A Machine Learning based Carbon footprint tracking system for keeping Clean Environment

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***Abstract*— The Carbon Footprint Tracker is a cutting-edge tool designed for precise measurement and continual monitoring of carbon emissions of an individual. Its streamlined interface facilitates easy input of diverse activities contributing to carbon footprints, ensuring a comprehensive overview of environmental impact. Real-time analytics offer dynamic visualizations and detailed breakdowns, enabling users to identify and target specific areas for reduction. Some of the existing systems are needed to provide the data and this making it more task on the user and also making it purely data driven, thus entering the wrong data will also give wrong results. This seems to be less efficient. Our tracker stands out with its one of the kind's customizable sustainability plans, tailoring recommendations to user-defined goals, so in order to eliminate this inefficient method we propose a tracking system that tracks the user movements with the help of GPS which helps in precises location and distance and gyroscope which gives a movement. Based on this the amount of carbon emitted is presented in a graph, well dignified way.**

***Index Terms*— Direct emission, Indirect Emission, Terragram, GPS, sklearn, xgboost**

I. INTRODUCTION

A carbon footprint represents the total greenhouse gas emissions, primarily carbon dioxide, directly (scope1) and indirectly (scope2) associated with an individual, organization, event, or product.

A. Direct Emission(scope 1)

These pollutants are easily identified and measurable, making them an important starting point for determining a company's environmental impact. Scope 1 emissions include fuel burning in boilers and cars, fugitive emissions from industrial activities, and chemical manufacturing reactions. Measuring and reducing Scope 1 emissions enables businesses to accept direct responsibility for their most immediate environmental effect.

B. Indirect Emission(scope 2)

This is a crucial and critical part of the carbon emission, Scope 2 includes emissions related to bought energy, such as electricity and heating, emphasizing the buried carbon impact within seemingly simple supplies. It serves as a critical measure of human impact on the environment, influencing climate change, and contributing to global warming. The average global carbon footprint is 4 tons of CO2 per person per year. The Carbon Footprint Tracker represents a pivotal advancement in environmental stewardship, offering a holistic solution to measure, analyze, and mitigate individual and organizational carbon emissions.

In an era where climate change looms large, this innovative tool serves as a beacon for sustainable living and responsible business practices. By seamlessly integrating into daily routines, the tracker simplifies the process of recording diverse activities that contribute to one's carbon footprint, fostering heightened awareness of environmental impact. Real-time analytics generate dynamic visualizations and detailed breakdowns, empowering users to pinpoint key contributors and make informed decisions towards reduction.

The tool extends beyond measurement, providing a personalized roadmap for users to adopt eco-friendly practices. With a commitment to education, it acts as an invaluable resource hub, delivering insights on green alternatives and energy efficiency. As a catalyst for collective action, the tracker incorporates social integration features, encouraging a sense of shared responsibility and collaboration in the pursuit of a sustainable and eco-conscious future.

II. Principles of existing System

Some of the systems that are taken into consideration are as follows

A. Capture

Capture is a carbon footprint calculator app that helps you understand, reduce, and offset your environmental impact. It offers comprehensive tracking of emissions from various sources, personalized tips and challenges, educational content on climate change and sustainability, and optional carbon offsets to support verified projects. With its user-friendly interface and engaging features, Capture empowers everyone to make informed choices towards a more sustainable future. But this application is mainly driven purely on the data and this application needs the user to interact more so as to provide the data for the calculation, although the application may be good in terms of the design but it seems to be inefficient.

B. Klima

Klima helps you understand and reduce your carbon footprint through personalized recommendations, community support, and carbon offset options. It tracks your lifestyle choices, analyzes their environmental impact, and offers achievable challenges to help you lower your footprint. Connect with a supportive community of like-minded individuals to share tips, celebrate milestones, and stay motivated on your sustainability journey. This application is also very data drive where the user has to provide the data for the calculation. This application is unique in its own way by providing gamification or task to complete the milestones for the user so as to reduce the carbon emission, but application is very complex to handle by the user.

III. Efficient tracking system

We propose a system called TerraGram which says “which connects to Earth”. This application is designed to reduce the carbon emitted by an individual. The main overview of this application is that

A. Efficient Location Tracking System

This application aims to provide the efficient location tracking, rather than the user providing the data. In this application we use the GPS (Global Positioning System) based location tracking so that precise distance can be calculated without minimum of error and minimum of user interaction with the system.
As we go behind in chapters of history of space-based navigation systems, GPS project was the first launched by US Department of defence in 1973, initially with 24 satellite aim. Currently, there are 31 satellites used by GPS. With Russian Glonass, Chinese BeiDou, Indian IRNSS and EU's Galileo, there are multiple such satellite-based systems. More details about development of GPS system can be referred in [4],[5] and [6].
The GPS module used gives seven different information such as: Latitude, Longitude, Altitude, Accuracy, Date and time, Bearing, Speed. Apart from this, the application is able the get the gyroscopic reading, along with the help of the GPS. Due to the integration of both GPS and Gyroscope the system can calculate and think the user is moving from place to place.

B. Transportation Mode Detection

This application also aims to get the transportation mode by its own. This can be achieved with by training the model with the help of xgboost. xgboost (Extreme Gradient Boosting) algorithm proposed by Dr. Chen Tianqi of the University of Washington, is an integrated learning algorithm based on the GBDT model, being an improvement of the GBDT algorithm. It is improved based on the original Gradient Boosting algorithm, and the training speed and accuracy of the model is improved to a great extent [1].
xgboost processes the data in advance before training and stores the results, which can be used repeatedly in subsequent iterations, thus reducing the computation complexity, achieving parallelization, and improving the efficiency of the algorithm [2]. xgboost has two interfaces in the Python environment, one is the native interface and the other is the xGBoost interface through sklearn. The xgboost interface was selected to build the model through sklearn. The third-party packages used in the experiment included Numpy, Pandas, sklearn and xgboost. It was carried out based on the win10 operating system (64 bit) and in Python 3.7 development environment [1].
sklearn, which is an autoML library for Python. It can automate the selection of modeling technique as well as selection of data preprocessing method, setting of hyperparameters and construction of ensemble [7].

This application has the ability to detect six modes of transportation: Walking, Bicycling, Bike, Car, Bus, Train. Initially the application thinks that the user is doing nothing but as the time lapses about 5 seconds the application with the help of GPS and xgboost the application predicts the type of transportation mode being used for transportation.

With higher precision and shorter time-consuming, and is widely used different areas. Corresponding to the complexity of the algorithm, it is difficult to adjust the parameters due to the high quantity of parameters. In view of the problem of parameter adjustment, many people have proposed improved schemes, such as grid search, random search [3].

C. Recommendation to reduce the Emission

This application also aims to provide recommendation to the user if he exceeds the limit of emission. The application is able to send the user alert message that the user has exceeded the limit.

D. System Analysis

This application is unique in its own way, the application is seen to be a simple model but much of the work is done by the sensors that is GPS and Gyroscope, the work is in behind the screen.

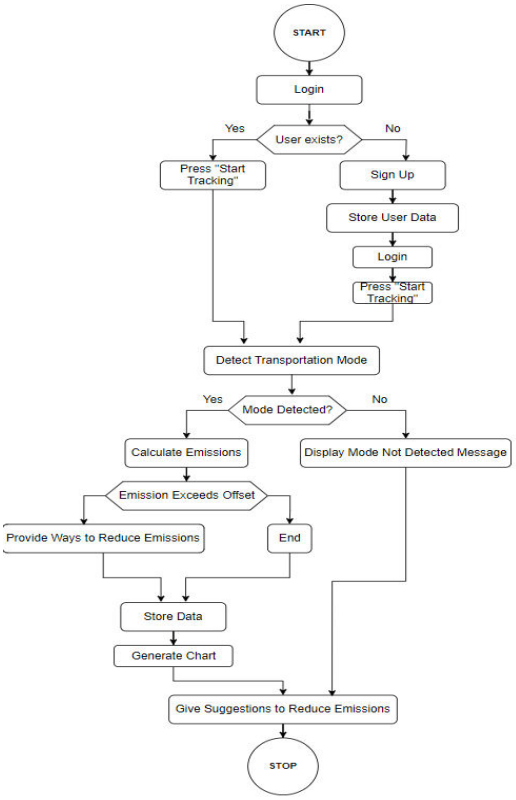


Figure 1. Flow chart of this system

Fig. 1 represent the flow-chart of the system where the user can login, if the user is new to the system the user has to sign up first and then he has to press “start tracking” button, as soon as the button is pressed the system will detect which type of transportation system is being used this uses the algorithm called the xgboost which works more like gradient decision tree but this algorithm is boosted so as to get the faster response, this algorithm is used to detect which type of vehicle is the user is travelling in or within the time span of 5 seconds. Next if the mode is detected then calculate the emission based on the distance travelled this is done with the help of GPS system. Suppose if the user is not been detected moving of a min the offset value is checked, if the carbon produced is in the limit the pie chart is generated automatically and if the user has exceeded the offset the system will send the message to reduce the emission. Finally, the data is stored in the internal storage

itself, if the user still moves after 1 minute the calculation is resumed and appropriate dynamic pie chart and line chart is generated. These charts help the user to get their emission and help themselves reduce the carbon emission.

TABLE I. TRANSPORTATION WITH THERE CO2 EMISSION PER KILOMETER

Means of transport		CO2 only operation and Fuel Supply [g CO2/pkm]	CO2 Grand Sum [g CO2/pkm]
Long Distance Train		0.7	6.4
Regional Train		1.5	9.7
Local Bus		91.8	100.3
Boat		116.2	119.2
Car, Average	Urban	171.9	201.3
	Rural	130.2	159.5
	Highway	170.7	200.0
Car, Small (Diesel)	Urban	97.4	122.0
	Rural	79.2	103.9
	Highway	110.1	134.7
Car (Gasoline)	Urban	215.8	256.2
	Rural	163.4	203.8
	Highway	214.2	254.6
Aeroplane (500 KM)		228.8	229.5

Table I provides the information about the means of transportation with there corresponding CO2 emission. Its been observed that Car with Gasoline in Urban and Highway along with Aeroplan found to produce much of CO2 to the atmosphere.

E. Results

The results are provided to the user with the interactive pie chart and line chart

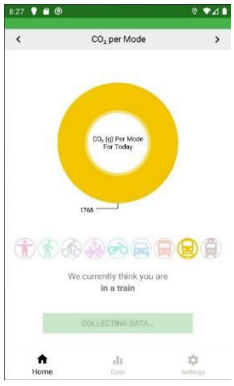


Figure 2. Pie Chart of CO2 per mode

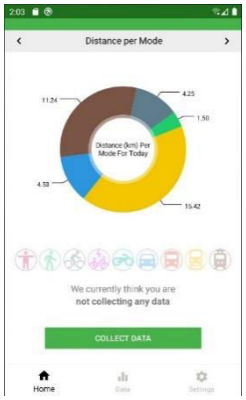
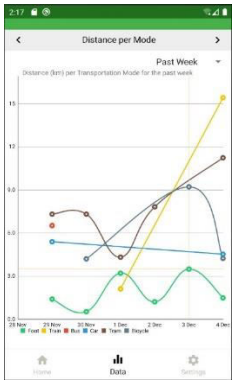


Figure 3. Distance per mode

Figure 2 and Figure 3 gives the interactive report of the CO2 emitted with the use of the transportation mode and also distance travelled with each mode with their percent of CO2 emission.



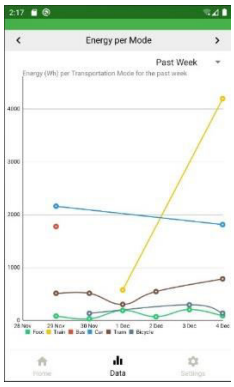


Figure 4. Statists of Energy per mode

Figure 5. Statists of Distance per mode

Figure 4 and Figure 5. give the stats on the energy used and corresponding distance travelled by the user and can be viewed as Past Week, This Month and This year and all the data is stored in the internal storage for further analysis.

III. CONCLUSIONS

In this paper, the application can track the user carbon emission by the distance that they have travelled with the help of GPS and also with the help of xgboost by predicting the type of transportation mode used by the user. This application can be enhanced by utilizing the mobile tower, this method will also help in the in the tracking of the user without the GPS system.
But there are still more improvements can be done on the system by using the IOT systems that are connected to each thing that are capable of emitting the carbon.

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REFERENCES

[1] Jiawei Cao, Gang Cen, Yuefeng Cen and Weifeng Ma. "Short-Term Highway Traffic Flow Forecasting Based on XGBoost" (2020)
[2] Friedman, Jerome H. "Greedy Function Approximation: A Gradient Boosting Machine." Annals of Statistics 29.5(2001):1189-1232.
[3] A. Gupta, S. Sharma, S. Goyal and M. Rashid, "Novel XGBoost Tuned Machine Learning Model for Software Bug Prediction," 2020 International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2020, pp. 376-380, doi: 10.1109/ICIEM48762.2020.9160152.
[4] Philip S. Noe and Kenneth A. Myers,"A Position Fixing Algorithm for the Low-Cost GPS Receiver", IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-12, Issue: 2.
[5] E.M. Lassiter,"Navstar Global Positioning System: A Satellite Based Microwave Navigation System", IEEE-MTT -S International Microwave Symposium, 1975.
[6] Spilker James, "Global Positioning System: Signal Structure and Performance Characteristics", 1978.
[7] Kazuya Tanaka,Akito Monden,Zeynep Yucel ,"Prediction of Software Defects Using Automated Machine Learning", 2019