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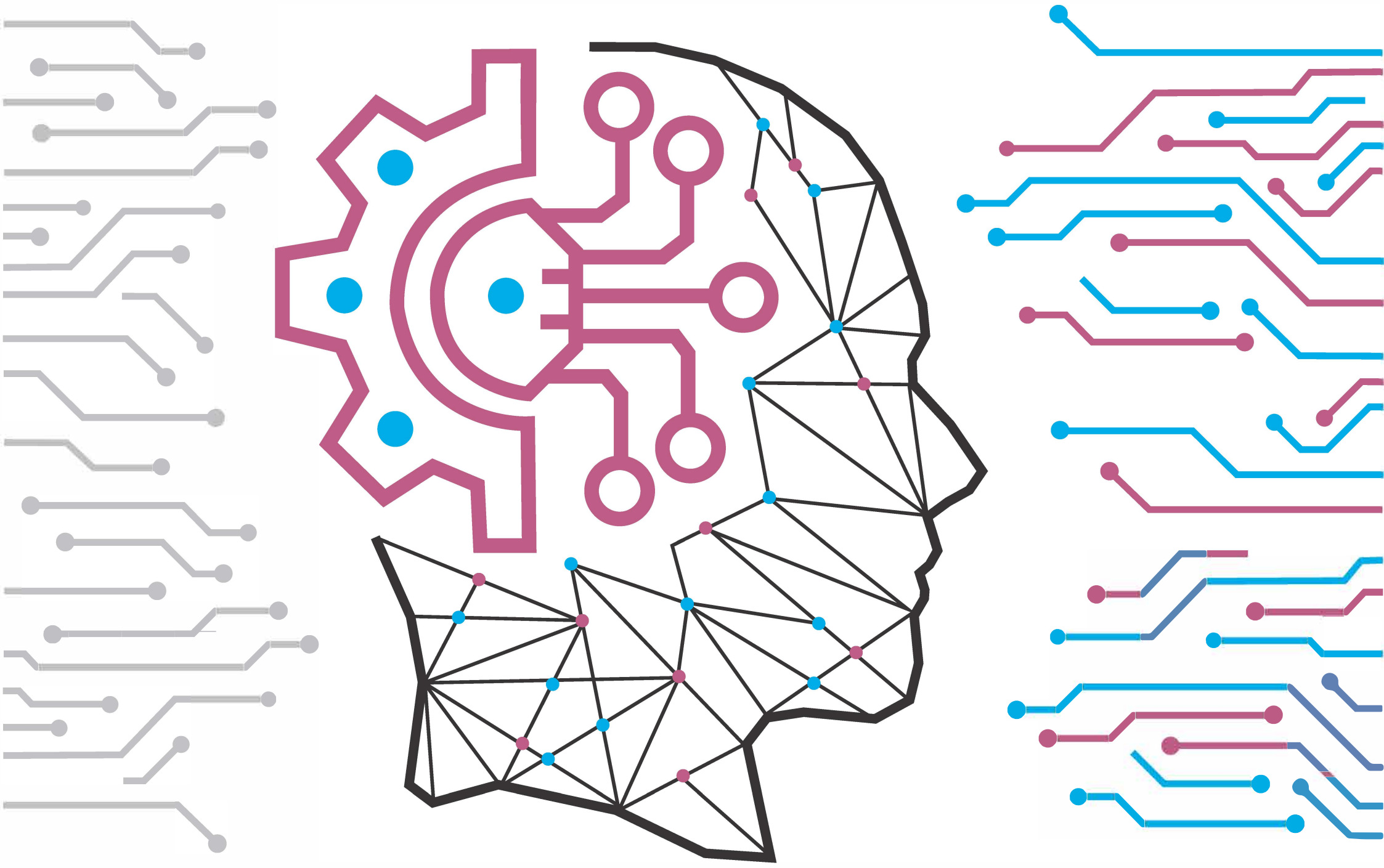

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THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

EXTENDED ABSTRACTS

e-BOOK

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OPTIMIZING CARBON EMISSION ANALYSIS FOR SUSTAINABLE ENVIRONMENTAL IMPACT

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ABSTRACT

This project aims to tackle the accessibility and cost challenges associated with carbon emission analysis tools by developing a user-friendly application system. The objectives are to democratize carbon emission calculations and optimize emission values using advanced swarm-based algorithms. The methodology includes designing an accessible application, performing a comprehensive carbon emission analysis for Engineering Tower 2 in accordance with GHG Protocol and ISO 14064 guidelines, and incorporating participation factors and utilization indices to refine emission values. The findings demonstrate that the application significantly reduces barriers to accurate emission assessments, and the detailed analysis highlights key areas for improvement in the carbon footprint of Engineering Tower 2. The optimization techniques enhance the precision and efficiency of emission reduction efforts. In conclusion, this project provides an effective and accessible tool for carbon management, promoting sustainable practices and contributing to global climate change mitigation efforts.

Keyword: Carbon Emission, User-Friendly Application, GHG Protocol, ISO 14064, Sustainability, Carbon Footprint, Emission Analysis

1. INTRODUCTION

Climate change is a critical global issue driven by increasing greenhouse gas emissions, particularly carbon dioxide (CO2). The need to accurately measure and mitigate carbon emissions has become a pressing concern for organizations worldwide (World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)). However, existing carbon emission calculation tools often lack accessibility, user-friendliness, or optimization capabilities hindering their ability to conduct accurate assessments and implement effective mitigation strategies (Zhang, n.d), (Yaacob, 2020), (Lai, 2011). Additionally, current frameworks lack avenues to optimize emission values based on participation factors or utilization indices, presenting a critical gap in sustainable impact analysis (Huang, 2024).

This study aims to develop a user-friendly carbon emission calculation application system that is easily accessible to users worldwide. It also intends to conduct a comprehensive carbon emission analysis, focusing on Scope 1, 2, and 3 emissions, in accordance with the GHG Protocol and ISO 14064 guidelines of Engineering Tower 2 in Universiti Teknologi MARA. Furthermore, the project seeks to optimize carbon emission values through the integration of participation factors and utilization indices using swarm-based optimization algorithms (Álvarez-Castañeda, 2016).

The study incorporates swarm-based optimization algorithms to optimize emission values based on participation rates and utilization indices. However, the study is limited to the specific case of Engineering Tower 2 and may require further validation and adaptation for application in other

buildings or contexts. Additionally, the optimization algorithms employed may have inherent limitations or assumptions that could affect their accuracy or applicability in certain scenarios.

2. METHODOLOGY

The methodology employed in this project involves a series of well-defined steps aimed at achieving the specified objectives. These steps include the system design and development, data collection and analysis, carbon emission calculations, and optimization techniques. Each component is integral to the overall success of the project.

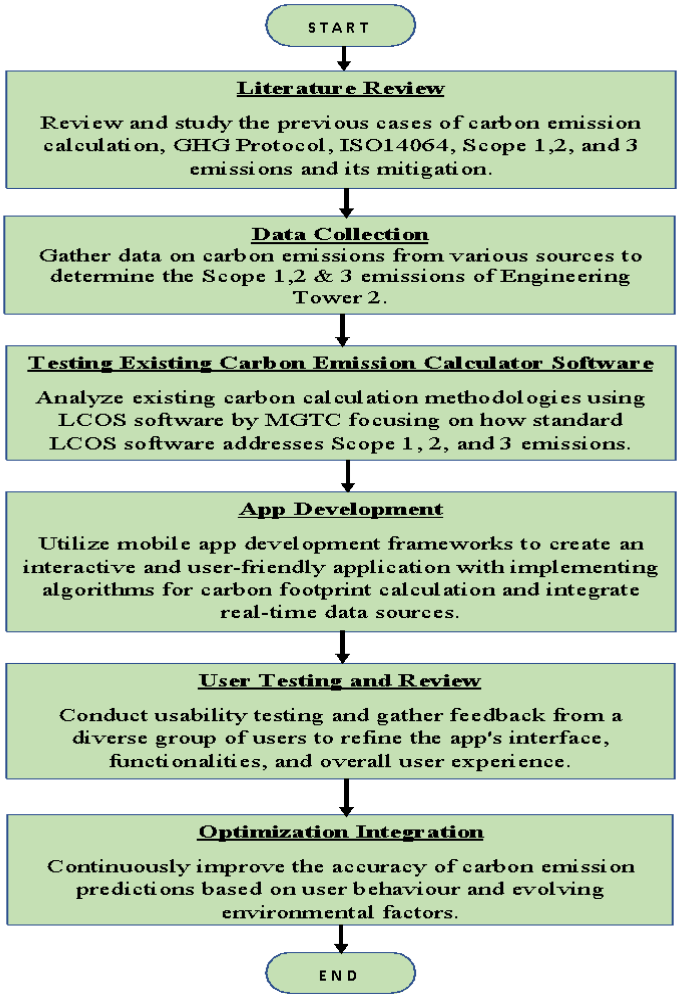

Figure 1 Methodology flowchart for optimizing carbon emission analysis and developing a user-friendly application system

3. FINDINGS

The findings of this study indicate that the developed carbon emission calculation application is both user-friendly and effective in accurately categorizing and analyzing emissions into Scope 1, 2, and 3 for Engineering Tower 2 at Universiti Teknologi MARA. The application adheres to the GHG

Protocol and ISO 14064 standards, ensuring high data accuracy and integrity. Preliminary user feedback confirms the system's accessibility and ease of use. Additionally, the integration of swarm-based optimization algorithms has enhanced the precision of emission estimates, revealing significant opportunities for reducing Scope 2 emissions through energy-saving measures and increased utilization of renewable energy sources. These findings suggest that the application is a valuable tool for organizations seeking to assess and mitigate their carbon footprints effectively.

SCOPE	CATEGORY	MULTIPLIER	EMISSION SOURCE	DIMENSION	ACTIVITY DATA	FACTOR VALUE(MARKET-BASED)	CARBON EMISSION(tCO2e)
SCOPE 1	Stationary Source Combustion Emissions		LPG	Volume (m³)	7	1.55709	10.89963
	Mobile Combustion Emission		Diesel	Volume (m³)	5	10.325115	51.625575
	Raw Material Generated CO2 Emissions		Methane	Volume (m³)	6	2.746333	16.477998
SCOPE 2	Net Purchased Electricity Use Generated Emissions	1	Lift	Energy Electricity (MWh)	49.05000	0.3757	18.428085
		10	Big Room	Energy Electricity (MWh)	0.04639	0.3757	0.17428723
		10	Small Room	Energy Electricity (MWh)	0.04495	0.3757	0.16887715
		1	Corridor	Energy Electricity (MWh)	0.01350	0.3757	0.00507195
		10	Staff Room	Energy Electricity (MWh)	0.06340	0.3757	0.2381938
		10	Laboratory	Energy Electricity (MWh)	0.04540	0.3757	0.1705678
		3	Washroom	Energy Electricity (MWh)	0.00036	0.3757	0.000405756
		2	Office	Energy Electricity (MWh)	0.20609	0.3757	0.154856026
SCOPE 3	Category 7: Employee Commuting	240	Bus	Distance(km)	15	0.113	406.8
		236	Car	Distance(km)	25	0.118	696.2
		2409	Motorcycle	Distance(km)	10	0.204	4914.36
		1	Flight	Distance(km)	680	0.117	79.56
TOTAL							6195.263548

Figure 2 Examples of total of carbon emission for Engineering Tower 2

4. CONCLUSION

In conclusion, this study successfully developed a user-friendly carbon emission calculation application adhering to the GHG Protocol and ISO 14064 standards, providing accurate analyses of Scope 1, 2, and 3 emissions for Engineering Tower 2 at Universiti Teknologi MARA. The application, noted for its accessibility and ease of use, offers precise emission estimates and identifies significant opportunities for reducing Scope 2 emissions through energy-saving measures and renewable energy utilization. The findings indicate that this tool is valuable for organizations aiming to effectively assess and manage their carbon footprints, thereby supporting global efforts in climate change mitigation and sustainable practice promotion.

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