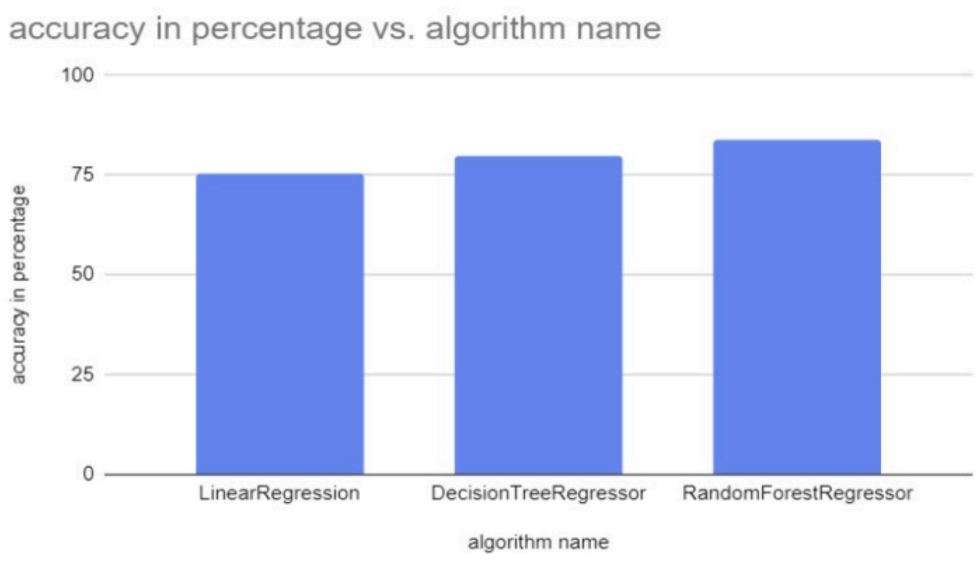

Fig.3.6 : Comparative Analysis of LR, DTR and RFR.

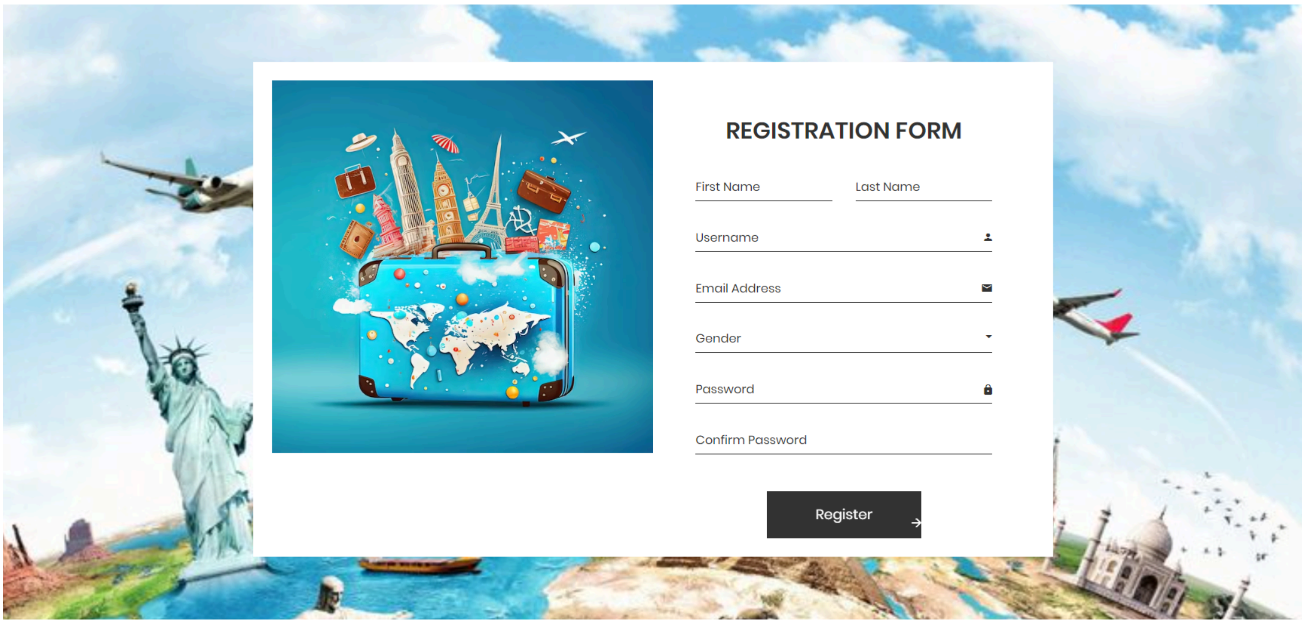

Fig 3.7 : Registration form

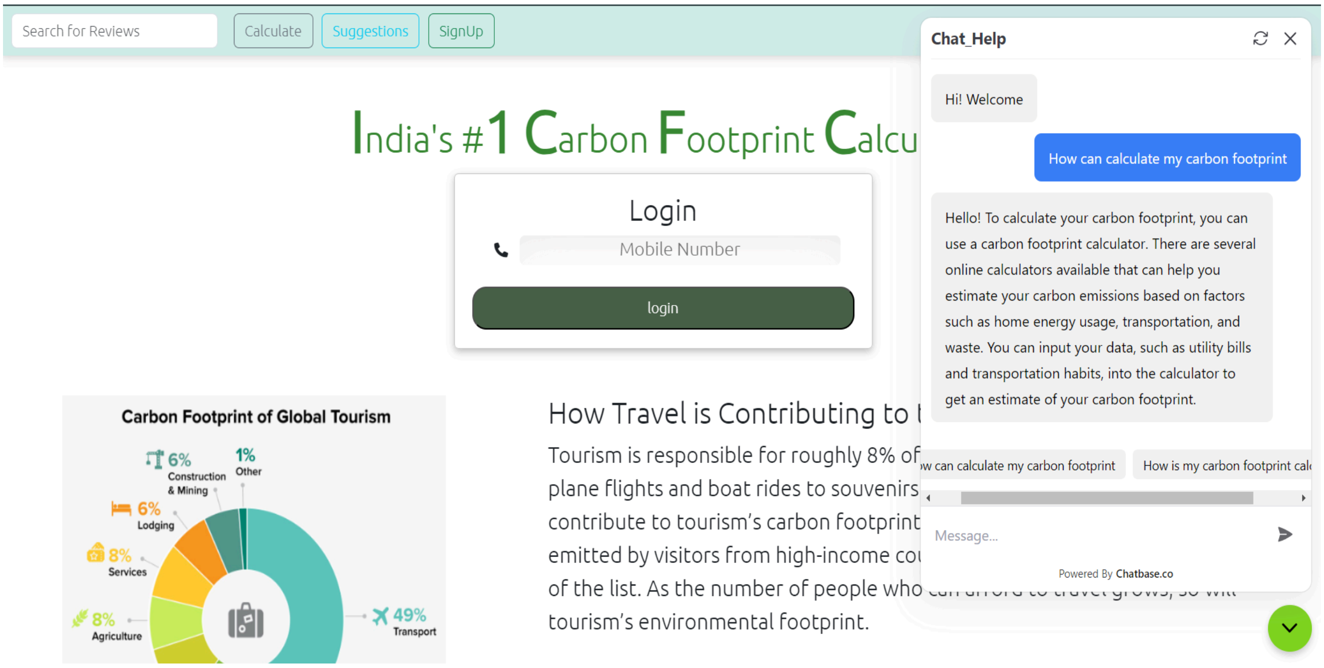

Fig 3.8.1 : Home page

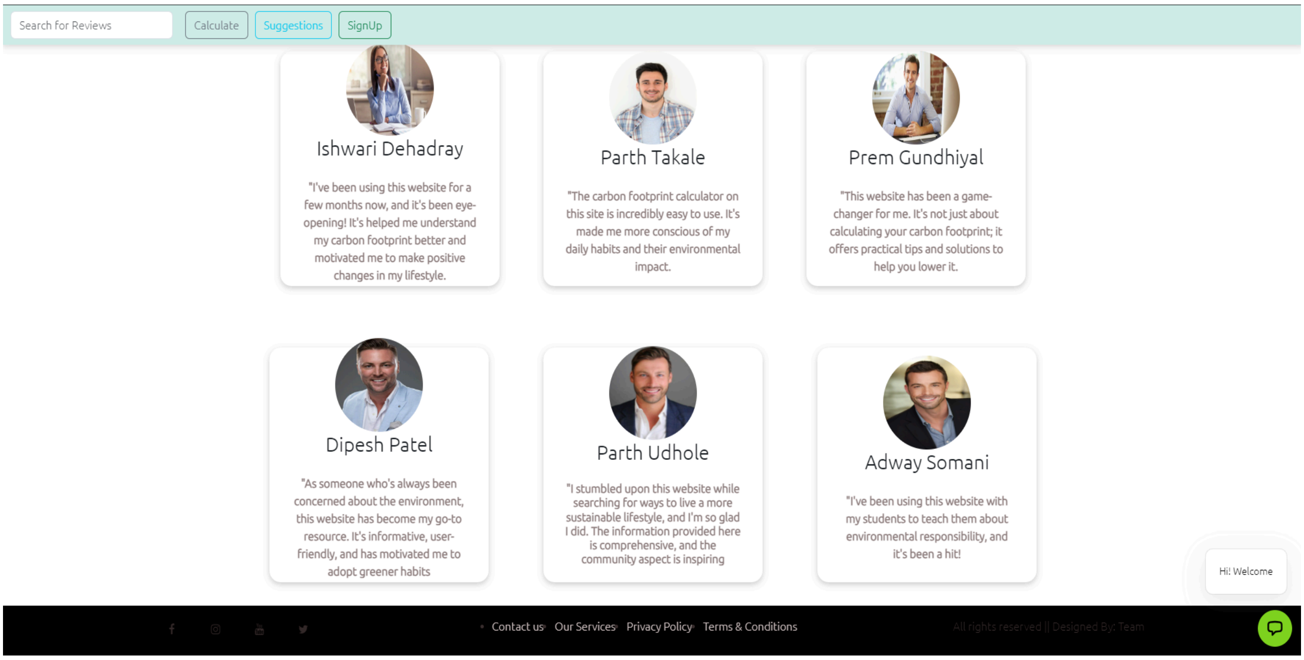

Fig 3.8.2 : Home page

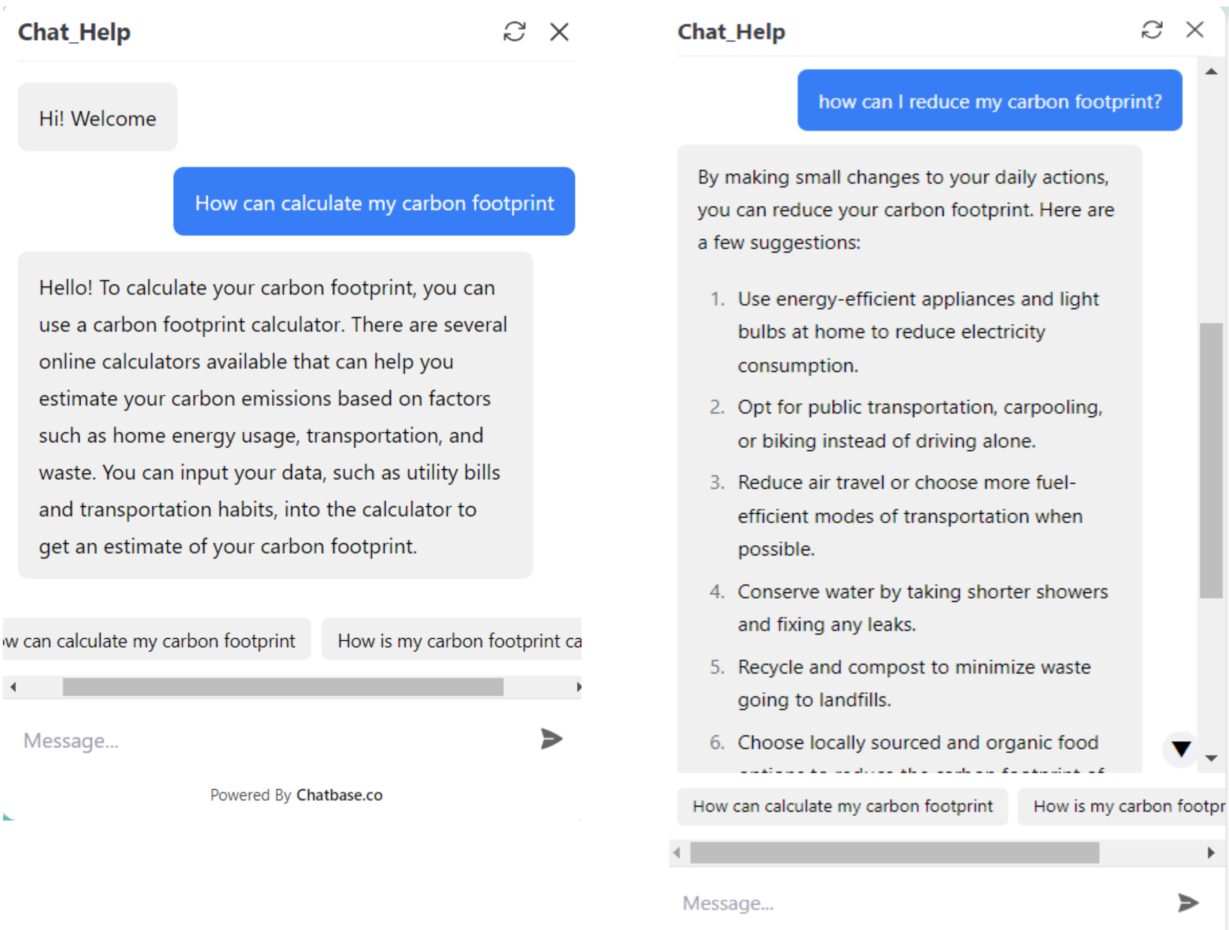

Fig 3.9 : Chatbot

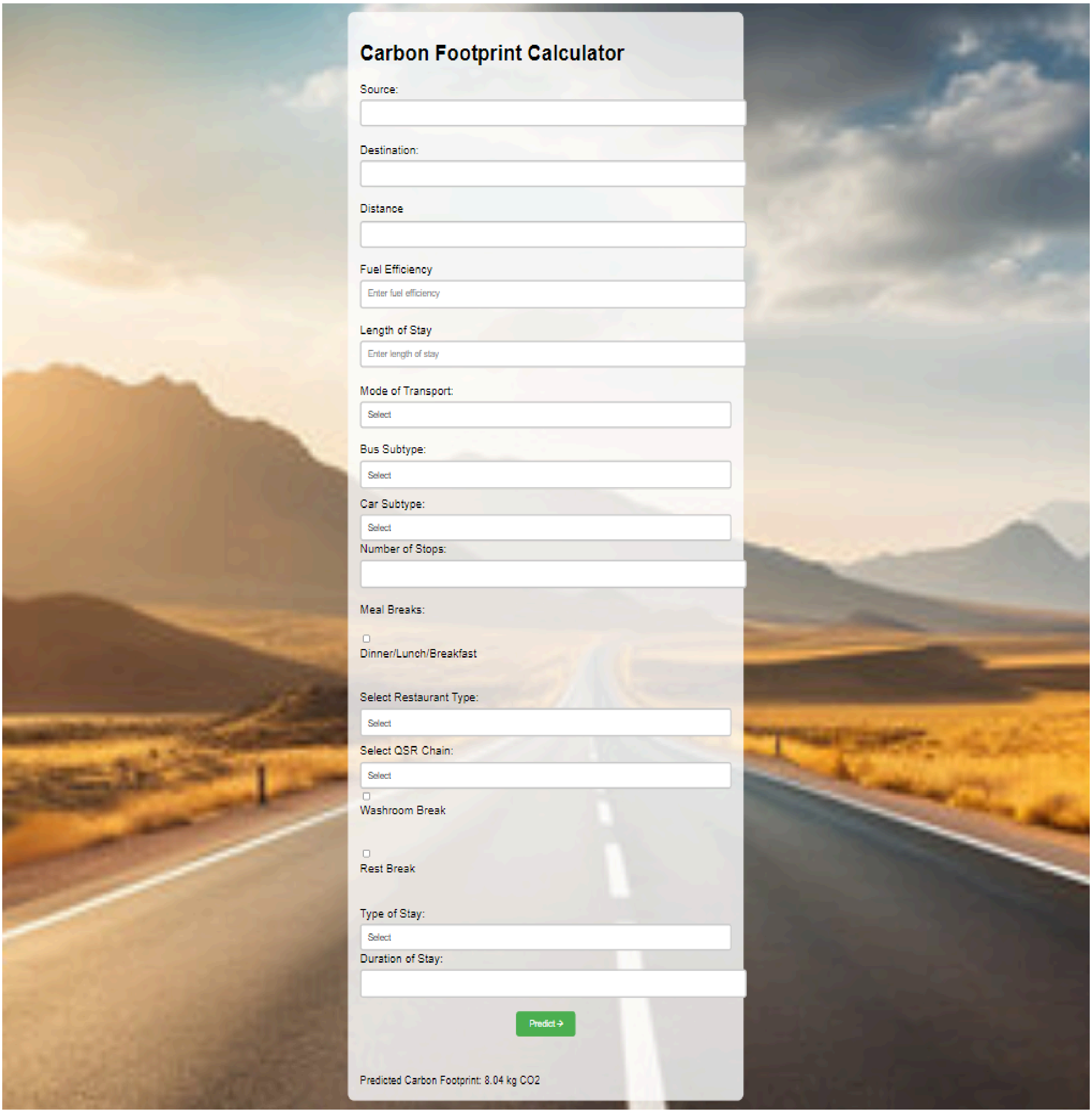

Fig 3.10 : Carbon footprint calculator

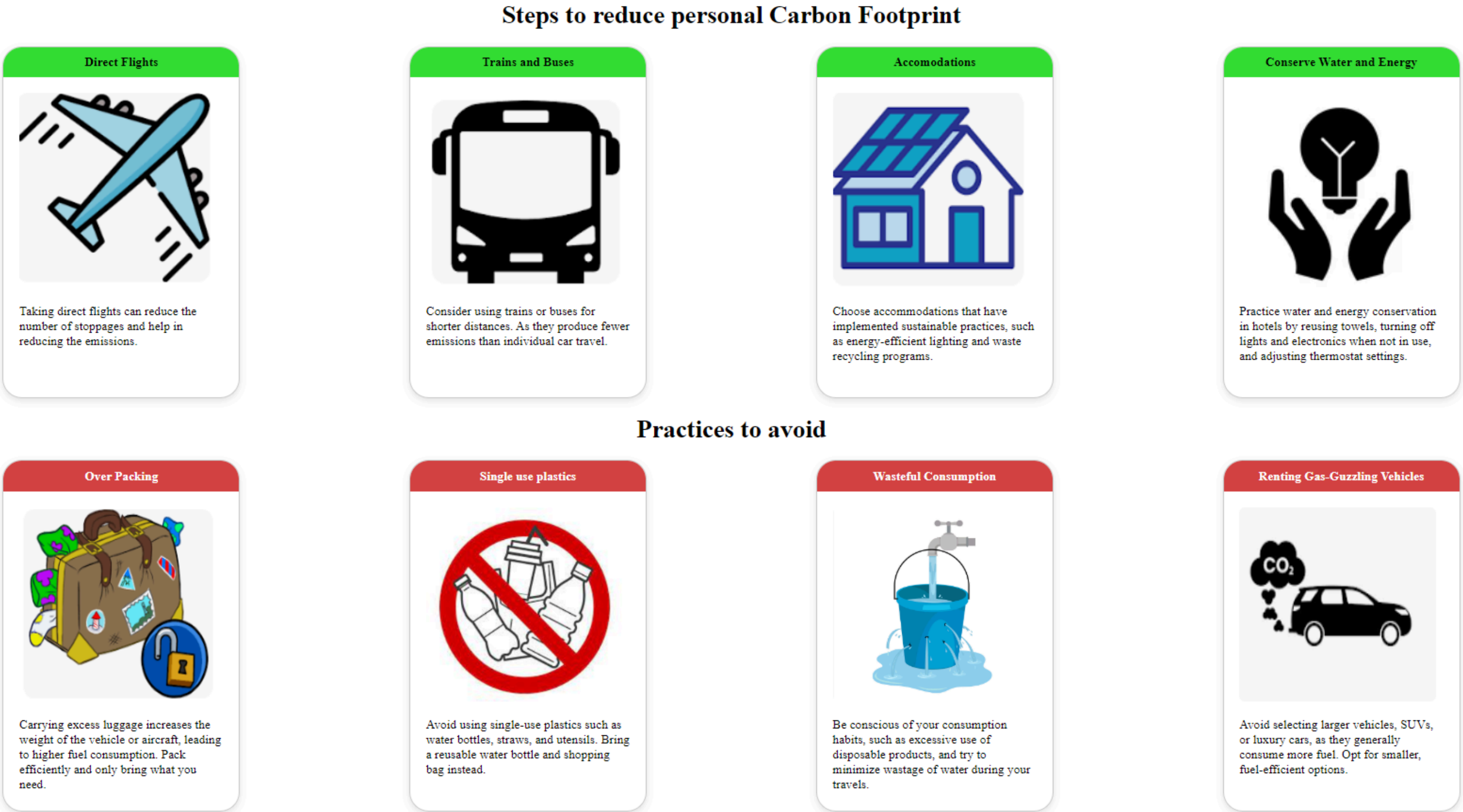

Fig 3.11 : Suggestions page

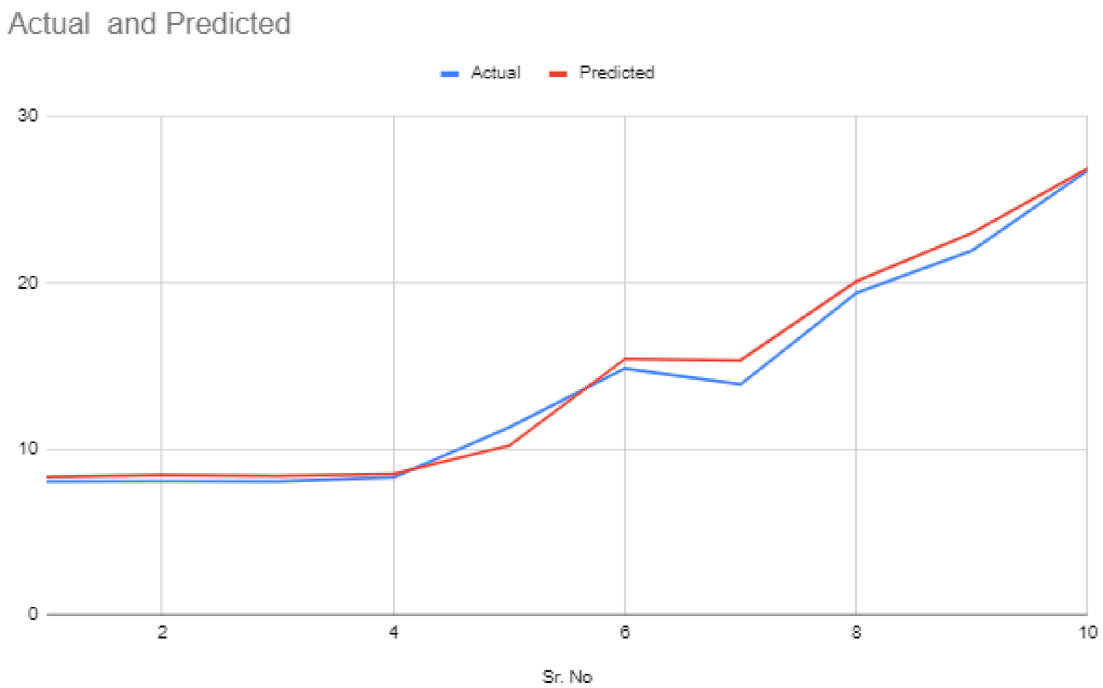

Fig 3.12 : Actual v/s Predicted values

3.6. Conclusion and future work:

The future scope of Machine Learning (ML) models for predicting carbon emissions due to tourism is promising and can contribute significantly to sustainable tourism practices and environmental conservation. Here are some aspects of its future scope:

➢**Improved Accuracy**: ML models will likely become more accurate in predicting carbon footprints by incorporating larger and more diverse datasets. This will enable more precise estimations of emissions associated with various aspects of tourism, such as transportation, accommodation, and activities.

➢**Predictive Analytics:** ML models can be used for predictive analytics to anticipate how climate change and environmental factors will impact tourism destinations and, consequently, their carbon emissions.

➢**Customized Recommendations:** ML models can offer personalized recommendations to tourists, suggesting eco-friendly transportation options, accommodations, and activities based on their preferences and carbon footprint goals.

➢ **Further Data Collection and Analysis:** Continuous data collection and analysis are essential to monitor progress and identify new sources of emissions. This includes tracking changes in the carbon footprint over time and evaluating the impact of new technologies and practices.

In conclusion, ML models have a substantial future scope in predicting and mitigating the carbon emissions associated with tourism. They can contribute to more sustainable and responsible tourism practices, which are crucial for protecting the environment and ensuring the long-term viability of the tourism industry.

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