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ASEAN Countries' Life and Death Expectancy Visualization Dashboard

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ABSTRACT

Death is the complete cessation of life processes that every living thing experiences at some point. It is influenced by various factors, including biological, behavioral, and societal determinants. Big data and data visualization are essential tools for understanding complex datasets and making informed decisions. This study focuses on life and death expectancy in ASEAN countries, aiming to address increasing rates of heart diseases, cancer, accidents, and infectious diseases by developing an interactive dashboard using Power BI. Despite available data, there is a lack of user-friendly dashboards that inform the public about causes of death, contributing to a lack of awareness and preventive measures. The objective is to identify trends and patterns in life and death expectancy, design and develop a dashboard, and evaluate its usability. The research scope includes collecting data from official sources like the Department of Statistics Malaysia and Kaggle and classifying the causes of death into meaningful categories. The significance of this study lies in providing accessible information to the public, raising awareness about health issues, and aiding individuals and governments in making informed health decisions. By highlighting health disparities and informing public health policies, the dashboard aims to improve healthcare systems and overall quality of life in ASEAN countries. This research follows the Waterfall Model, including planning, design, development, implementation, and evaluation phases. The process involves extracting, loading, and transforming data through Apache Hive. Microsoft Power BI is used to visualize the data extracted from the warehouse. The dashboard was evaluated by 40 respondents to validate its functionality, usability, and overall performance. Positive feedback highlights its potential as a valuable tool for public health in ASEAN countries.

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1. INTRODUCTION

Big data encompasses extensive and complex datasets that challenge traditional data processing tools (Thudumu et al., 2020). Data visualization translates these datasets into graphical formats, revealing hidden patterns, trends, and insights that facilitate informed decision-making and enhance public understanding (Gandhi & Pruthi, 2020). This research employs Microsoft Power BI to develop an interactive dashboard aimed at visualizing life and death expectancy across ASEAN countries, addressing the lack of accessible and user-friendly health information tools.

In ASEAN countries, prevalent causes of death include heart diseases, cancer, accidents, and infectious diseases (Nguyen & Trevisan, 2020). Despite the availability of extensive data, there is a significant gap in user-friendly dashboards that effectively communicate this information. Limited access to such tools can hinder public awareness and informed decision-making regarding health risks. Disparities in healthcare access exacerbate these issues, leading to inadequate health information for underserved populations and potentially poorer health outcomes. This study aims to bridge this gap by creating a dashboard that provides clear, accessible information on life expectancy and the causes of death.

The objectives of this research are interconnected and aim to address the lack of accessible health information in ASEAN countries. First (1), to analyze trends and patterns in life and death expectancy across the region, forming the basis for the second objective (2), which is to design and develop a user-friendly dashboard to visualize this data. Lastly (3), the study evaluates the dashboard's usability through a user acceptance test to ensure its effectiveness in presenting data clearly and usefully. The project involves gathering data on mortality causes from sources like the Department of Statistics Malaysia (DOSM) and Kaggle and developing an interactive dashboard to enhance public health awareness. This research is significant in empowering individuals to make informed health decisions, supporting targeted public health interventions, and aiding policymakers and researchers in improving healthcare outcomes. By addressing the existing information gap, the dashboard will help reduce health disparities and promote better health practices in ASEAN countries.

2. LITERATURE

This reviews the literature relevant to the research study, drawing on previous work and related articles. It covers four main areas: life expectancy, causes of death, big data, and related studies. The life expectancy section examines factors affecting longevity and average ages in ASEAN countries. The causes of death section identify four major health concerns in the region: diabetes mellitus, road accidents, hypertensive diseases, and liver cancer. The big data section focuses on data visualization, exploring its application across various domains, categories, and tools. All claims are substantiated by prior research.

2.1 Life Expectancy

The Life Expectancy and Deaths Overview (2023) defines life expectancy as a statistical measure that expresses the average number of years a group of people within a particular population or demographic group should expect to live, if current rates of mortality and health conditions persist throughout their lives. Life expectancy is influenced by a range of factors, including genetics, lifestyle choices, access to healthcare, socioeconomic conditions, and public health measures.

2.2 Cause of death

Numerous factors such as individual health conditions, lifestyle choices, environmental factors, access to healthcare, and broader societal determinants influence the diverse causes of death. The leading causes

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of death in ASEAN countries are diabetes mellitus, accidents, hypertensive diseases, and liver cancer. Diabetes mellitus is a chronic disorder characterized by elevated blood glucose levels due to insufficient insulin production, increasingly prevalent in ASEAN countries due to rapid industrialization and genetic predisposition (WHO, 2019). Road accidents are another major cause, with approximately 1.35 million fatalities annually, driven by factors like infrastructure issues and risky human behaviors (Ahmed et al., 2023). Hypertensive diseases, linked to consistently high blood pressure, can also lead to severe health complications and mortality if unmanaged (Zeng et al., 2021). Liver cancer, particularly hepatocellular carcinoma (HCC), is another significant cause of death, originating in the liver cells and accounting for most liver cancer cases, with other types including cholangiocarcinoma and angiosarcoma (Chidambaranathan-Reghupaty et al., 2021). Understanding these causes is crucial for public health strategies and medical research.

2.3 Related Work

There are various types of dashboards out there. This research has selected five cases that related to dashboard developments involving system science and engineering on Covid-19, cancer, malaria, diabetes as well as population as clarified in the next sub sections.

2.3.1 Systems Science and Engineering COVID-19 Dashboard

The Systems Science and Engineering COVID-19 Dashboard (Fig. 1), developed by Dong et al. (2022), utilizes ArcGIS for data visualization and a GitHub repository to provide access to the underlying data. This dashboard offers a snapshot of cumulative COVID-19 data, displaying information such as confirmed cases, deaths, and other statistics at various geographic levels. The data is collected through custom web and data scraping techniques as well as manual collection. It provides various visualizations like line charts to present trends over time. This dashboard primarily relies on fusion logic and ArcGIS for its approach method, enabling users to interact with and explore the data comprehensively.

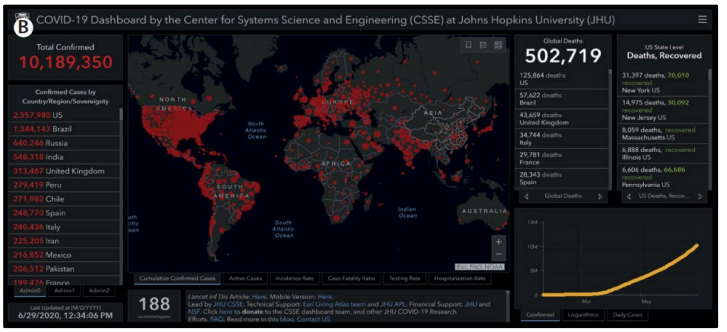

Fig. 1. Systems Science and Engineering COVID-19 Dashboard

2.3.2 CancerMAS Dashboard

Hamidi et al. (2020) developed the CancerMAS Dashboard, focusing on visualizing cancer data in Malaysia. The dashboard is built using Python, with the Dash library employed for creating a low-fidelity wireframe of the user interface. The data is cleaned and visualized using Python, with different tabs allowing users to filter and explore data based on gender, ethnicity, and cancer type. It features scatter plots and bar charts as primary visualization techniques. The CancerMAS Dashboard adopts a machine learning

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approach to handle and present data effectively, allowing users to delve into subgroup analyses and regional cancer incidences.

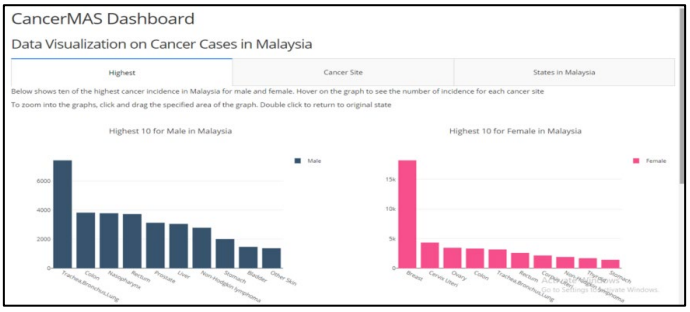

Fig. 2. CancerMAS Dashboard

2.3.3 Visualization of Epidemiological Data

Yadav and Sharma (2022) designed the NIMR-MDB (National Institute of Malaria Research-Malaria Dashboard) using R, particularly focusing on the Shiny and ggplot2 packages. This dashboard provides visual analysis of malaria data across Indian states and districts from 2010 to 2018. The approach leverages the capabilities of R for statistical analysis, data manipulation, and visualization. The dashboard allows users to customize geographic maps with various color schemes and classification techniques, facilitating the exploration of malaria data through geospatial visualizations. Fig. 3 illustrates GIS mapping of malaria parameters at the state or district level, specifically tailored for researching the national malaria situation.

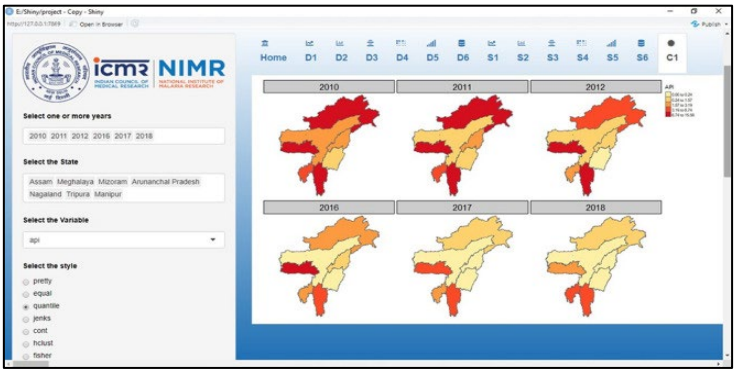

Fig. 3. GIS mapping of malaria parameters at state or disrict / level.

2.3.4 Exploration and Analysis of Diabetes

Rahman et al. (2021) created an interactive dashboard, DiaVis, to explore diabetes data in Bangladesh. Built using a free text search and multiple coordinated views (MCVs), this dashboard enables users to interact with the dataset using various inputs like keyboards and mice. The visualizations include bar charts and geospatial maps that highlight the distribution of diabetes cases across different regions. The dashboard allows users to hover over regions to see detailed statistics, enhancing the understanding of diabetes trends

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across the country. Fig. 4 exhibits how the system helps the user interpret the diabetes dataset using a dashboard.

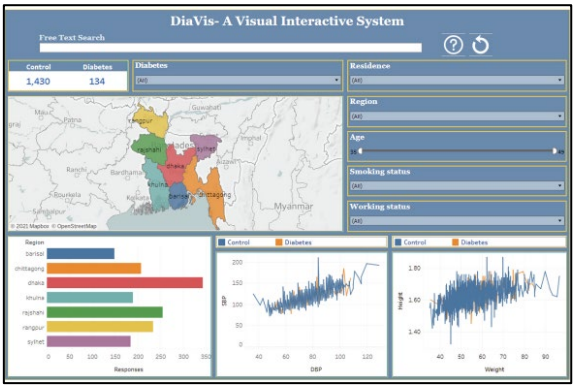

Fig. 4. DiaVis- A Visual Interactive System

2.3.5 National Population-Based Time-Series Cross-Sectional Study

Tai et al. (2023) developed a dashboard using Tableau to visualize population-based time-series data. The dashboard features a bump chart, which can be filtered by demographic characteristics such as sex and age. Each cause of death (COD) is represented by a specific color in the bump chart, with detailed information available via tooltips when hovering over data points. The approach method relies on Tableau, and the visualization technique focuses on bump charts, making it easy to see trends and changes in leading causes of death over time. Fig. 5 illustrates the ranking of the 10 leading causes of death for both sexes of all ages in the United States.

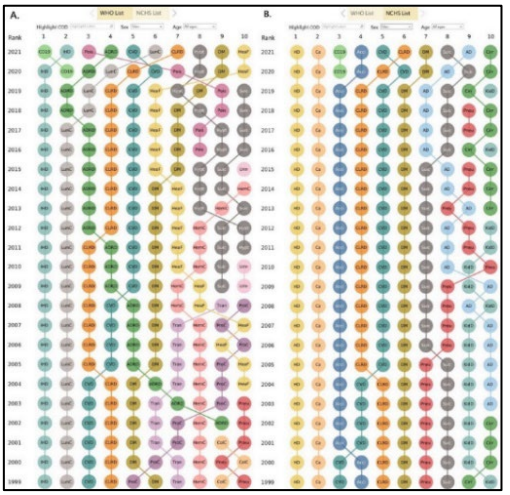

Fig. 5. Ranking of the 10 leading causes of death in the United States

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3. METHODOLOGY

The Waterfall model is employed in this study, consisting of five key phases: Planning, Design, Development, Testing, and Evaluation. This model was chosen over other software development methodologies, such as Agile or Spiral, due to its structured and sequential approach. The Waterfall model is ideal for projects where requirements are well-defined from the outset, allowing each phase to be fully completed before progressing to the next. In this study, the clear objectives and steps from data collection to final visualization made the Waterfall model a more suitable choice. This approach minimizes the need for revisiting earlier stages, facilitating a systematic progression through each phase, and ultimately ensuring the successful achievement of the research objectives. Fig. 6 illustrates how the Waterfall model was adapted in the research.

3.1 Planning

Planning is crucial for achieving the first objective, starting with analyzing and identifying the problem of limited access to health information in ASEAN countries. The phase defined the objective, scope, and significance, including creating a dashboard to improve public awareness and decision-making (Fig. 6). Data was sourced from Kaggle and the Department of Statistics Malaysia, and a project timeline was developed using a Gantt chart in Microsoft Excel. This phase successfully met Objective 1.

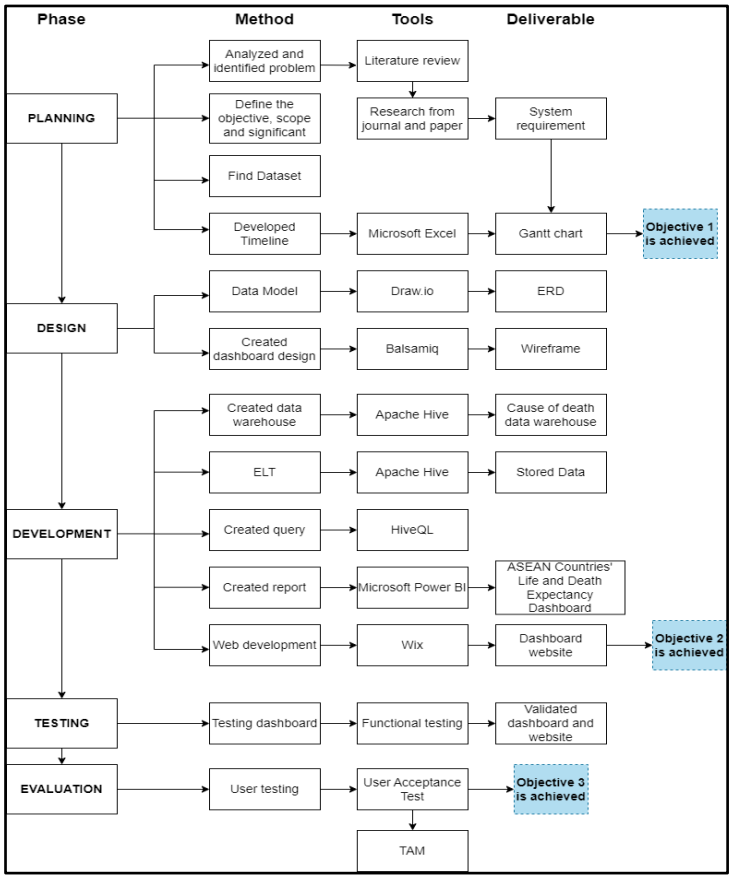

Fig. 6. Overview of the methodology

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3.2 Design

Phase 2, starting after requirements gathering, focuses on ideation. It involves developing a data model using an Entity-Relationship Diagram (ERD) with tools like Draw.io, chosen for its intuitive interface and collaborative features, to visualize database structure and relationships. The phase also includes designing the dashboard, translating objectives into a user-friendly interface through a wireframe created with Balsamiq, which allows for rapid prototyping and adjustments based on feedback.

3.3 Development

The development phase of the ASEAN Countries Life and Death Expectancy Visualization Dashboard involves several detailed steps that fulfill the objective of designing and developing a comprehensive dashboard for life and death expectancy trends in ASEAN countries. The process begins with data collection, where datasets on causes of death, accident statistics, and health-related information were sourced from Kaggle and the Department of Statistics Malaysia (DOSM). These datasets, provided in CSV format, were then imported into the Hive data warehouse. Hive was chosen for its capacity to efficiently manage large-scale datasets and its integration capabilities with big data tools, allowing for effective data organization into relevant tables for easy querying.

Following the data loading, a thorough cleaning and transformation process took place. This involved renaming columns for consistency and clarity, removing unnecessary data such as irrelevant regions and unused columns, and filtering and aggregating the datasets to ensure they were optimized for analysis. Once the data was prepared, it was imported into Power BI for visualization. Power BI was selected for its powerful analytical capabilities, extensive visualization options, and user-friendly interface, which facilitates the creation of interactive dashboards that can be easily shared and accessed by end-users.

In Power BI, the dashboard was designed to be user-friendly and interactive, featuring various key pages such as the homepage, diabetes mellitus statistics, road accidents, liver cancer cases, and hypertension data. Different types of visualizations were employed to present the data effectively, including pie charts to show proportions, line graphs to illustrate trends over time, and maps to depict data geographically. Interactive features like slicers and filters were incorporated, allowing users to customize their analysis by selecting specific countries, years, or causes of death. This step-by-step process ensures that the website (Fig. 7) and the dashboard (Fig. 8) are well-designed and developed, meeting the study's objective and enabling insightful analysis of life and death expectancy trends in ASEAN countries.

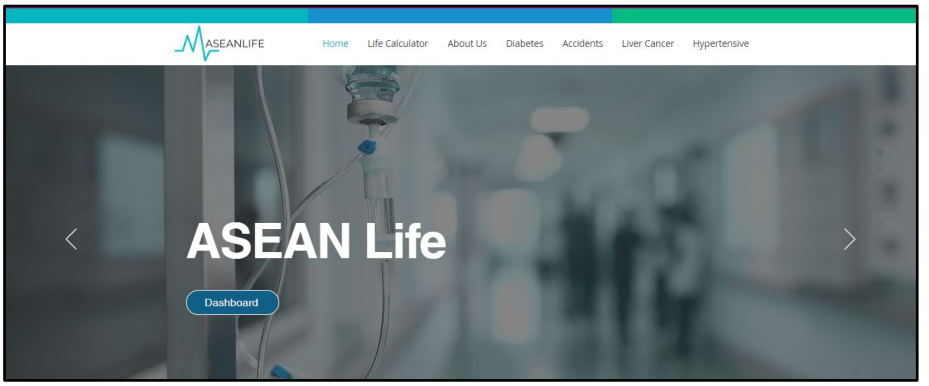

Fig. 7. The website

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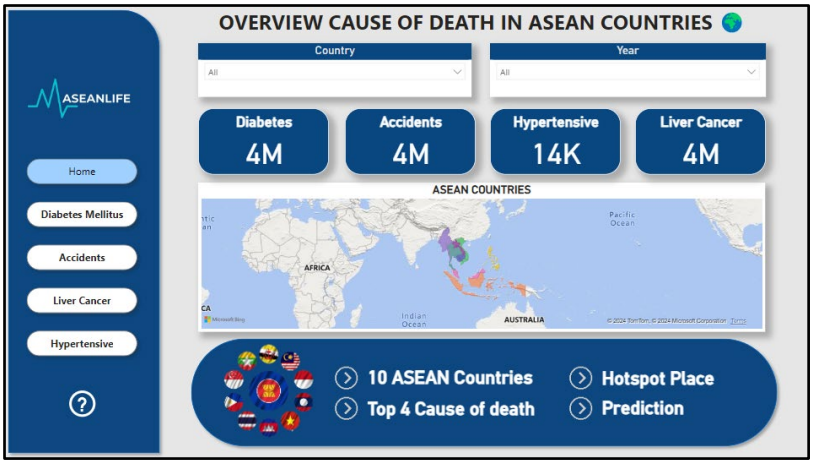

Fig. 8. ASEAN countries' life and death expectancy visualization dashboard

3.4 Testing

The Testing Phase is essential for verifying that the system functions correctly, meets quality standards, and is free of critical errors. This phase includes a thorough evaluation of functionality, performance, security, and usability. Functional testing focused on ensuring that the dashboard met all specified requirements and operated seamlessly. The final step before publishing involved listing and verifying the system's requirements. This process confirmed that the dashboard provided a reliable and exceptional user experience.

3.5 Evaluation

User Acceptance Testing (UAT) is crucial in the evaluation phase, involving end-users to ensure the software meets their expectations and requirements. This study utilized the Technology Acceptance Model (TAM) as it effectively measures user acceptance by assessing four key dimensions: perceived usefulness, perceived ease of use, attitude and intention to use. TAM is particularly relevant in this context as it provides a theoretical framework that links user attitudes towards technology to their actual usage behavior. By employing TAM, the study can gain insights into how well the ASEAN Countries' Life and Death Expectancy Visualization Dashboard aligns with user needs, enhancing the understanding of factors influencing user acceptance and satisfaction. Additionally, the model's focus on user perceptions allows for identifying areas of improvement, ensuring that the software is not only functional but also intuitive and beneficial for its intended audience. Forty respondents from various age groups participated, validating that the software aligned with user needs and business processes. The objective was achieved by the end of this phase.

4. RESULTS AND DISCUSSIONS

In the final phase, the prototype system was evaluated using the Technology Acceptance Model (TAM), with 40 respondents aged 18 and above, including students, employed, unemployed, retired individuals, and public and health government representatives. The survey, which covered public background, user experience in four areas (Ease of Use, Usefulness, Attitude, and Intention to Use), and a section for

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comments, showed high satisfaction with the system by using a 5-point Likert scale. Respondents provided positive feedback, with suggestions for future improvements to be considered in the system's next version.

The Perceived Ease of Use (PEU) measures how easy and intuitive the ASEAN Countries' Life and Death Expectancy Visualization Dashboard is for adults to navigate and understand. It assesses aspects like ease of exploration, clarity of interactions, mental effort required, and the ability of users to use the dashboard independently where this dimension can get 4.525 for the mean value.

The second dimension, Perceived Usefulness (PU) is a degree to which the ASEAN Countries' Life and Death Expectancy Visualization Dashboard is considered useful. It focuses on whether the dashboard enhances knowledge about causes of death and life expectancy, improves the effectiveness of gathering related information, is useful in daily life, and provides all necessary information without needing other sources. It also evaluates the dashboard's role in raising public health awareness that resulting 4.567 mean value from the respondents.

Next, the third dimension of TAM evaluation model is Attitude (ATT). This dimension measures how much users enjoy and appreciate using the ASEAN Countries' Life and Death Expectancy Visualization Dashboard. The questionnaire results indicate that the average score for this dimension is 4.621 showing that the respondents have high mean value for overall satisfaction with the dashboard, including their positive feelings toward finding information about causes of death, using the life calculator, raising public awareness, and interacting with the website.

This dimension is the final aspect of the TAM evaluation model. Intention to Use (BI) measures how likely users are to adopt the ASEAN Countries' Life and Death Expectancy Visualization Dashboard in the future. It assesses users' plans to use the dashboard to spread public awareness, their preference for it as a resource for information on health issues, and their willingness to support it if they encounter it elsewhere. The mean score for this dimension is determined to be 4.425 showing a strong agreement with the thought that they intended to utilize the dashboard beneficially.

Feedback on the ASEAN Countries' Life and Death Expectancy Visualization Dashboard highlights its clarity, ease of use, and effectiveness. Users praised its functionality but suggested expanding content, especially to include mental health, and improving layout and navigation. Overall, the feedback strongly supports the dashboard while pointing to areas for future enhancement. In a TAM survey, the dashboard received high ratings indicating it is user-friendly, beneficial, and likely to be adopted. Fig. 9 illustrates the average comparison for every dimension.

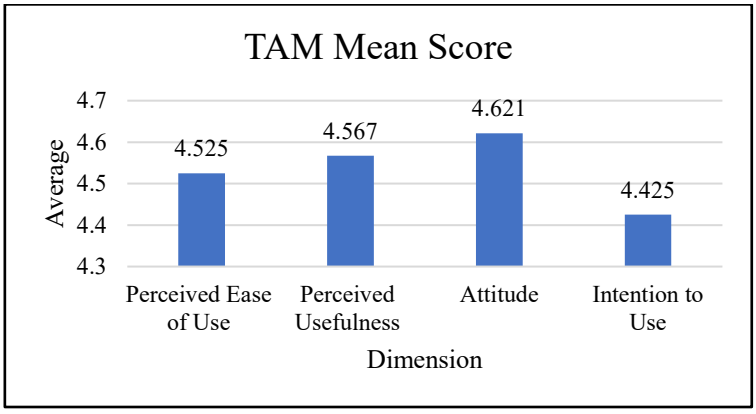

Fig. 9. Average comparison for every dimension

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5. CONCLUSION AND RECOMMENDATIONS

In summary, this study successfully developed the ASEAN Countries' Life and Death Expectancy Visualization Dashboard, achieving its three primary objectives: identifying trends and patterns in life and death expectancy, designing and developing the dashboard, and evaluating its usability through user acceptance testing. The dashboard, utilizing tools such as Balsamiq, Microsoft Power BI, and Apache Hive, addresses the critical issue of limited access to health information in ASEAN countries, providing valuable insights for the public, healthcare providers, and policymakers. Recommendations for future enhancements include expanding the range of diseases covered to provide broader health information, implementing intuitive icon-based navigation to improve user experience, maintaining a visually appealing design to engage users, and incorporating personalized input features to enhance the relevance and accuracy of life expectancy calculations for individual users.

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7. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

8. AUTHORS' CONTRIBUTIONS

Nurul Shazwani Azri: Conceptualization, methodology, formal analysis, and investigation; Norfiza Ibrahim: Supervision, data analysis, validation, review, and editing; Azmi Abu Seman: Software development, application design, and system implementation; Nadia Abdul Wahab: Data curation, resources, and participant coordination; Aznoora Osman: Visualization and project administration.

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