PROJECT REPORT

ON

CARBON FOOTPRINT CALCULATOR

DONE BY

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**1**. **INTRODUCTION**

* 1. BACKGROUND :

With the growing concerns about climate change and its detrimental effects on the planet, there has been an increasing emphasis on reducing carbon emissions to mitigate environmental damage. Carbon footprint refers to the total amount of greenhouse gases (GHGs) emitted into the atmosphere due to human activities, particularly the burning of fossil fuels. These emissions contribute significantly to global warming, air pollution, and other environmental issues.

A **carbon footprint calculator** is a tool designed to estimate the amount of carbon dioxide (CO₂) and other greenhouse gases emitted by an individual, organization, or product's activities. The aim of such a tool is to raise awareness, encourage more sustainable behaviors, and provide actionable insights to reduce overall emissions.

1.2 OBJECTIVE :

The primary objective of this project is to develop a carbon footprint calculator that can help individuals and organizations estimate their carbon emissions and understand their environmental impact. The tool will also provide recommendations on how to reduce emissions, track progress, and promote sustainability.

* 1. SCOPE :

This project focuses on building a simple web-based carbon footprint calculator for individuals. The calculator will take into account various factors such as transportation, energy consumption, waste generation, and lifestyle choices. It will provide users with an estimate of their annual carbon emissions and suggest ways to lower their carbon footprint.

1. **METHODOLOGY** 
   1. Requirements Gathering :

To begin the development of the carbon footprint calculator, the first step was gathering requirements. This involved understanding the key factors contributing to carbon emissions and identifying the relevant data inputs that should be included in the calculator. The key categories of carbon footprint considered for the calculator are:

* **Transportation**: Fuel usage (car, plane, public transport, etc.)
* **Energy Consumption**: Electricity, natural gas, and heating sources.
* **Waste Management**: Waste disposal methods and recycling practices.
* **Diet**: Type of food consumed (meat-heavy diets vs plant-based diets).
* **Lifestyle Choices**: Frequency of travel, use of digital devices, etc.

**2.2** Data Sources and Formulae :

The data required for calculating the carbon footprint includes average emission factors for different activities. Some of the sources used for emission factors include:

* **Transportation**: Emission factors for car travel depend on vehicle type, fuel efficiency, and distance traveled. Average emissions for air travel were also included.
* **Energy Consumption**: Emission factors for electricity depend on the energy mix (renewable vs. fossil fuels). For example, coal-based electricity has a higher carbon footprint than wind or solar energy.
* **Waste Management**: The amount of waste produced, including food waste and recycling practices, contributes to the overall footprint.
* **Diet**: Data on the average carbon emissions for different types of food (e.g., red meat has a significantly higher footprint than vegetables).
  1. Development Process :

The project was developed using the following steps:

* **Step 1: User Input Design** The user interface was designed to be simple and intuitive. The user is asked to input data in categories such as:
  + Number of car miles driven per week
  + Electricity usage in kilowatt-hours (kWh)
  + Waste generated per month (in kilograms)
  + Type and frequency of diet (meat-based or plant-based)
  + Frequency of air travel
* **Step 2: Emissions Calculation :**  Based on the user inputs, the tool uses predefined emission factors to calculate the carbon footprint for each activity. For example, car emissions are calculated using the formula:

Emissions from Car=Miles Driven×Emission Factor (kg CO₂ per mile

**Step 3: Carbon Footprint Summary :** After collecting and processing the inputs, the calculator presents a summary of the total carbon footprint in terms of tons of CO₂ per year. The summary also breaks down emissions by category (transportation, energy, waste, etc.).

* **Step 4: Recommendations** : The tool provides suggestions on how users can reduce their carbon footprint, such as using public transport, reducing energy consumption, recycling more effectively, or adopting a plant-based diet.
  1. Technologies Used :
* **Frontend**: HTML, CSS, JavaScript (for building the user interface and interactions).
* **Backend**: Python (Flask or Django for processing calculations and serving the web page).
* **Data**: Emission factor data from credible sources such as the EPA, IPCC, and academic studies.

1. **Results**

**3.1** Prototype Overview :

The initial version of the carbon footprint calculator was deployed as a web-based application. Users can visit the website, input their data, and receive a carbon footprint estimate with personalized suggestions for reducing emissions.

* **User Interface**: Simple forms with drop-down menus and sliders for input data.
* **Results Dashboard**: Displayed carbon footprint values in an easy-to-understand format, with visual aids such as pie charts and bar graphs.

3.2 Sample Output :

After entering the data (e.g., 500 miles driven per month, 350 kWh electricity consumption, etc.), the user might receive an output like the following:

* **Total Carbon Footprint**: 10.5 tons of CO₂ per year.
  + **Transportation**: 6.2 tons CO₂
  + **Energy Consumption**: 3.1 tons CO₂
  + **Waste**: 1.2 tons CO₂
* **Suggestions**:
  + Use public transport to reduce emissions by 2.5 tons CO₂ per year.
  + Switch to energy-efficient appliances to save 0.8 tons CO₂ annually.
  + Reduce meat consumption and adopt a plant-based diet to lower emissions by 1 ton CO₂.

3.3 User Feedback :

After initial deployment, the tool received positive feedback for its ease of use and informative results. Users appreciated the personalized recommendations that helped them identify specific areas to focus on for reducing their carbon footprint.

1. **Discussion**
   1. Challenges :

* **Data Accuracy**: The accuracy of the calculator depends heavily on the precision of emission factors. Variations in factors like vehicle efficiency, energy sources, and waste management can affect results.
* **User Data**: The tool requires users to provide accurate data, and many people may find it difficult to estimate certain inputs like electricity usage or waste production accurately.
* **Complexity**: Although the tool is designed to be user-friendly, the concept of a carbon footprint can still be complex for some users, particularly in understanding how small changes can add up to significant emissions reductions.
  1. Future Improvements :
* **Mobile App**: To increase accessibility, the calculator could be developed as a mobile application for on-the-go use.
* **Integration with Utility Data**: Partnering with utility companies could allow the tool to pull real-time data on electricity consumption directly from users' accounts.
* **Additional Features**: The tool could be enhanced to support organizational-level carbon footprint calculations, integrating with business data such as production processes, supply chains, and employee commuting.

1. **Conclusion**

The carbon footprint calculator is an effective tool for raising awareness about the environmental impact of daily activities. It allows users to estimate their carbon emissions and take informed actions to reduce their carbon footprint. By promoting sustainable practices and providing actionable recommendations, the tool can contribute significantly to efforts aimed at reducing global greenhouse gas emissions.

Continued development and refinement of such tools will play a key role in fostering a more sustainable and environmentally conscious society.

6. **References**

* EPA Greenhouse Gas Emission Factors
* IPCC (Intergovernmental Panel on Climate Change) Reports
* "Carbon Footprint: A Global Problem" by David L. Brown, Environmental Science Journal
* Online carbon footprint databases (e.g., Carbon Footprint Ltd, WWF Carbon Calculator)