e-ISSN: 2579-3772
doi: 10.61769/telematika.v20i2.734

Conversational Information System Dashboard for Zero New Stunting Campaign

Tjong Wan Sen[1,*], Yosi Yonata[2]

[1]*Faculty of Computer Science, President University*
Jababeka Education Park, Jl. Ki Hajar Dewantara, Bekasi, Indonesia
[2]*Program Studi Sistem Informasi, Institut Teknologi Harapan Bangsa*
Jl. Dipati Ukur No. 80-84, Bandung, Indonesia
[2]yosi@ithb.ac.id

*Correspondence: [1]wansen@president.ac.id

Abstract*— The crucial issue of stunting requires innovative solutions for effective monitoring, intervention, and prevention. In this paper, an integrated information system dashboard is presented that utilises real-time data analysis and data processing to provide comprehensive insights into stunting eradication efforts. This facilitates access for healthcare providers and policymakers to actionable information essential for evidence-based decision-making. The dashboard developed uses digital technology to automatically analyse and visualise stunting data, operating continuously 24/7. This allows users to participate in an interactive and data-driven decision-making process. The personalised, user-friendly interface provides a tailored experience that meets the specific needs and preferences of diverse stakeholders. A rapid application development method with an object-oriented approach was used to develop this dashboard. The feasibility of this dashboard was demonstrated through a series of simulations and evaluations. Based on the trial results, if implemented, the dashboard can provide significant benefits to the Zero New Stunting campaign in Kecamatan Cikarang Timur.

Keywords*— *stunting eradication, integrated information system, data visualization, evidence-based decision-making, public health monitoring

Abstrak*— Isu krusial terkait penanggulangan *stunting* memerlukan solusi inovatif untuk pemantauan, intervensi, dan pencegahan yang efektif. Dalam makalah ini, disajikan dasbor sistem informasi terintegrasi yang memanfaatkan analisis data dan pemrosesan data waktu nyata guna memberikan wawasan komprehensif mengenai upaya pemberantasan *stunting*. Hal ini memfasilitasi penyedia layanan kesehatan dan pembuat kebijakan dalam mengakses informasi yang dapat ditindaklanjuti yang penting untuk pengambilan keputusan yang berbasis bukti. Dasbor yang dikembangkan menggunakan teknologi digital untuk menganalisis dan memvisualisasikan data *stunting* secara otomatis dan beroperasi secara berkelanjutan 24/7. Hal ini memungkinkan pengguna untuk berpartisipasi dalam proses pengambilan keputusan yang interaktif dan berbasis data. Antarmuka yang dipersonalisasi dan ramah pengguna memberikan pengalaman yang disesuaikan untuk memenuhi kebutuhan dan preferensi spesifik dari beragam pemangku kepentingan. Metode *rapid application development* dengan pendekatan berorientasi objek digunakan dalam pengembangan dasbor ini. Kelayakan dasbor ini didemonstrasikan melalui serangkaian simulasi dan evaluasi. Berdasarkan hasil uji coba, jika diimplementasikan, dasbor dapat memberikan manfaat signifikan bagi kampanye *Zero New Stunting* di Kecamatan Cikarang Timur.

***Kata Kunci*— pengentasan *stunting*, sistem informasi terintegrasi, visualisasi data, pengambilan keputusan berbasis data, pengawasan kesehatan masyarakat**

I. INTRODUCTION

Stunting eradication is a critical issue that requires innovative solutions for effective monitoring, intervention, and prevention. In this paper, the significant challenges associated with stunting in Kecamatan Cikarang Timur are emphasized, emphasizing the need for multifaceted solutions. However, the Electronic Community-Based Nutrition Recording and Reporting Application (e-PPGBM) "currently lacks an analytical tool to assist nutrition officers in monitoring trends in nutritional issues over time" [1]. While progress has been made, much work remains to ensure that every child can grow and develop healthily. Continuous efforts in technology integration, community involvement, policy reforms, and healthcare training are essential to overcoming these challenges and achieving sustainable development goals.

Thewe integrated information system dashboard leverages data analytics and real-time data processing to provide comprehensive insights into stunting eradication efforts. Prior evidence also indicates that some health-dashboard designs still have limitations in analytic drill-down; for example, a reported design gap is the absence of time, area/region, and geographic filtering parameters, which makes it difficult to drill down and detail the information as needed [2]. The way stunting is monitored and addressed is transformed by this technology, enabling interventions in many new environments. These AI-powered tools assist healthcare providers and policymakers in answering queries and generating actionable insights, thereby enhancing decision-making and intervention strategies. Nevertheless, usability can remain a practical barrier in digital stunting tools; in a web-based intervention, "The System Usability Scale scored below an average of 58.7, indicating that usability improvements were needed" [3]. The dashboard provides instant feedback and support, offering a tailored experience that meets the specific needs and preferences of different stakeholders. This is especially useful for those who may need additional support outside of regular office hours.

Our integrated information system dashboard offers personalized action plans tailored to the needs of individual communities. The Rapid Application Development method with an object-oriented approach was used to create this platform. The proof of concept of this dashboard is demonstrated through a series of experiments and evaluations. At the data-collection layer, prior work highlights persistent operational issues—"several problems were found, including writing and counting errors and delays in data distribution"—underscoring the need for an integrated, real-time dashboard approach to reduce avoidable latency and data-quality errors [4]. Based on the trial results, the designed platform can attract the attention of many healthcare professionals and policymakers. The contributions of this paper are threefold. First, a novel integrated information system dashboard that combines data analytics and real-time data processing is proposed to provide comprehensive insights into stunting eradication efforts. Second, the effectiveness of the platform is demonstrated through a series of experiments and evaluations. Finally, a framework is provided for future research and development in intelligent information systems for public health management.

The integrated information system dashboard can revolutionize stunting monitoring and intervention. By providing instant feedback and comprehensive insights, it enhances decision-making and intervention strategies. While these tools offer substantial benefits, stakeholders should use them to support, not replace, critical judgment. Further high-quality research is needed to confirm efficacy and guide evidence-based dashboard design.

II. METHODOLOGY

The research methodology employed in developing an integrated information system dashboard for stunting eradication will utilize a combination of the Rapid Application Development (RAD) method for software development in the design and construction of the dashboard, along with thorough operational testing [5], [6]. The RAD method is particularly appropriate for ensuring the application can be developed in a short time frame (less than one year). The method emphasizes an iterative approach, where each stage

is repeated and refined based on evaluation feedback and testing. Effective collaboration between researchers, developers, and users, such as healthcare providers and policymakers, is crucial for the success of the dashboard development. This collaborative approach ensures that the platform meets the specific needs and preferences of its users. Thorough documentation of the research process, including the design decisions, development steps, and evaluation results, is essential for reproducibility and future development. This comprehensive documentation serves as a valuable resource for continuous improvement and scaling of the dashboard.

In general, this research follows five stages: business understanding, analysis, design, implementation, and testing. First, the business understanding phase identifies specific needs and challenges related to stunting eradication. Next, the analysis phase involves gathering and analyzing data to inform the design and development of the dashboard. The design phase focuses on creating a user-friendly, effective interface, while the implementation phase involves developing and integrating dashboard components. Finally, testing ensures the dashboard's performance and that it meets user needs. This structured, iterative process enables the development team to create an integrated information system dashboard that supports stunting eradication and provides stakeholders with valuable, actionable insights.

Business understanding is the first and critical stage for this development project. This stage consists of problem definition, project scope or boundary, and a feasibility study. Problem Definition, clearly articulating the problem related to stunting eradication that the integrated information system dashboard aims to address, is crucial. This goes beyond just identifying needs; it focuses on the business justification for the project. Specific pain points, such as the lack of real-time data, inefficient monitoring processes, and limited access to actionable insights, are identified. All expected benefits, such as improved decision-making, enhanced intervention strategies, and better resource allocation, are thoroughly discussed. Using the project scope, the project's boundaries are set, detailing what will be included and excluded in the dashboard. This helps manage expectations and prevents scope creep. Features to be included might encompass real-time data analytics, customizable reports, user-friendly interfaces, and secure data storage. Excluded features might be those that are not immediately necessary, or that could complicate the initial deployment, such as advanced predictive analytics or integration with external non-healthcare databases. A feasibility study assesses the project's technical, economic, and operational feasibility. Technical feasibility involves evaluating whether the necessary technology and expertise are available to develop and implement the dashboard. Economic feasibility assesses whether the project is financially viable, considering costs such as development, deployment, and maintenance against the expected benefits. Operational feasibility examines whether the project can be effectively integrated into existing systems and whether users can use it effectively. All constraints, such as budget limitations, technological challenges, and potential resistance to change, are considered. By following these structured steps in the business understanding phase, the development team can ensure that the integrated information system dashboard for stunting eradication is well-justified, clearly defined, and feasible, setting a strong foundation for the subsequent stages of the project.

The analysis stage consists of needs assessment, target audience analysis, and technology assessment. In the needs assessment phase, the specific needs that the integrated information system dashboard aims to address are identified. This involves analyzing existing stunting data, conducting surveys or interviews with healthcare providers, policymakers, and communities affected by stunting, and reviewing relevant literature. The goal is to understand current gaps in data management and intervention strategies, and to identify the specific requirements the dashboard must meet to be effective. In the target audience analysis phase, understanding the target audience's characteristics is crucial. This includes analyzing the demographics, roles, and responsibilities of healthcare providers, policymakers, and community workers who will use the dashboard. Factors such as their technological proficiency, data literacy, and the context in which they operate are considered. By understanding their needs and limitations, the dashboard can be tailored to

provide a user-friendly, effective interface that meets their specific needs. In the technology assessment phase, understanding the available technologies is essential to determine the feasibility and suitability of the proposed dashboard. This includes assessing data analytics tools, real-time data processing systems, and user interface technologies. Integration of advanced technologies, such as machine learning and artificial intelligence, is also explored to enhance the dashboard's capabilities. The assessment ensures that the chosen technologies can meet the data requirements and provide the desired functionalities. By following these structured steps in the analysis stage, the development team can ensure that the integrated information system dashboard for stunting eradication is well-designed, user-centric, and technologically feasible, laying a strong foundation for successful implementation and use.

The development stage involves several critical steps:

1. *Objective formulation*

   Clear objectives that will guide the design and development process are defined. These objectives should be Specific, Measurable, Achievable, Relevant, and Time-bound (SMART). For example, the system should aim to provide real-time data on stunting rates, offer predictive analytics for future trends, and facilitate community engagement and intervention tracking.

2. *User-centered design*

   The target users, which include health professionals, policymakers, and community workers, are investigated to achieve a deep understanding of their needs. Their needs, behaviors, and preferences must be meticulously analyzed through techniques such as user interviews, surveys, and the creation of user personas. This ensures that the system is tailored to meet the users' requirements effectively.

3. *Content design*

   The system content is structured in a logical and engaging manner. This includes integrating multimedia elements like graphs, charts, and videos to make the data more comprehensible. The content should align with the set objectives, for instance, by offering detailed reports on stunting cases and interactive maps showing affected regions.

4. *Interface design*

   An intuitive and user-friendly interface is designed, which is considered crucial. The dashboard should facilitate easy navigation and interaction, enabling users to access and interpret data effortlessly. Features such as customizable dashboards, easy-to-read visuals, and responsive design should be incorporated to enhance user experience.

5. *Integration of advanced technologies*

   Advanced technologies such as Machine Learning (ML) models are incorporated, which can significantly enhance the system's functionality. These models can be used to provide personalized recommendations, generate predictive analytics, and even simulate intervention outcomes. For example, ML can help predict areas at risk of high stunting rates based on various socio-economic factors.

6. *Usability testing (early and iterative)*

   Usability tests with representative users are conducted, which is essential throughout the design and development process. This helps identify and address usability issues early on, ensuring the system is both effective and user-friendly. Feedback from these tests should be used to make iterative improvements to the system.

The implementation stage consists of coding and debugging. In this phase, all design outputs are translated into code to build the system. This stage encompasses the actual coding of the dashboard, including the development of software components and presentation elements, as well as the integration of advanced technologies. During the coding stage, design specifications are translated into actual code. Writing software components that will handle data collection, storage, analysis, and visualization. The presentation elements, such as dashboards, charts, and graphs, are also coded to ensure they display information clearly and accurately. Moreover, advanced technologies like Machine Learning (ML) models are integrated to enhance the system's functionality, providing data analytics and personalized recommendations. Interactive prototypes of the dashboard are created to test and refine the user interface (UI) and user experience (UX). These prototypes can range from low-fidelity, such as paper sketches, to high-fidelity, including interactive simulations. Prototyping enables early user feedback, facilitating iterative improvements and ensuring the final product meets user needs. Minimum Viable Product (MVP) focuses on developing a core set of features that address the most critical user needs. Allows for early release of the dashboard to gather user feedback. For instance, the initial version might include basic features like data visualization and reporting tools. Feedback from this stage is invaluable and informs the development of subsequent features, ensuring the system evolves in line with user requirements. Thoroughly testing the system to identify and resolve technical issues or usability problems. Comprehensive testing is conducted to ensure that all components of the dashboard function correctly and efficiently. It helps detect bugs and fix them promptly, ensuring a smooth user experience and reliable system performance.

And lastly, the testing stage of developing an integrated information system dashboard for stunting eradication consists of several critical evaluations: usability testing, effectiveness testing, formative evaluation, and summative evaluation. First, usability testing is performed to evaluate the dashboard's ease of use and user satisfaction. This phase involves observing how health professionals, policymakers, and community workers interact with the system, identifying any difficulties they encounter while navigating the dashboard and interpreting the data. Feedback gathered at this stage is used to adjust the user interface and overall user experience. Next, effectiveness testing assesses the dashboard's impact on users' ability to effectively track and address stunting, measuring how well the system supports knowledge acquisition, decision-making, and intervention planning. For example, does the dashboard provide accurate and timely data that enables users to make informed decisions about resource allocation and intervention strategies? Meanwhile, formative evaluation, conducted throughout the development process, gathers continuous user feedback to drive ongoing improvements to the system. This includes regular check-ins with health professionals, policymakers, and community workers to understand their evolving needs and evaluate how well the dashboard meets them. The feedback helps refine features, improve data visualization, and enhance the system's overall functionality. Finally, summative evaluation conducts a comprehensive assessment to determine the dashboard's overall performance and potential for wider adoption. This evaluation examines whether the dashboard has achieved its objectives, such as reducing stunting rates and improving intervention outcomes, and assesses user satisfaction and system impact on policy-making and community engagement. The results help determines if the dashboard is ready for broader implementation and what further enhancements may be needed.

III. Result and Discussion

The results reported in this section focus on the development of an integrated information system dashboard for stunting eradication and its rigorous testing within controlled laboratory and limited real-world environments. The development process adhered to the methodologies previously outlined, addressing both the user interface and the underlying data analytics and predictive models. The dashboard's development followed a structured approach that included objective formulation, user-centered design,

content design, interface design, and the integration of advanced technologies. The aim was to create a comprehensive, user-friendly platform to monitor and effectively address stunting. The dashboard's performance and reliability were evaluated by monitoring key metrics, including load time, response accuracy, and system uptime. These tests were carried out in both laboratory settings and limited real-world environments to ensure comprehensive validation.

A. Load Time

The dashboard demonstrated rapid load times, which is crucial for ensuring that users can quickly access and interact with the data. This is particularly important for health professionals and policymakers who need to make timely decisions based on the latest information. The dashboard's ability to generate relevant, precise data insights was another critical metric. The system provided accurate real-time data on stunting rates, predictive analytics for future trends, and interactive graphs. High response accuracy ensures users can rely on the dashboard to make informed decisions and plan effective interventions. The system uptime remained consistently high, reflecting the robustness of the backend infrastructure. This high uptime is essential to maintaining the dashboard's reliability and availability, especially during critical times when data access is most needed. To ensure the dashboard's effectiveness in practical scenarios, extensive testing was conducted in limited real-world environments. This involved deploying the dashboard across various regions in Kecamatan Cikarang Timur and gathering feedback from end users, including health professionals, policymakers, and community workers. The real-world validation helped identify any potential issues and refine the system to better meet user needs.

B. Overall Performance

The integrated information system dashboard demonstrated excellent performance and reliability, with rapid load times, high response accuracy, and consistent uptime, resulting in a seamless user experience. These results show the dashboard is well-equipped to support stunting eradication efforts and is suitable for wider adoption. The comprehensive testing methodologies ensured a robust, user-friendly, and effective tool for combating this issue.

Based on the results of the prior needs analysis, the integrated information system dashboard for stunting eradication is designed with key features that address its users' critical requirements. These features are categorized into three primary modes: data collecting and processing, data analysis and reporting, and intervention management.

1) *Data collecting and processing* is analogous to the simple question-and-answer formats found in popular chat platforms. This mode is specifically designed for users such as health professionals and policymakers, enabling them to query the system for precise data points, emerging trends, and in-depth insights. The dashboard provides real-time data on stunting rates, demographics, and other key metrics, enabling informed decision-making. Users can interact with the system dynamically and in a user-friendly manner, posing questions and receiving detailed reports, comprehensive charts, and visualizations. This interactive engagement ensures users have access to an extensive, up-to-date repository of information essential to their decision-making. An example is shown in Fig. 1. In the screen-captured picture, a user issued the ‘grafik’ command to view the latest graph of a child's condition, and ‘status’ to view details such as name, weight, etc. Furthermore, users can send new data points or update existing data, with the dashboard's backend handling data processing seamlessly. An example is shown in Fig. 2. In the screen-captured picture, a user sends ‘tgl 2024-1-15’ text to inform the dashboard of a data point for Date of Birth for the current child (new data or update existing data). This mode is crucial for providing users with a robust tool that delivers accurate, timely information, empowering them to make well-informed decisions based on real-time data and trends.

Fig. 1 A sample of user interaction with the dashboard using simple chat commands

Fig. 2 A sample of user interaction with the dashboard to give a new data point or update existing data

2) Data analysis and reporting assesses various factors contributing to stunting and forecasts future trends. This mode utilizes simple machine learning algorithms to analyze historical data and predict the risk of stunting. Users can explore different scenarios and interventions, understanding their potential impact before implementation. An example is shown by Fig. 3. In the screen captured picture, a user sends ‘tgl 2024-05-15’ text to inform the dashboard of a data point for Date of Birth for the current child and predict the current child status. From status, data analysis shows that ‘umur’ changes from ‘0.68 tahun' to ‘0.35 tahun’. Also ‘status’ changed from ‘berat kurang’ to ‘normal’. This mode provides a broad evaluation of the situation and introduces new insights, enabling users to anticipate challenges and plan effectively.

3) Intervention management uses a sophisticated dashboard to visualize all pertinent information in an organized manner. The granularity of the data and information is dynamically adjusted based on the users' requirements. Some of the data within the dashboard is editable, and any dependent data would automatically be updated to reflect these changes. For example, ‘max’ or ‘min’ in ‘BERAT’, if changed, will affect ‘SKOR’. The dashboard is also enhanced with animations to facilitate better comprehension. For example, animation is based on time daily. This is good to show progress. Figure 4 illustrates a sample dashboard implemented using Google Looker Studio. The data sourced from the chat interface, as shown in previous figures, is seamlessly integrated into the backend and serves as the primary data source for the visualization tool. By integrating these primary modes, the dashboard serves as a comprehensive tool for addressing stunting. It combines real-time data access, predictive analytics, and detailed intervention management to support health professionals, policymakers, and community workers in efforts to eradicate stunting. The system features a user-friendly and intuitive interface, enabling users to navigate and use its features easily to make a significant impact on stunting rates. The system also consistently achieves high uptime, demonstrating the robustness of the backend infrastructure.

Fig. 3 A sample of user interaction with the dashboard to simulate data analysis

The development of an integrated information system dashboard for stunting eradication is intended to include features such as an interactive chat. The interactive chat mode is similar to existing deep learning with transformer architecture [7]–[9]. Based on large language model (LLM) applications, such as ChatGPT, Claude, Gemini, and others [10], [11] , users can engage in conversation mode. The dashboard can receive input or instructions to be written to the database table and provide responses accordingly. The dashboard, supported by an LLM backend, is designed to understand users' queries.

Fig. 4 is the architecture diagram of the supporting system for the integrated information system dashboard. Clients could be smartphones, laptops, or desktops. All connected to a web server that controls all traffic [12]. Requests to and responses from a large language model are conducted by this web server. LLM processes each request and responds accordingly. All-important data is stored in the database as memory and history for future use.

Fig. 5 is the flowchart for natural language processing for user requests. User instructions are checked and interpreted by the LLM to generate a sequence of actions for the computer to perform to fulfill the user's needs. If the LLM's result is OK, the web server will perform some formatting before sending it back to the user. Fig. 6 is an example of a screen capture of a laptop or desktop version powered by Power BI data visualization [12], [13]. This version is intended especially for officers who frequently interact with this dashboard.

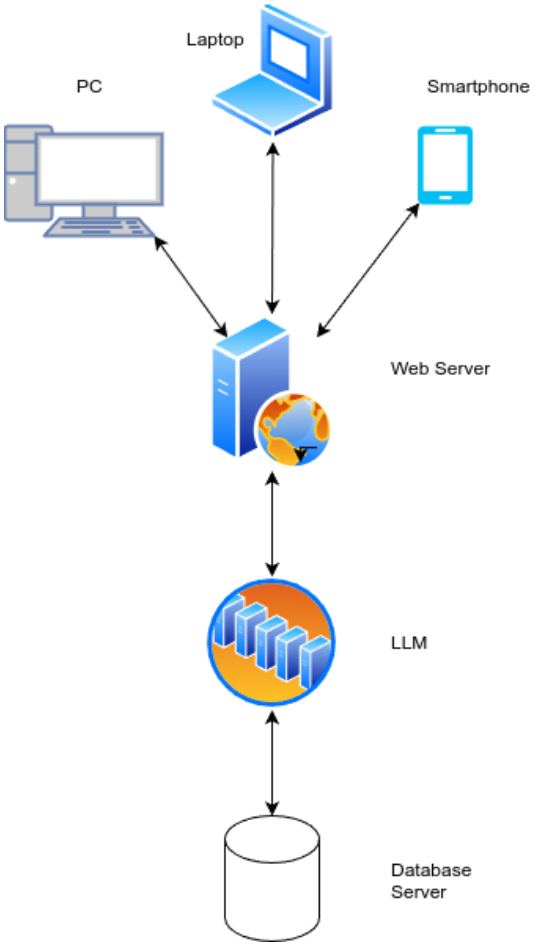

Fig. 4 System architecture diagram

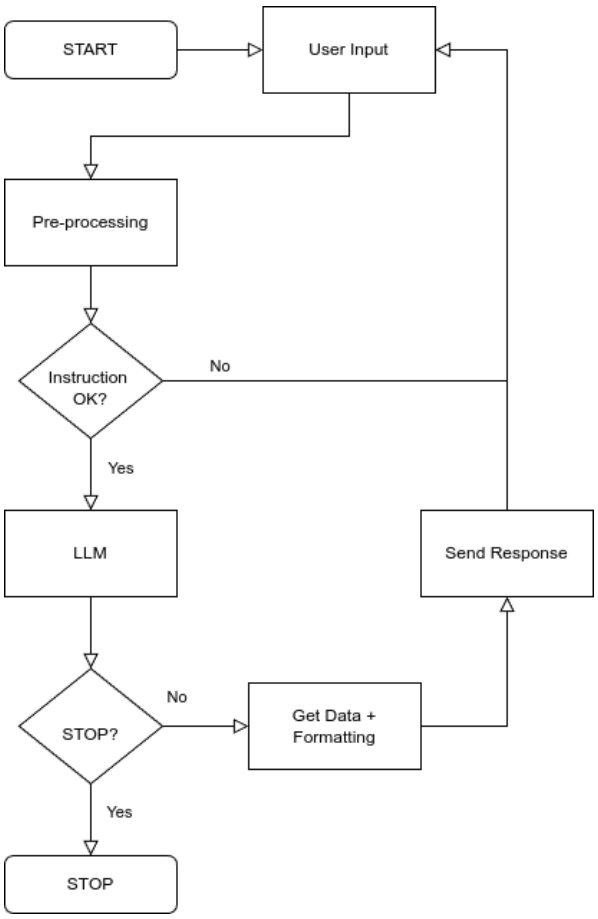

Fig. 5 NLP for user instruction flowchart

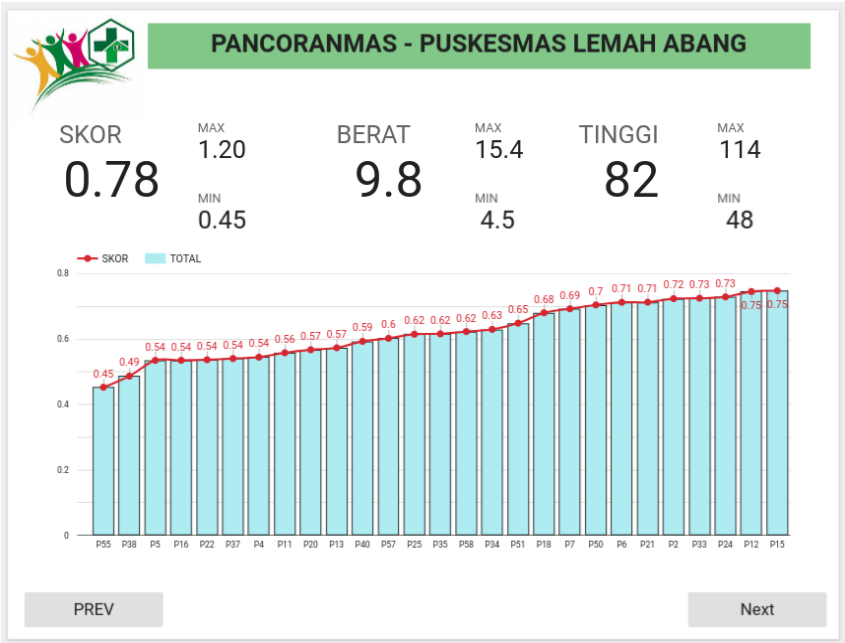

Fig. 6 A sample of user interaction with the dashboard to give a new data point or update existing data

IV. CONCLUSIONS

The developed information dashboard prototype for stunting eradication was assessed and determined to be capable and suitable for implementation within public health systems. The dashboard significantly enhances user comprehension through the strategic utilization of visualization techniques. It was designed to process and display integrated data from diverse sources, including health records, nutritional surveys, and socioeconomic data. The implementation utilized Google Looker Studio for visual representation, incorporating animation to further enhance user understanding. Real-time data updates were integrated into backend databases, ensuring the provision of current, unified information. Evaluation results confirm that the dashboard effectively supports monitoring and evaluation of stunting in Kecamatan Cikarang Timur. Feedback received will be utilized for subsequent adjustments and alignments.

ACKNOWLEDGEMENT

We would like to express our deepest gratitude to Lembaga Riset dan Pengabdian Masyarakat (LRPM) Universitas President for their financial support, which made this research possible.

REFERENCES

[1] Manjilala and A. Ipa, "Visualisasi data E-PPGBM menggunakan Google Data Studio," *Media Gizi Pangan*, vol. 31, no. 2, pp. 240–245, 2024.

[2] H. Hizriansyah, G. Y. Sanjaya, S. Hariyanto, and D. Panggarjito, "Perancangan model dashboard untuk pelaporan dan visualisasi data kesehatan sebagai sistem monitoring di Dinas Kesehatan Gunungkidul," *J. Sist. Inf. Kesehat. Masy.*, vol. 8, no. 1, pp. 1–9, Apr. 2023.

[3] N. Kurniawan, S. Mulyono, P. Fitriyani, and E. P. Yulianti, "Empowering cadres: The impact of KEPITING, a web-based application on stunting knowledge and attitudes," *J. Ners*, vol. 20, no. 1, pp. 79–90, Feb. 2025, doi: 10.20473/jn.v20i1.65890.

[4] N. D. Arrachman and others, "Toddler nutrition status monitoring dashboard as a support for stunting reduction acceleration program in Temanggung Regency," *Int. J. Heal. Lit. Sci.*, vol. 2, no. 1, Jun. 2024, doi: 10.60074/ihelis.v2i1.40.

[5] N. M. Daud, N. A. Bakar, and H. M. Rusli, "Implementing rapid application development (RAD) methodology in developing practical training application systems," in *Proc. International Symposium on Information Technology*, Jun. 2010, pp. 1664–1667.

[6] I. Maramba, A. Chatterjee, and C. Newman, "Methods of usability testing in the development of eHealth applications: A scoping review," *Int. J. Med. Inform.*, vol. 126, pp. 95–104, Jun. 2019, doi: 10.1016/j.ijmedinf.2019.03.018.

[7] K. Sharifani and M. Amini, "Machine learning and deep learning: A review of methods and applications," *World Inf. Technol. Eng. J.*, vol. 10, no. 7, pp. 3897–3904, 2023.

[8] A. Mohammed and R. Kora, "A comprehensive review on ensemble deep learning: Opportunities and challenges," *J. King Saud Univ. -- Comput. Inf. Sci.*, vol. 35, no. 2, pp. 757–774, Feb. 2023.

[9] S. Singh and A. Mahmood, "The NLP cookbook: Modern recipes for transformer-based deep learning architectures," *IEEE Access*, vol. 9, pp. 68675–68702, May 2021, doi: 10.1109/ACCESS.2021.3077828.

[10] E. Kasneci *et al.*, "ChatGPT for good? On opportunities and challenges of large language models for education," *Learn. Individ. Differ.*, vol. 103, p. 102274, Apr. 2023, doi: 10.1016/j.lindif.2023.102274.

[11] H. Naveed *et al.*, "A comprehensive overview of large language models," *ACM Trans. Intell. Syst. Technol.*, vol. 16, no. 5, pp. 1–72, Aug. 2025, doi: 10.1145/3664910.

[12] W. S. Tjong, "Aplikasi mobile untuk menekan biaya penjualan produk pertanian lokal," *J. Nusant. Apl. Manaj. Bisnis*, vol. 8, no. 1, pp. 78–89, Apr. 2023, doi: 10.29407/nusamba.v8i1.18725.

[13] H. Zamil, "Business intelligence systems in finance and accounting: A review of real-time dashboarding using Power BI & Tableau," *Am. J. Sch. Res. Innov.*, Jan. 2024.

Tjong Wan Sen, completed his doctoral programme at Bandung Institute of Technology in 2009. Currently, he is a permanent lecturer at the Master of Informatics Engineering Programme at the Faculty of Computer Science,

President University. His research and teaching focus on the development of artificial intelligence models for voice, image, and natural language. Also pursuing its realisation into applications, both for mobile and desktop devices.

Yosi Yonata. received a Bachelor of Engineering degree from Electrical Engineering, Bandung Institute of Technology (ITB) in 2000 and a Master of Engineering degree also from Electrical Engineering ITB in the field of Information Technology in 2002. Currently active as a permanent lecturer at the ITHB Information Systems Department.