Indonesian Journal of Electrical Engineering and Computer Science
Vol. 99, No. 1, Month 2099, pp. 1~1x
ISSN: 2502-4752, DOI: 10.11591/ijeecs.v99.i1.pp1-1x

NOW2 Waste Management System: Advancing Environmental Sustainability Through Digital Endowments

Edward Nathan Samuel[1], P.M. Winarno[2], Siti Fara Fadila Binti Abd Razak[3],
[1,2] Department of Informatics, Faculty of Engineering and Informatics, Universitas Multimedia Nusantara, Tangerang, Indonesia
[3,4,5,6,...]

Article Info

Article history:

Received month dd, yyyy
Revised month dd, yyyy
Accepted month dd, yyyy

Keywords:

Sustainable Waste Management,
Renewable Energy,
Green Financing,
Net Zero Emission,
Web Technology,

ABSTRACT

The Net Zero Waste Wise (NOW2) system is a digital platform that transforms waste donations into financial resources for Waqfs (Muslim Endowments), supporting renewable energy and charitable projects while promoting sustainable waste management. By leveraging recycling revenues, NOW2 offers an eco-friendly alternative to traditional SUKUK financing, aligning with the United Nations' Sustainable Development Goals (SDGs 7, 11, 12, and 13). Built with TypeScript, Next.js, Tailwind CSS, NextAuth, and Prisma ORM, the system ensures efficient user experience, robust data security, scalable database management, and a stable platform for service delivery. NOW2 also facilitates transparent donation tracking, enhancing trust and accountability within the community. This paper explores the technological architecture and financial model of the successfully developed NOW2, highlighting its potential as a replicable solution for sustainable waste management in developing nations like Malaysia. By converting waste into financial value, NOW2 addresses environmental challenges and empowers communities through charitable giving, offering a scalable and impactful approach to zero-waste initiatives.

Commented [EN1]: The result of this research (now2 system have been successfully developed), (kalau ada pengujian, tambahkan tingkat kepuasan user)

Corresponding Author:

Edward Nathan Samuel
Department of Informatics, Faculty of Engineering and Informatics, Universitas Multimedia Nusantara,
15810 Tangerang, Indonesia
Email: edward.nathan@student.umn.ac.id

1. INTRODUCTION

Municipal solid waste (MSW) management has emerged as a critical environmental challenge worldwide, with escalating waste generation rates posing significant threats to urban sustainability. In Malaysia, more than 30,000 tons of MSW are produced daily, highlighting the urgency of adopting sustainable waste management practices. Traditional methods, including landfilling and incineration, are increasingly ineffective due to their environmental impacts, limited land availability, and rising operational costs. Consequently, innovative solutions are needed to address these challenges while promoting environmental sustainability and community welfare.

The Net Zero Waste Wise (NOW2) system offers a transformative approach to MSW management by digitizing waste donation processes and converting them into financial resources for Waqfs (Islamic endowments). By facilitating the circular economy, NOW2 not only minimizes waste accumulation but also channels financial aid towards community development initiatives. Unlike conventional systems, NOW2 integrates advanced web technologies such as TypeScript for type safety, Next.js for server-side rendering (SSR), Tailwind CSS for responsive UI design, NextAuth for secure authentication, and Prisma ORM for efficient database management. This technological synergy ensures a seamless user experience, robust security, and scalable data management, positioning NOW2 as an innovative digital platform for sustainable waste management.

Existing literature emphasizes the importance of digital platforms in enhancing waste management efficiency through real-time monitoring, data analytics, and stakeholder collaboration. However, most solutions are limited to waste tracking and recycling, lacking integration with charitable frameworks such as Waqfs. The unique value of NOW2 lies in its dual impact: environmental sustainability and digital endowment. By leveraging waste-to-value mechanisms, NOW2 bridges the gap between waste management and charitable giving, offering a novel model for sustainable community development.

This paper explores the technological architecture, implementation strategies, and scalability of the NOW2 system. It examines the system's impact on environmental sustainability and digital endowments, highlighting its potential as a replicable model for other developing nations. By addressing the limitations of conventional waste management systems, this study contributes to the growing body of research on digital innovation for sustainable development.

2. LITERATURE REVIEW

2.1. ZERO WASTE PARADIGM

The zero-waste paradigm has gained significant attention as a sustainable approach to addressing global waste management challenges. According to the Ellen MacArthur Foundation, zero waste aims to redesign resource life cycles so that products are reused or repurposed without generating environmental pollution. This paradigm not only minimizes landfill dependency but also enhances resource recovery through recycling and reuse initiatives, promoting a circular economy [1].

Several studies have emphasized the importance of integrating digital technologies into waste management systems. Digital platforms enable real-time tracking, data analytics, and enhanced stakeholder collaboration, revolutionizing traditional waste management practices [2], [3]. By leveraging these technological advancements, the zero-waste paradigm facilitates more efficient resource management and contributes to environmental sustainability.

2.2 DIGITAL PLATFORMS FOR WASTE MANAGEMENT

Digital platforms have transformed waste management by enhancing operational efficiency and promoting sustainability. Emerging technologies such as the Internet of Things (IoT) and cloud computing provide real-time data collection and monitoring capabilities, enabling waste management systems to optimize resource allocation and reduce environmental impact [4], [5].

Fintech solutions are also being explored to support sustainability, including digital endowments that align with sustainable development goals. Recent developments in green finance and Islamic SUKUK have further facilitated environmentally conscious projects by providing financial mechanisms that encourage sustainable investments [6], [7]. These platforms enable better monitoring of waste streams, fostering transparency and accountability in waste management practices.

Several digital waste management systems have been successfully implemented globally. For instance, South Korea's RFID-based waste tracking system has significantly reduced food waste through data-driven policies and public awareness campaigns [8]. Similarly, Singapore's Smart Waste Management System utilizes IoT sensors to optimize waste collection routes, reducing operational costs and environmental emissions [9]. These examples highlight the transformative potential of digital platforms in achieving zero-waste goals.

2.3 CHALLENGES AND TECHNOLOGIES USED

Despite the numerous benefits of adopting a zero-waste approach, several challenges persist. In developing nations, inadequate infrastructure, lack of public awareness, and financial constraints hinder the effective implementation of zero-waste strategies [10]. The United Nations Environment Programme (UNEP) underscores the importance of waste-to-energy technologies as a viable solution to address waste accumulation while generating renewable energy [11]. However, issues related to high operational costs and environmental regulations continue to pose challenges.

To overcome these challenges, these web technologies have been integrated into the Net Zero Waste Wise (NOW2) system:

2.3.1 **Next.js**: Enhances performance through server-side rendering (SSR) and static site generation, improving user experience and SEO [12].

2.3.2 **TypeScript**: Ensures maintainability by providing type safety during development, reducing runtime errors [13].

2.3.3 **Tailwind CSS**: Simplifies responsive UI design with utility-first classes, promoting consistent and maintainable styling [14].

2.3.4 **Prisma ORM**: Facilitates scalable database interactions with type-safe query operations, ensuring efficient data management [15].

2.3.5 **NextAuth**: Secures authentication processes using OAuth and JSON Web Tokens (JWT), enhancing user privacy and data security [16].

2.3.6 **GitHub**: Enables secure collaboration and continuous integration/continuous deployment (CI/CD) practices, streamlining development workflows [17].

By incorporating these advanced web technologies, the NOW2 system demonstrates how digital innovation can effectively address pressing environmental concerns while driving sustainable development. This approach not only enhances operational efficiency but also provides a scalable model for digital endowments, contributing to community development and environmental sustainability.

2.4 Method

This study focuses on developing a platform that enables users to convert waste into digital endowments, promoting environmental sustainability and reducing the daily accumulation of landfill waste. To achieve this, research was conducted to enhance the accessibility of the service. Flowcharts were created to outline the transaction flow for each user within the application. Two flowcharts were designed to illustrate the overall application flow and the system's operations across multiple entities. The first flowchart also maps the user journey throughout the system after authentication via their own login credentials, as shown in Figure 1.

Figure 1. Creating Transaction

After the transaction is done by each of the users, the system then hands the newly made transaction to screeners and transformers. The user still has an action to do before the rest of the entities can continue. After the user completes the deposit of their trash, the transaction is handed to the screener, who would then screen the trash, separating valuable waste, and disposables. The screener would also give an estimate of how much waste could be sold as a number for the transformer to use as a guideline. The screened waste is then transformed into money by methods that each individual transformer can freely use. The transformer would input the amount of money that is made into the data, then finally transfer it to Waqfs. After all the process is done, the system would automatically generate a receipt for the user that would be accessible from the history section of their home screen.

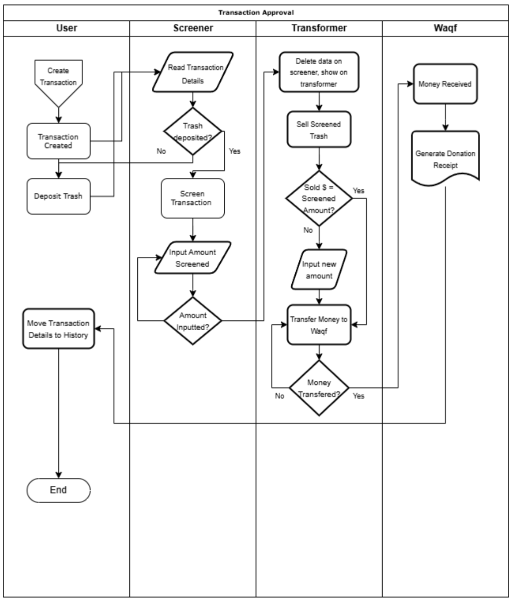


Figure 2. Processing Transaction

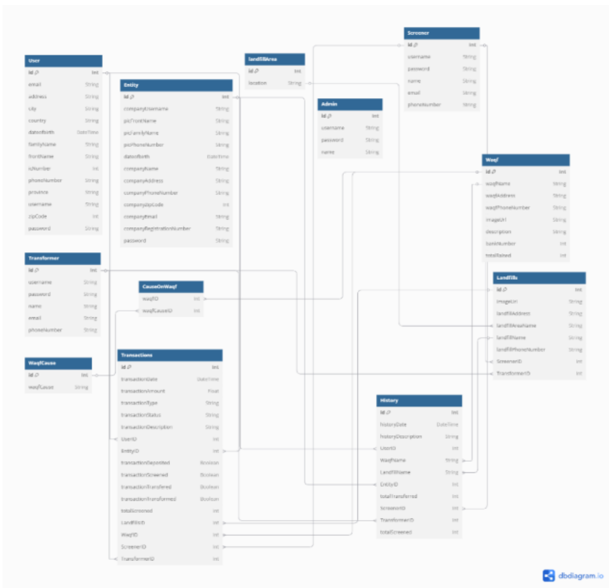


Figure 3. Database Diagram

3. RESULTS AND DISCUSSION (10 PT)

In this section, it is explained the results of research and at the same time is given the comprehensive discussion. Results can be presented in figures, graphs, tables and others that make the reader understand easily [14], [15]. The discussion can be made in several sub-sections.

3.1. Development Results

The development of the NOW2 platform successfully integrates a robust authentication system, ensuring secure and efficient access to platform functionalities. Implemented primarily using Next.js, the authentication framework leverages NextAuth.js alongside a custom-built middleware to enhance security, optimize efficiency, and facilitate session management. This dual-layer authentication approach strengthens user identity verification while enabling seamless interaction with protected system features.

The login page, as the primary entry point for authenticated users, employs a meticulously designed interface with a strong emphasis on security, user experience, and accessibility. Credential authentication is conducted through a secure pipeline, utilizing advanced encryption protocols to safeguard data transmission and mitigate risks of unauthorized access. Furthermore, adherence to Web Content Accessibility Guidelines (WCAG) ensures inclusivity for users with diverse needs.

The system's authentication architecture benefits from Next.js's file-based routing and server-side rendering (SSR), optimizing performance and response times. The CSS framework Tailwind CSS enhances UI consistency and responsiveness, streamlining the development process. The platform's efficient engineering is evidenced by its rapid completion within a one-month timeframe, demonstrating the effectiveness of Next.js and Vercel in modern web application development.

The authentication feature is seamlessly integrated into the login and registration pages, as illustrated in Figures 4–6. This implementation ensures data integrity, confidentiality, and usability, reinforcing NOW2's commitment to secure, scalable, and accessible digital solutions.

Figure 4. Login Screen

The registration page is more or less the same for user and entities, but, there are diffference in the type of data collected between the two of them. The registration page is aimed at simplicity, but still adheres to the essential datas that are needed for the system to run. The registration process for the broader user mandates the input of the following fields: Front Name, Family Name, Username, IC Number (for tax verification), Birthdate, Email, Malaysian Phone Number, and Address as seen on Figure 5.

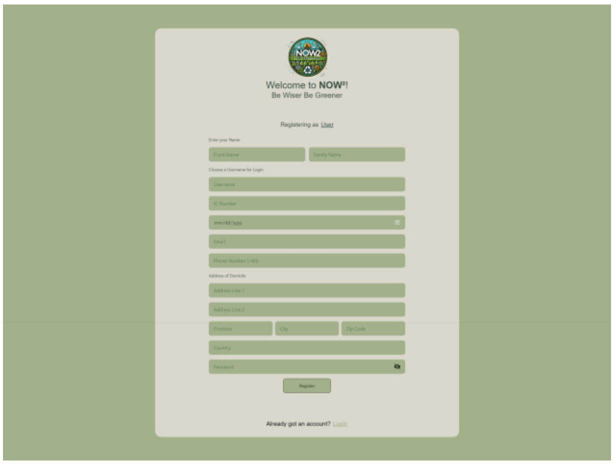


Figure 5. User Register Screen

The company registration page as seen on Figure 6. is designed to collect essential business information needed for onboarding organizations into the NOW2 platform. The following fields are required:

Person In Charge (PIC) Information
- Full Name – Required to identify the responsible individual.
- Email – Must be in a valid format for official communication.
- Phone Number – Captures a valid contact number for verification.

Company Details
- Company Username – Unique within the system to distinguish accounts.
- Company Name – Official name of the organization.
- Company Creation Date – Records the founding date for reference.
- Company Registration Number – Required for official business validation.

Contact Information
- Company Email – Used for official communication.
- Company Phone Number – Business contact number.
- Company Address Line – Captures the physical location of the company.

Figure 6. Company / Organization Register Screen

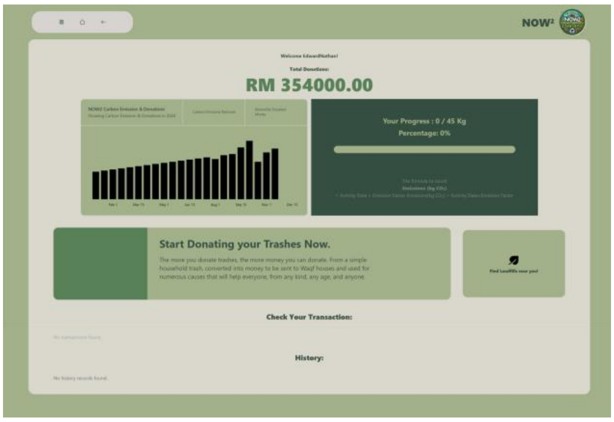
The home screen's design that can be seen in Figure 7 focuses on three core functionalities to drive environmental engagement through personalized data visualization and actionable insights. A dynamic header greets users by name using profile data from system databases, establishing immediate personal connection. The central interface element is a real-time interactive dashboard showing kilograms of CO_2 emissions offset through user activities, with visual trend lines comparing personal contributions to community averages.

Adjacent to emissions data, a financial transparency panel displays accumulated donation amounts through layered bar graphs showing allocation percentages across environmental projects, with hover details revealing specific initiative impacts. Progress metrics calculate emission reductions using the formula:

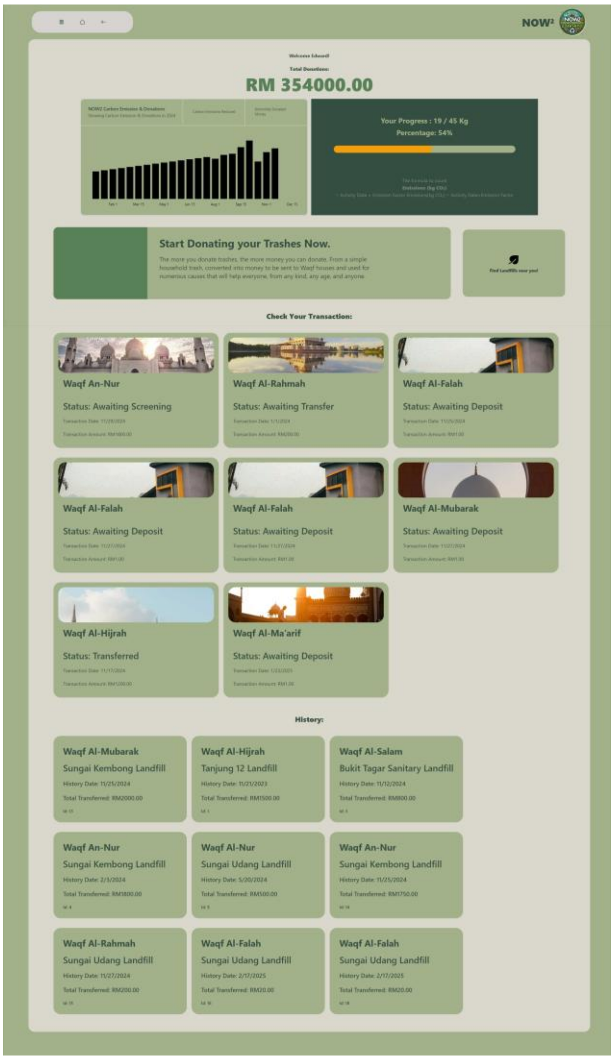
$$\textbf{Net Emission Reduction}=(\textbf{Activity Data}\times\textbf{Emission Factor})-\textbf{Baseline Consumption}\textbf{Net Emission Reduction}=(\textbf{Activity Data}\times\textbf{Emission Factor})-\textbf{Baseline Consumption}$$

presented through animated gauges showing percentage completion toward personalized sustainability goals. A persistent "Find Landfills Near You" button in the action toolbar triggers a choice for the user to select the closest area near them that offers the service.

All visualizations refresh automatically upon new activity input, with achievement badges appearing when users reach milestone thresholds. The layout employs progressive disclosure - tapping any data widget expands secondary screens with historical comparisons, peer benchmarking, and detailed impact reports. The user's activity is color-coded to follow their monthly goal's progress (green for ≥ 70%, yellow for 33% - 69&, red for < 33%) while maintaining WCAG AA accessibility standards.



(a). Empty User Home Screen



(b) Filled User Home Screen

Figure 8. User Home Screen

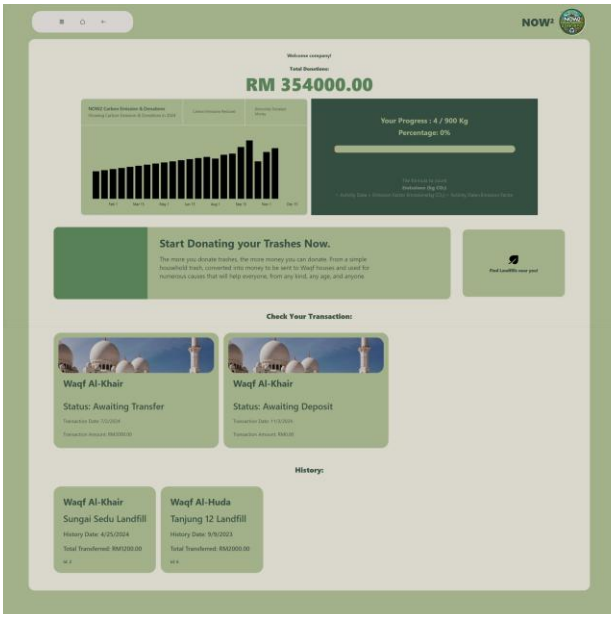


Figure 9. Filled Company/Organization Screen

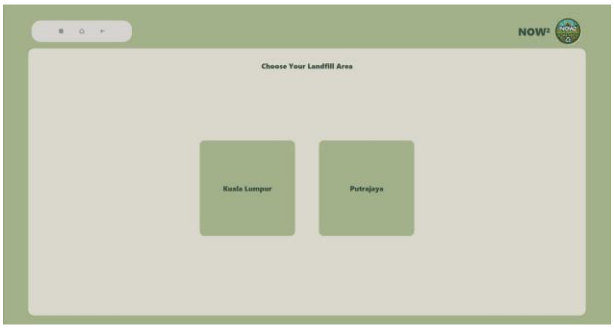


Figure 10. Choose Landfill Area

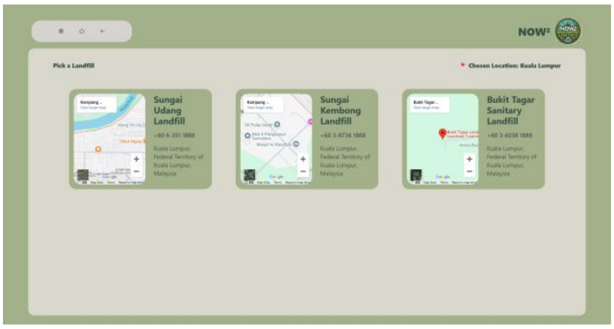


Figure 12. Choose Landfill

Figure 13. Landfill Details

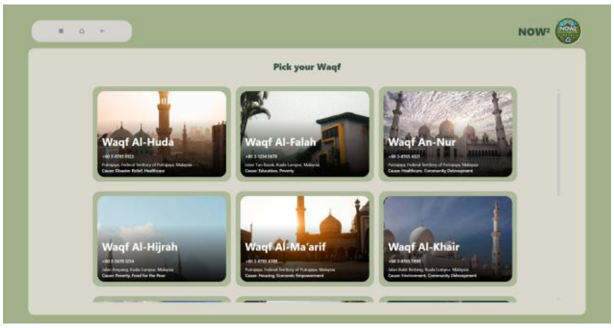


Figure 14. Choose Waqf

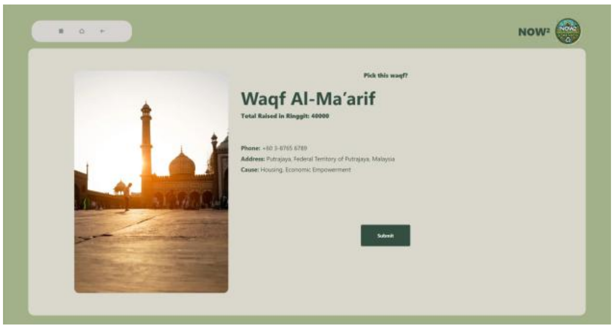


Figure 15. Waqf Details

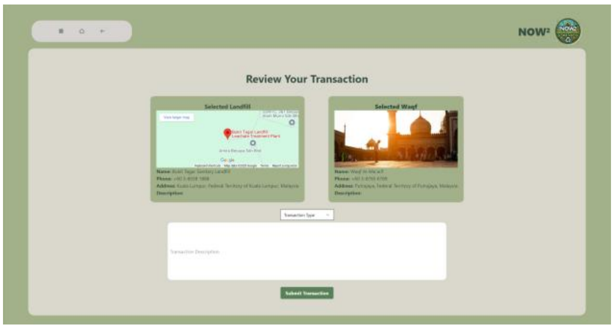


Figure 16. Transaction Confirmation Details

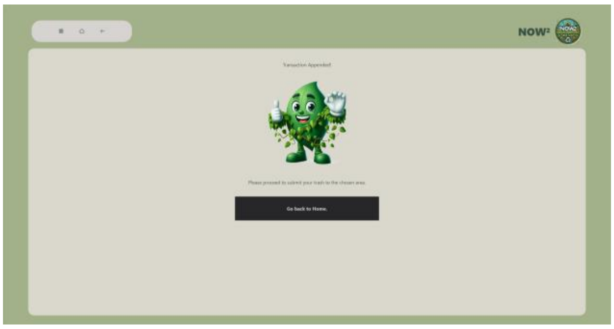


Figure 17. New Transaction Made Screen

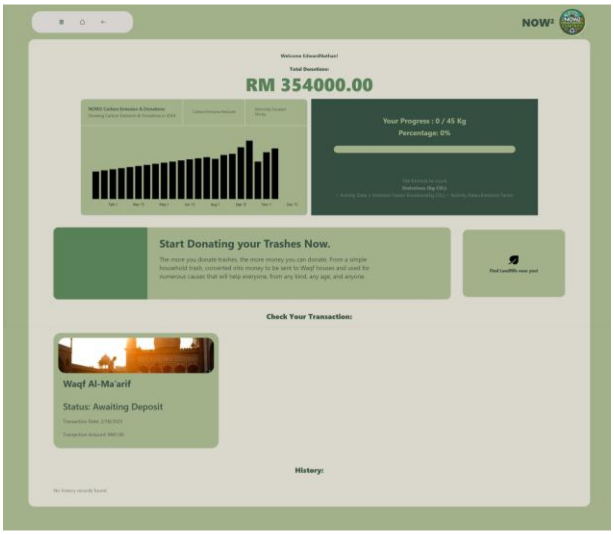


Figure 18. New Transaction Details

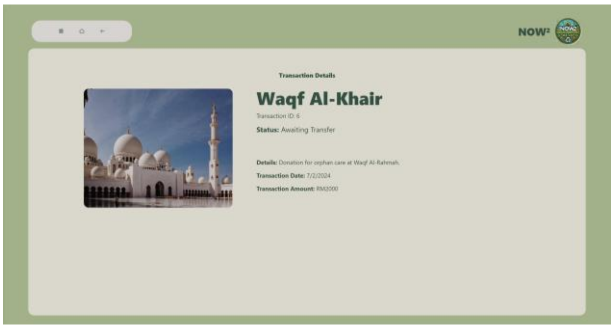


Figure 19. Transaction Details

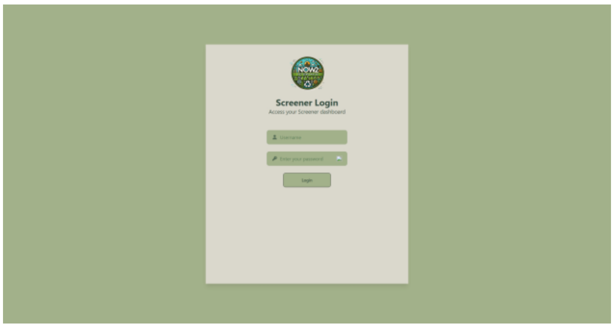


Figure 20. Screener Login Page

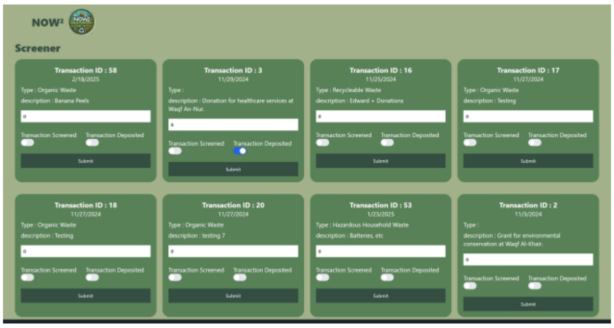


Figure 21. Screener Page

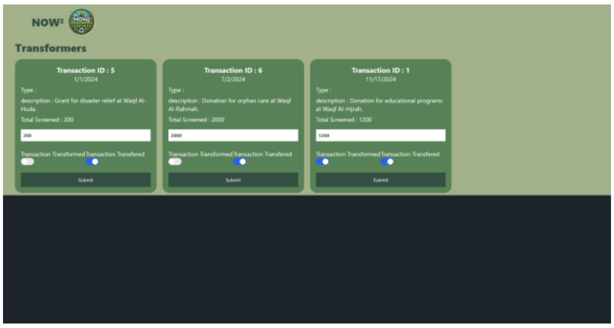
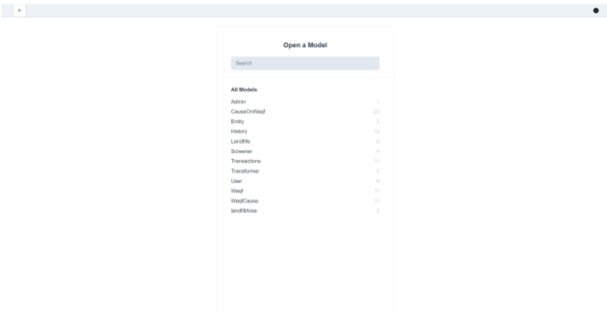
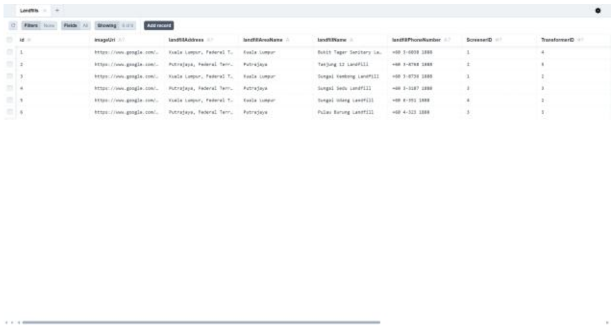


Figure 23. Transformers Page



(a)



(b)

Figure 24. Admin Page

All symbols that have been used in the equations should be defined in the following text.

3.2. Sub section 2

Proper citation of other works should be made to avoid plagiarism. When referring to a reference item, please use the reference number as in [16] or [17] for multiple references. The use of "Ref [18]..." should be employed for any reference citation at the beginning of sentence. For any reference with more than 3 or more authors, only the first author is to be written followed by *et al*. (e.g. in [19]). Examples of reference items of different categories shown in the References section. Each item in the references section should be typed using 8 pt font size [20]–[25].

3.2.1. Subsub section 1

yy

3.2.2. Subsub section 2

zz

4. CONCLUSION (10 PT)

Provide a statement that what is expected, as stated in the "INTRODUCTION" section can ultimately result in "RESULTS AND DISCUSSION" section, so there is compatibility. Moreover, the prospects for the development of research results and the application of further studies can also be added to the next (based on the results and discussion).

$$E_v - E = \frac{h}{2.m}\left(k_x^2 + k_y^2\right)$$

ACKNOWLEDGMENTS *(if applicable)* (10 PT)

This section should acknowledge individuals who provided personal assistance to the work but do not meet the criteria for authorship, detailing their contributions. It is imperative to obtain consent from all individuals listed in the acknowledgments.

AUTHOR CONTRIBUTIONS STATEMENT *(mandatory)* (10 PT)

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration. **The recommended number of authors is at least two, with one of them designated as the corresponding author.** The corresponding author will be responsible for all correspondence related to the paper and must ensure that the other authors are included in the communication regarding submission, revision, and publication processes. We encourage authors to include a statement in the paper that shares and accurately describes each author's contribution. To be eligible for authorship, each individual must have contributed to at least one of the following: conceptualization, methodology, formal analysis, or investigation, as well as at least one aspect of writing (either original draft preparation or writing reviews and editing).

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Author 1 name	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	
Author 2 name		✓				✓		✓	✓	✓	✓	✓		
Author 3 name	✓		✓	✓		✓			✓		✓		✓	
…..														
Author x name					✓		✓			✓		✓		✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

See the examples below:

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Muhammad Usman Akram	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	
Siti Zaiton Mohd Hashim		✓				✓		✓	✓	✓	✓	✓		
Mohd Ali Hassan	✓		✓	✓			✓			✓	✓		✓	✓

CONFLICT OF INTEREST STATEMENT *(mandatory)* (10 PT)

To ensure fair and objective decision-making, authors must declare any associations that pose a conflict of interest (financial, personal, or professional) in connection with manuscripts. Non-financial competing interests include a declaration of political, personal, religious, ideological, academic, and intellectual competing interests. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. If there are no conflicts of interest, please include the following author's statement: Authors state no conflict of interest.

DATA AVAILABILITY *(mandatory)* (10 PT)

The data availability statement is a valuable link between a paper's results and the supporting evidence. It is a brief statement about whether the authors of an article have made the evidence supporting their findings available, and if so, where readers may access it. Data availability statements help to promote transparency and reproducibility in research and to increase the visibility of valuable evidence produced or gathered during the course of research. As part of our commitment to supporting open research, our journal now requires all manuscripts to include a data availability statement in order to be accepted for publication. Examples:

- The data that support the findings of this study are openly available in [repository name] at http://doi.org/[doi], reference number [reference number].
- The data that support the findings of this study will be available in [repository name] [URL / DOI link] following a [6 month] embargo from the date of publication to allow for the commercialization of research findings.
- The data that support the findings of this study are available on request from the corresponding author, [initials]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.
- Derived data supporting the findings of this study are available from the corresponding author [initials] on request.
- The data that support the findings of this study are available from [third party]. Restrictions apply to the availability of these data, which were used under license for this study. Data are available [from the authors / at URL] with the permission of [third party].
- The authors confirm that the data supporting the findings of this study are available within the article [and/or its supplementary materials].
- The data that support the findings of this study are available from the corresponding author, [author initials], upon reasonable request.
- Data availability is not applicable to this paper as no new data were created or analyzed in this study.

REFERENCES (10 PT)

The main references are international journals and proceedings. All references should be to the most pertinent, **up-to-date sources**, and the **minimum number of references** should be **25** (for original research papers) and **50** (for review papers). References are written in IEEE style. You can access a more comprehensive guide at http://ipmuonline.com/guide/refstyle.pdf. Use a tool such as EndNote, Mendeley, or Zotero for reference management and formatting; choose IEEE style. Please use a consistent format for references—see examples (8 pt):

[1] Journal/Periodicals

Basic Format:

J. K. Author, "Title of paper," *Abbrev. Title of Journal/Periodical*, vol. *x*, no. *x*, pp. *xxx-xxx*, Abbrev. Month, year, doi: *xxx*.

Examples:

- M. M. Chiampi and L. L. Zilberti, "Induction of electric field in human bodies moving near MRI: An efficient BEM computational procedure," *IEEE Trans. Biomed. Eng.*, vol. 58, pp. 2787–2793, Oct. 2011, doi: 10.1109/TBME.2011.2158315.
- R. Fardel, M. Nagel, F. Nuesch, T. Lippert, and A. Wokaun, "Fabrication of organic light emitting diode pixels by laser-assisted forward transfer," *Appl. Phys. Lett.*, vol. 91, no. 6, Aug. 2007, Art. no. 061103, doi: 10.1063/1.2759475.

[2] Conference Proceedings

Basic Format:

J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, (location of conference is optional), year, pp. *xxx–xxx*, doi: *xxx*.

Examples:

- G. Veruggio, "The EURON roboethics roadmap," in *Proc. Humanoids '06: 6th IEEE-RAS Int. Conf. Humanoid Robots*, 2006, pp. 612–617, doi: 10.1109/ICHR.2006.321337.
- J. Zhao, G. Sun, G. H. Loh, and Y. Xie, "Energy-efficient GPU design with reconfigurable in-package graphics memory," in *Proc. ACM/IEEE Int. Symp. Low Power Electron. Design (ISLPED)*, Jul. 2012, pp. 403–408, doi: 10.1145/2333660.2333752.

[3] Book

Basic Format:

J. K. Author, "Title of chapter in the book," in *Title of His Published Book*, X. Editor, Ed., *x*th ed. City of Publisher, State (only U.S.), Country: Abbrev. of Publisher, year, ch. *x*, sec. *x*, pp. *xxx–xxx*.

Examples:

- A. Taflove, *Computational Electrodynamics: The Finite-Difference Time-Domain Method* in Computational Electrodynamics II, vol. 3, 2nd ed. Norwood, MA, USA: Artech House, 1996.
- R. L. Myer, "Parametric oscillators and nonlinear materials," in *Nonlinear Optics*, vol. 4, P. G. Harper and B. S. Wherret, Eds., San Francisco, CA, USA: Academic, 1977, pp. 47–160.

[4] M. Theses (B.S., M.S.) and Dissertations (Ph.D.)

Basic Format:

J. K. Author, "Title of thesis," M.S. thesis, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.

J. K. Author, "Title of dissertation," Ph.D. dissertation, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.

Examples:

- J. O. Williams, "Narrow-band analyzer," Ph.D. dissertation, Dept. Elect. Eng., Harvard Univ., Cambridge, MA, USA, 1993.
- N. Kawasaki, "Parametric study of thermal and chemical nonequilibrium nozzle flow," M.S. thesis, Dept. Electron. Eng., Osaka Univ., Osaka, Japan, 1993.

*In the reference list, however, list all the authors for up to six authors. Use *et al.* only if: 1) The names are not given and 2) List of authors more than 6. *Example*: J. D. Bellamy *et al.*, Computer Telephony Integration, New York: Wiley, 2010.

See the examples:

REFERENCES

[1] M. Sigala, A. Beer, L. Hodgson, and A. O'Connor, *Big Data for Measuring the Impact of Tourism Economic Development Programmes: A Process and Quality Criteria Framework for Using Big Data*. 2019.

[2] G. Nguyen *et al.*, "Machine Learning and Deep Learning frameworks and libraries for large-scale data mining: a survey," *Artif. Intell. Rev.*, vol. 52, no. 1, pp. 77–124, 2019, doi: 10.1007/s10462-018-09679-z.

[3] C. Shorten and T. M. Khoshgoftaar, "A survey on Image Data Augmentation for Deep Learning," *J. Big Data*, vol. 6, no. 1, 2019, doi: 10.1186/s40537-019-0197-0.

[4] R. Vinayakumar, M. Alazab, K. P. Soman, P. Poornachandran, A. Al-Nemrat, and S. Venkatraman, "Deep Learning Approach for Intelligent Intrusion Detection System," *IEEE Access*, vol. 7, pp. 41525–41550, 2019, doi: 10.1109/ACCESS.2019.2895334.

[5] K. Sivaraman, R. M. V. Krishnan, B. Sundarraj, and S. Sri Gowthem, "Network failure detection and diagnosis by analyzing syslog and SNS data: Applying big data analysis to network operations," *Int. J. Innov. Technol. Explor. Eng.*, vol. 8, no. 9 Special Issue 3, pp. 883–887, 2019, doi: 10.35940/ijitee.I3187.0789S319.

[6] A. D. Dwivedi, G. Srivastava, S. Dhar, and R. Singh, "A decentralized privacy-preserving healthcare blockchain for IoT," *Sensors (Switzerland)*, vol. 19, no. 2, pp. 1–17, 2019, doi: 10.3390/s19020326.

[7] F. Al-Turjman, H. Zahmatkesh, and L. Mostarda, "Quantifying uncertainty in internet of medical things and big-data services using intelligence and deep learning," *IEEE Access*, vol. 7, pp. 115749–115759, 2019, doi: 10.1109/ACCESS.2019.2931637.

[8] S. Kumar and M. Singh, "Big data analytics for healthcare industry: Impact, applications, and tools," *Big Data Min. Anal.*, vol. 2, no. 1, pp. 48–57, 2019, doi: 10.26599/BDMA.2018.9020031.

[9] L. M. Ang, K. P. Seng, G. K. Ijemaru, and A. M. Zungeru, "Deployment of IoV for Smart Cities: Applications, Architecture, and

Challenges," *IEEE Access*, vol. 7, pp. 6473–6492, 2019, doi: 10.1109/ACCESS.2018.2887076.
[10] B. P. L. Lau *et al.*, "A survey of data fusion in smart city applications," *Inf. Fusion*, vol. 52, no. January, pp. 357–374, 2019, doi: 10.1016/j.inffus.2019.05.004.
[11] Y. Wu *et al.*, "Large scale incremental learning," *Proc. IEEE Comput. Soc. Conf. Comput. Vis. Pattern Recognit.*, vol. 2019-June, pp. 374–382, 2019, doi: 10.1109/CVPR.2019.00046.
[12] A. Mosavi, S. Shamshirband, E. Salwana, K. wing Chau, and J. H. M. Tah, "Prediction of multi-inputs bubble column reactor using a novel hybrid model of computational fluid dynamics and machine learning," *Eng. Appl. Comput. Fluid Mech.*, vol. 13, no. 1, pp. 482–492, 2019, doi: 10.1080/19942060.2019.1613448.
[13] V. Palanisamy and R. Thirunavukarasu, "Implications of big data analytics in developing healthcare frameworks – A review," *J. King Saud Univ. - Comput. Inf. Sci.*, vol. 31, no. 4, pp. 415–425, 2019, doi: 10.1016/j.jksuci.2017.12.007.
[14] J. Sadowski, "When data is capital: Datafication, accumulation, and extraction," *Big Data Soc.*, vol. 6, no. 1, pp. 1–12, 2019, doi: 10.1177/2053951718820549.
[15] J. R. Saura, B. R. Herraez, and A. Reyes-Menendez, "Comparing a traditional approach for financial brand communication analysis with a big data analytics technique," *IEEE Access*, vol. 7, pp. 37100–37108, 2019, doi: 10.1109/ACCESS.2019.2905301.
[16] D. Nallaperuma *et al.*, "Online Incremental Machine Learning Platform for Big Data-Driven Smart Traffic Management," *IEEE Trans. Intell. Transp. Syst.*, vol. 20, no. 12, pp. 4679–4690, 2019, doi: 10.1109/TITS.2019.2924883.
[17] S. Schulz, M. Becker, M. R. Groseclose, S. Schadt, and C. Hopf, "Advanced MALDI mass spectrometry imaging in pharmaceutical research and drug development," *Curr. Opin. Biotechnol.*, vol. 55, pp. 51–59, 2019, doi: 10.1016/j.copbio.2018.08.003.
[18] C. Shang and F. You, "Data Analytics and Machine Learning for Smart Process Manufacturing: Recent Advances and Perspectives in the Big Data Era," *Engineering*, vol. 5, no. 6, pp. 1010–1016, 2019, doi: 10.1016/j.eng.2019.01.019.
[19] Y. Yu, M. Li, L. Liu, Y. Li, and J. Wang, "Clinical big data and deep learning: Applications, challenges, and future outlooks," *Big Data Min. Anal.*, vol. 2, no. 4, pp. 288–305, 2019, doi: 10.26599/BDMA.2019.9020007.
[20] M. Huang, W. Liu, T. Wang, H. Song, X. Li, and A. Liu, "A queuing delay utilization scheme for on-path service aggregation in services-oriented computing networks," *IEEE Access*, vol. 7, pp. 23816–23833, 2019, doi: 10.1109/ACCESS.2019.2899402.
[21] G. Xu, Y. Shi, X. Sun, and W. Shen, "Internet of things in marine environment monitoring: A review," *Sensors (Switzerland)*, vol. 19, no. 7, pp. 1–21, 2019, doi: 10.3390/s19071711.
[22] M. Aqib, R. Mehmood, A. Alzahrani, I. Katib, A. Albeshri, and S. M. Altowaijri, *Smarter traffic prediction using big data, in-memory computing, deep learning and gpus*, vol. 19, no. 9. 2019.
[23] S. Leonelli and N. Tempini, *Data Journeys in the Sciences*. 2020.
[24] N. Stylos and J. Zwiegelaar, *Big Data as a Game Changer: How Does It Shape Business Intelligence Within a Tourism and Hospitality Industry Context?* 2019.
[25] Q. Song, H. Ge, J. Caverlee, and X. Hu, "Tensor completion algorithms in big data analytics," *arXiv*, vol. 13, no. 1, 2017.

BIOGRAPHIES OF AUTHORS (10 PT)

In this section, authors are required to provide their professional biography, which should include their academic background, current position, research interests, and any significant contributions to the current study. Additionally, authors should include links to their professional profiles, such as ORCID (*mandatory)* and, *if applicable*, Google Scholar, Scopus Author ID, or Web of Science (WoS) ResearcherID. This helps establish the author's academic identity and enhances the visibility of their research.

Required Information:

- **Full name**: Include the author's full name as it appears in official records. If preferred, authors may use the format consistent with his/her Scopus profile.
- **Email address for each author**: Provide the author's professional email address to facilitate correspondence.
- **Social media account:**
    - **ORCID iD**: This is a mandatory. Each author must include their ORCID iD (https://orcid.org/), which helps link his/her research output to their identity.
    - **Google Scholar Profile:** Include the link to the author's Google Scholar profile. If the author does not have a Google Scholar profile, they may create a new one and include the link.
    - **Scopus Author ID:** If available, include the Scopus Author ID to enhance visibility on Scopus.
    - **Web of Science (WoS) ResearcherID:** Include the Web of Science ResearcherID. If the author does not have a WoS profile, they may create a new one and include the link.
- **Brief biography:** Provide a concise overview of the author's academic background, research interests, notable publications, and contributions to the current paper. This should be no longer than 150 to 200 words (9 pt).
- **Professional achievements:** If available, mention any important awards, recognition, or research projects the author has been involved in.

Photo Submission: Authors must submit a clear, professional headshot (3x4 cm). The photo should be of high quality, well-lit, and not blurry. Avoid using photos that are overly casual or low resolution.

Below is an example of how to format the biography section for each author:

BIOGRAPHIES OF AUTHORS (10 PT)

	**Muhammad Usman Akram** is Associate Professor at college of Electrical & Mechanical Engineering, National University of Sciences & Technology, Pakistan. He Holds a PhD degree in Computer Engineering with specialization in medical image analysis. His research areas are image/signal processing, biometrics, medical image analysis and pattern recognition. He is cofounder of RISETech which is a technology-based company and their innovative products received appreciation at national and international level. Dr Usman has filed a number of patents and industrial designs on his innovative ideas and has been awarded with two international patents. His research interests include image/signal processing, biometrics, medical image and analysis, and pattern recognition. He can be contacted at email: Usman.akram@ceme.nust.edu.pk. (9 pt)
	**Siti Zaiton Mohd Hashim** received the B.Sc. degree in computer science from the University of Hartford, USA, the M.Sc. degree in computing from the University of Bradford, U.K., and the Ph.D. degree in soft computing from The University of Sheffield, U.K. She used to hold several administrative posts with the School of Computing, Universiti Teknologi Malaysia (UTM), Johor, from 2007 to 2018, including the Head of Department, the Deputy Dean of Postgraduate Studies, and the Deputy Dean of Academic. She was also the Director of the Big Data Centre (Centre of Excellence), UTM, from 2019 to February 2020. She is currently a Professor with the Department of Data Science and the Dean of Undergraduates, Universiti Malaysia Kelantan (UMK). She has authored or coauthored more than 150 publications: 80 proceedings and 57 journals, with 19 H-index and more than 1000 citations. She can be contacted at email: sitizaiton@umk.edu.my. (9 pt)
	**Prof. Dr. Mohd Ali Hassan** his higher studies in MS Food Engineering by coursework at the at the department of Food Science, University of Leeds from 1981-1982. He is attached to the Faculty of Biotechnology and Biomolecular Sciences. His research area then was on spray drying of food. With a small research grant provided by UPM, he developed the process for producing spry-dried coconut milk which made the national headlines. His vast experience and expertise in the field of biotechnology and biomolecular sciences have enabled him to become a national point of reference in the area of biomass, renewable energy and waste utilization. He has also served as a consultant to The Science Advisor Office, Prime Minister's Department, on the national project on biomass utilisation and is the national representative for the Asia Biomass Association headquartered in Tokyo, Japan. He can be contacted at email: alihas@upm.edu.my. (9 pt)