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# Community-Based Welfare Services System: Utilizing Machine Learning with Data Visualization to Improve Access and Service Delivery

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***Abstract*—** Community, from the global perspective, serves as an essential service for the welfare of every person and nurtures their well-being in every nation. This research was categorically the mixed-method approach, known as qualitative descriptive and quantitative experimental or developmental research design. In this study, a purposive sampling method was utilized to select 300 respondents who met the established criteria set by the researcher. Purposive sampling ensured that individuals selected for the study possessed specific characteristics or experiences relevant to the research objectives. The study designed and implemented a web-based application for a community-based welfare services system, integrating machine learning algorithms with data visualization techniques to enhance access and efficiency in service delivery. Likewise, the study aimed to gather insights from diverse perspectives within the community, enriching the depth and breadth of the research findings.

Hence, to effectively address the social welfare needs and overcome barriers faced by senior citizens and single parents in Barangay Canlubang, Calamba City, Laguna, Specifically, it sought to answer the following research sub-questions such: How can technology be leveraged to enhance the access and quality of immediate care for senior citizens? How can data visualization and machine learning techniques be harnessed to optimize the efficiency, accessibility, and efficacy of the community welfare services system? What is the level of acceptability perceived by respondents in evaluating the community-based welfare services system using the ISO/IEC 25010 standard? As the results implied, the test case scenario showed that the system passed all the tests performed by the respondents and the general mean weighted average of 4.04 with the verbal interpretation of "Acceptable" to the group of respondents. Furthermore, the assessment summary highlights the system's strong performance across various dimensions, as perceived by different respondent groups. It demonstrates the system's ability to effectively support diverse user needs, ensuring functionality, efficiency, usability, reliability, security, maintainability, and portability in line with ISO/IEC 25010 standards.

***Keywords*—** Welfare Services, Service System, Data Visualization, Predictive Analytics

## I. INTRODUCTION

Global community welfare services serve as a vital framework for nurturing unity and enhancing well-being among nations. They play pivotal roles in addressing the interconnected arrays of challenges that transcend individual borders, ranging from poverty alleviation and healthcare provision to education access and environmental sustainability (Hohman et al., 2020). In facilitating collaborative efforts and fostering mutual understanding, these services promote shared responsibility and solidarity across diverse communities worldwide. Their overarching objective is to cultivate a harmonious global ecosystem where all individuals have equitable access to resources and opportunities, causing the fostering of inclusive growth and a sense of collective ownership in creating a better world for present and future generations (Burkholder & Krauskopf, 2022).

In developed nations, there is a pervasive recognition of the importance of robust social safety nets, accessible healthcare, and quality education, often viewed as foundational rights essential for individual well-being and societal progress (Chaudhry, 2021). These countries prioritize establishing and maintaining comprehensive welfare systems focused on providing citizens with feelings of security and opportunities (Alsultanny, 2022b). Conversely, in many developing nations, the focus often lies on urgent needs such as poverty alleviation and primary healthcare provision as these countries grapple with significant socioeconomic disparities and limited resources (Kamath & Liu, 2021a).

On an international scale, there is a growing consensus on the imperative of global collaboration to address pressing challenges effectively. Issues such as climate change, poverty, and inequality are increasingly recognized as interconnected and requiring collective action (Eigen & Sadovnik, 2021). There is an emphasis on promoting sustainable development practices and ensuring equitable distribution of resources to foster

inclusive growth and address systemic injustices (Kube et al., 2023).

Within the Philippine context, the Social Welfare Act of 1968 stands as a testament to the government's commitment to providing comprehensive social welfare services to its citizens (Alsultanny, 2022a). By enshrining the principles of social justice, the legislation underscores the state's responsibility to uplift marginalized and vulnerable sectors of society. Through various programs and initiatives, the aim is to improve the living conditions of disadvantaged Filipinos, including those affected by poverty, disability, illness, or natural disasters (Hohman et al., 2019). The legislation acknowledges the unique challenges cultural minorities experience, recognizing the importance of cultural sensitivity and inclusion in social welfare efforts (Yu & Wu, 2023). By facilitating their integration into mainstream society, the government seeks to promote social cohesion and ensure that every community pursues national development goals.

The Social Welfare Act serves as the Philippine government's cornerstone in efforts about multifaceted social issues while upholding the dignity and rights of all its citizens (Repetto, 2023). It reflects a commitment to fostering a more just and equitable society where everyone has equal opportunity to thrive and contribute to the nation's progress (Saliu et al., 2020).

Barangay Canlubang is the largest and most densely populated barangay within Calamba City, Laguna, boasting a demographic landscape predominantly composed of individuals aged between 15 and 64 (Vijithasena & Herath, 2022). While the gender distribution slightly favours females, the socioeconomic fabric of the community reveals a spectrum of educational attainment levels among households, indicative of opportunities for further development (Kube et al., 2022). The service industry attends as its primary employer, reflecting the barangay's role as a bustling economic hub (Chatzimparmpas et al., 2020). Despite the presence of challenges such as poverty, unemployment, and infrastructural deficiencies, Barangay Canlubang possesses inherent growth potential, attributed to its strategic proximity to the city's economic nucleus and abundant natural resources, including the expansive Laguna de Bay (Ghanta et al., 2018).

The socioeconomic milieu of Barangay Canlubang, characterized by its diversity, encompasses a spectrum of income levels ranging from low-income households to affluent families (Ngo et al., 2022). The industrial sector also serves as a significant source of employment, with a considerable portion of the population engaged in various roles within the surrounding industrial parks (Sharma & Sharma, 2019). Moreover, there is a notable emergence of small-scale enterprises and service providers, indicative of a burgeoning entrepreneurial spirit within the community.

Despite notable strides in economic development, Barangay Canlubang grapples with challenges related to adequate provisions of social welfare services to its residents (Gur Ali, 2022). The social welfare system is under strain due to the barangay's burgeoning population and finite resources. In light of these observations, the researcher purposely required collaboration with the local government, particularly the barangay authorities, to address these pressing concerns (Tageldin & Venter, 2023). The overarching goal is to facilitate enhanced access to information, optimize service delivery mechanisms, and cater to the diverse essential needs of senior citizens of the barangay, thereby fostering a more inclusive and supportive community environment (Kumar & Sharma, 2021).

## II. METHODOLOGY

### *Samples*

Non-probability sampling is selected due to the specific characteristics of our study population and practical limitations inherent in the research process. This approach allows for selecting participants based on subjective judgment rather than random selection, which is particularly advantageous when targeting individuals with specialized knowledge and expertise in community welfare services and technology utilization. It is a none random technique that does not need underlying theories or a set number of participants (Etikan, 2016)

Within the framework of non-probability sampling, purposive sampling is employed to identify participants who meet predefined criteria relevant to our research objectives. This deliberate selection process ensures that participants possess the qualifications and perspectives to contribute meaningfully to the study. Criteria for participant selection may include involvement in community welfare services, expertise in information technology, direct engagement in decision-making processes, or representation from diverse demographics within the community.

Using purposive sampling, we aim to gather insights from individuals who can offer valuable perspectives on utilizing machine learning and data visualization to enhance access and service delivery within community welfare services. This targeted approach enhances the relevance and applicability of our research findings to

the specific context of our study, ensuring that we capture diverse viewpoints and experiences relevant to our research topic.

In this case, the researcher purposely used the senior citizens of Barangay Canlubang. They were chosen because they are the study's primary beneficiaries and direct participants. Also, the researcher identified the group of individuals who participated in the study as experts in information technology, such as IT experts, barangay health workers, and administrative officers.

***Algorithm Analysis***

The researcher discussed the algorithm analysis within Community-based Welfare Services, leveraging Machine Learning and Data Visualization for enhanced accessibility and service delivery

Another kind of ML algorithm, data tree is known to be a white-box type of algorithm. It thereby offers decision-making algorithms that are not as opaque as the black box algorithms like programming a neural network. This algorithm is much faster than neural network algorithm in the process of learning.

Data set size and the number of variables can be factors which determine the time of execution of decision trees. A decision tree is a model of this type that is contribution-free or non-parametric meaning that it doesn't depend on the probability distribution hypotheses. Decision trees successfully make use of high dimensional data and display clearly perceivable results too.

The researcher followed the standard steps in implementing the decision tree algorithm as follows:

The time complexity of decision trees is based upon the number of records and the number of attributes in the given data. Decisions trees is a non-parametric or distribution-free approach that makes no assumptions concerning the probability distribution a decision tree may deal with high-dimensional data with sensible accuracy.

The following steps take the researcher's time in implementing the standard decision tree algorithm.

Choose first the best attribute that can be taken to split up the records. By using the Attribute Selection Measures, this attribute will be a decision node following by the dataset is divided into subsets. Then, tree building may be started over. This will be handled using this process for each child recursively until one of the conditions will be matched:

All the tuples are assigned to the same attribute.

There is no more remaining attribute.

There is no more instances.

***Attribute Selection Measures***

Attribute selection measure is a heuristic for splitting on the one model that cuts data into multiple portions that are better than any. It is also known as splitting rules, which means it acts as a guideline to identify reference points on a node where it has to split. Data source is then paired with the feature through ASM in which it rank rest the feature. The most significant score attribute will be kept as a splitting attribute. And for split points in the case of continuous-valued attribute classifying the branches are also to be specified. The well-known specific measures of the selection measures are the Information Gain, Gain Ratio and Gini Index.

***Information Gain***

Measure the impurity of the input set. The datasets collected are referred to as randomness or impurity in a system and are subject to the proper selection of attributes. Diversity in information theory signifies the absolute accuracy of logically pure samples that are considered to represent a whole group of elements. Knowledge shifting can be a satisfactory you'll or an immeasurable loss. Information Gain, on the other hand, identifies the difference between the average values of post-split and pre-split feature set by predicating the data through attribute values. ID3 (Iterative Dichotomiser) algorithm, apart from entropy concept (information gain), can also take a few other factors like attribute significance and size of data into consideration.

$$\text{Info}(D) = -\sum_{i=1}^{m} pi \log_2 pi$$

Where Pi is the probability that an arbitrary tuple in D belongs to class Ci.

$$\text{Info}_A(D) = \sum_{j=1}^{V} \frac{|Dj|}{|D|} \text{ X } \text{Info}(D_j)$$

$$\text{Gain}(A) = \text{Info}(D) - \text{Info}_A(D)$$

Where:

- Info(D) is the average amount of information needed to identify the class label of a tuple in D.
- Dj/D acts as the weight of the jth partition.
- InfoA(D) is the expected information required to classify a tuple from D based on the partitioning by A.

The attribute A with the highest information gain, Gain(A), is the splitting attribute at node N().

***Gain Ratio***

Less than enough cognitive load might favor the neuron with several outputs in the brain. It says it prefers the discreteness, not the number of elements. For instance, a partition, let's say it's customer_ID with zero info (data) as this is pure partition. This implies more information gain and smaller sizes for each subset created.

ID3 being its predecessor, C4.5 is its second improved version which is based on the same principle of extra information gained known as gain ratio. Bias problem is tackled with gain ratio: noise in information gain is normalized with Split Info. The C4.5 java algorithm implementation by J48 is one of the computational tools integrated in the WEKA data mining tool.

$$SplitInfo_A(D) = -\sum_{j=1}^{v} \frac{|D_j|}{|D|} \times \log_2\left(\frac{|D_j|}{|D|}\right)$$

$$GainRatio(A) = \frac{Gain(A)}{SplitInfo_A(D)}$$

The attribute with the highest gain ratio is chosen as the splitting attribute.

*Gini Index*

Another decision tree algorithm, CART (Classification and Regression Tree), uses the Gini method to create split points.

$$\text{Gini(D)}=1-\sum_{i=1}^{m} \text{Pi}^2$$

Pi is the probability that a tuple in D belongs to class Ci. Gini Index is a very classifying of a split attributes which can do damage to both the values, while there is the greatest information gain obtained through the split. We can weight the aggregated pollution number for every alternative result. If a binary split on attribute A partitions data D into D1 and D2, the Gini index of D is:Assume that the binary chop on the attribute A divides D into:

$$\text{Gini}_A(D)=\frac{|D1|}{|D|}\text{Gini}(D_1)+\frac{|D2|}{|D|}\text{Gini}(D_2)$$

For a case of a discrete-valued attribute, the subset that yields the minimum gini index value when an attribute is selected as the best split goes to the chosen branch in turning. For the problematic area of the continuous-valued attributes, the strategy is to implement each pair of the closest adjacent values as a possible split point. And the smaller Gini index value is evident, the splitting value is selected.

$$\Delta Gini(A) = Gini(D) - Gini_A(D).$$

The attribute with the minimum Gini index is chosen as the splitting attribute.

***Visualizing Decision Tree for Illness and Medication with one-is-to-one ration***

With a one-to-one ratio of medication-illness data, this analysis proves that the test result was one hundred percent accurate because all illnesses have corresponding medicines, regardless of whether they are generic or branded. This proved that in any data illness.

***Applied Concept and Techniques***

The adequate approach to comprehensively understanding the nature of the complex environment within community welfare services can be through a blend of a mixed-methods approach such as the descriptive research which gives an overview of the phenomena observed and the developmental research which helps in developing or improving IT solutions in the course of development. There is the integration of measures suitable for collecting both quantitative and qualitative data through the employment of purposive sampling in collecting the perspective of various people within the community.

State that the senior citizens, health workers, administrative officers, the president of Canlubang Unified Senior Citizens Association , and IT experts rendered their voices. The study integrates a decision tree algorithm through attribute selection measures like the information gain and gini index to improve service delivery. The role of data collection tools such as internet research and interviews and questionnaires/surveys to collect the perspective of various people in the study. The project management employed the Agile methodology which spanned over the planning, requirements analysis, design, implementation, testing, evaluation and deployment phases. The IT system development included selecting the right tools and technologies and prioritizing user-centric design and utilizing the Lavarel framework and TensorFlow for advanced technologies in machine learning. Testing enabled a check on whether the system met the established standards, and deployment included

installing the system for use. Maintenance involved monitoring and updating based on the need arising. These methodologies provide a comprehensive approach to improving community welfare services offering a greater view of accessibility and service delivery to the identified target.

***Data Collection Instrument***

Using semi-structured face-to-face interviews emerges as a pivotal component for data collection. The researcher used Google Meet to interview the respondents and gather essential data.

The following techniques are used:

***Interview***

The researcher interviewed the president of the Canlubang Unified Senior Citizens Association. There was a set of questions used in the interview that the researcher implicitly asked with regard to how they handle the welfare and benefits of the senior citizens member of the organization and the usual problems they encountered. The researcher also asked the respondents, if given a welfare services system that can help them to systematize their office, what would be the necessary features that would included in the system.

| SCALE | RANGE | DESCRIPTIVE RATING |
|---|---|---|
| 5 | 4.21 – 5.00 | Acceptable |
| 4 | 3.41 – 4.20 | Slightly Acceptable |
| 3 | 2.61 – 3.40 | Undecided/ Neither |
| 2 | 1.81 – 2.60 | Slightly Unacceptable |
| 1 | 1.00 – 1.80 | Unacceptable |

The researcher also interviewed the administrative officer in the senior citizen's affairs office of Calamba City for the purpose of knowing if there is an existing welfare services system in their office for monitoring the senior citizens of the barangay canlubang and to know the current state of the welfare services in terms of daily operation.

The researcher also interviewed the barangay health workers of Barangay Canlubang and asked how they help the senior citizens. The respondents gave the researcher valuable information on how the system would be developed and tailored to the senior citizens' requirements.

The researcher interviewed the IT experts because they have specialized skills, particularly in software development.

***Internet Research***

The researcher obtained related information, literature, and studies from the ready and available information from the internet. The researcher used scholastical articles, e-journals, and e-books related to community-based welfare services on the internet, utilizing the decision tree model.

***Questionnaires/Surveys***

After the development of the system, the questionnaires or surveys were answered by the senior citizens, barangay health workers, administrative officers, presidents of the senior citizens association, and IT experts.

The researchers used the video shared via Google Meet and asked them to rate the system. The researcher also demonstrated the system face-to-face for the selected senior citizens, barangay health workers, and presidents and asked them to answer the questionnaire.

The data the researcher collected were analyzed and evaluated with the help of a statistician.

***Statistical Treatment***

The Likert Scale was utilized to determine the mean of the variables in terms of their level of acceptance. The mean of each indicative statement about the variables were computed and interpreted using the following rating.

***Project Design***

The Agile Methodology, chosen to manage the software development process for the proposed framework, encompasses a structured yet flexible approach to enhance project management efficiency and adaptability. It is structured around several key stages, each contributing to the iterative refinement and evolution of the software solution.

The initial phase within the Agile Methodology is Planning, where comprehensive project planning occurs. Project objectives, scope, and timelines are delineated during this stage, laying the groundwork for subsequent activities and ensuring alignment with stakeholder expectations.

Following Planning, the Requirements Analysis and Design phase unfolds. Here, a thorough examination of

stakeholders' needs and expectations occurs, and software requirements are elicited, analyzed, and documented. Design activities focus on conceptualizing the software architecture, interface design, and overall system layout.

Subsequently, the Implementation phase commences, wherein developers translate the design specifications into functioning software components. Agile emphasizes iterative development, allowing for continuous integration and incremental enhancements to the software solution.

Concurrent with Implementation is the Testing phase, where various testing methodologies are employed to ensure the quality and functionality of the software. This phase includes unit testing, integration testing, and acceptance testing, aimed at detecting and addressing defects while ensuring adherence to requirements.

The evaluation phase runs parallel with Implementation and testing. Continuous assessment and feedback gathering from stakeholders and end-users occur during this phase, facilitating the identification of potential improvements and refining features based on evolving user needs.

The Deployment phase marks the release of the software solution into production. This phase involves the software's installation, configuration, and rollout to end-users. Agile principles advocate for incremental deployment, allowing for early delivery of value and ongoing iterations based on user feedback.

***Planning***

During the planning phase, the researcher engaged with various key stakeholders to ensure a comprehensive understanding of the project requirements and identify essential system functionalities. This collaborative approach involved consultations with Barangay officials, city administrative officers, and the Canlubang Unified Senior Citizens Association president.

The researcher initiated discussions with Barangay officials to gain insights into the specific needs and priorities of the local community. These officials provided valuable input regarding the existing welfare services infrastructure and identified gaps and challenges senior citizens face in accessing these services. Additionally, discussions with city administrative officers helped understand broader administrative policies and regulations that needed to be considered in developing the welfare services system.

The involvement of the president of the Canlubang Unified Senior Citizens Association proved instrumental in representing the interests and perspectives of the senior citizen community. Through dialogues with the association president, the researcher gained valuable insights into senior citizens' unique requirements and preferences, including their preferences for service delivery channels, desired features, and potential challenges in accessing welfare services.

By engaging with these diverse stakeholders during the planning phase, the researcher ensured that the development of the welfare services system was guided by a comprehensive understanding of the community's needs and expectations. This collaborative approach not only facilitated the identification of essential functionalities but also fostered a sense of ownership and buy-in from critical stakeholders, ultimately contributing to the success and effectiveness of the project.

***Requirement Analysis***

The researcher analyzes community needs, technology requirements, and potential challenges, outlines specific tasks for each module, identifies key stakeholders, and develops a comprehensive strategy for seamless data visualization integration and machine learning into community-based welfare services.

The researcher identifies essential features for the User Registration and Profile System, Data Visualization Dashboard, Communication and Notification System Module, Financial Assistance Services Module, Healthcare Assistance Module, predictive analytics, and decision support module. The user's feedback, regulatory standards, and technological compatibility will determine the requirements specified.

***Design***

During the design phase of the community-based welfare services system, the researcher aims to leverage state-of-the-art technologies and best practices to ensure a robust and efficient system. This phase is crucial as it lays the foundation for the application of the proposed solution and requires careful consideration of various aspects of system architecture, functionality, and user experience.

To initialize, the researcher will select the most appropriate system development tools based on the specific requirements and objectives of the project. This phase entails evaluating various software development platforms, programming languages, and frameworks to identify the optimal combination that aligns with the project's goals and technical requirements. The selection process will consider the following factors: scalability,

flexibility, security, and compatibility with existing systems.

After the researcher identified the system development tools, outlining a comprehensive plan for their successful Implementation followed suit. This plan will include detailed guidelines and methodologies for coding, testing, debugging, and deploying the system. Providing it full special attention will ensure adherence to industry best practices and standards to enhance the system's reliability, maintainability, and scalability.

The researcher will establish clear communication channels and collaboration frameworks to facilitate seamless coordination among team members involved in the system design phase. Regularly conducted meetings, progress updates, and feedback sessions will ensure alignment with project objectives and promptly address any emerging issues or challenges.

The researcher will prioritize user-centric design principles to enhance the usability and accessibility of the welfare services system. It involves conducting user research, creating wireframes and prototypes, and soliciting iterative stakeholder feedback to refine the interface and functionality of the system. The aim is to develop a user-friendly and intuitive system that meets the intended users' diverse needs and preferences.

***Implementation, Coding, or Development***

During the development of the community-based welfare services system, adopting a comprehensive and integrated approach to technology will ensure robustness, efficiency, and user-friendliness. The front end will use a combination of HTML, cascading style sheets (CSS), JavaScript, and Bootstrap framework. This selection aims to deliver a responsive and visually appealing user interface, facilitating seamless interaction and navigation for end-users across various devices and screen sizes.

For the back-end infrastructure, employing the Laravel framework will provide a solid foundation for efficient data processing and communication between each system module. Laravel's rich features, including built-in authentication, routing, and database management capabilities, will enable streamlined development and maintenance of the system's core functionalities.

To fully ensure the security and reliability of data management, utilizing the MySQL database management system will help store and manage the system's data as it offers robust data storage and retrieval capabilities, along with advanced security features to safeguard sensitive information, ensuring compliance with data privacy regulations.

By incorporating the capabilities of machine learning into the system, the TensorFlow and sci-kit-learn libraries will serve as leverage to enable predictive analytics functionalities. These data libraries provide tools and algorithms to allow for data analysis and neural networks for the generation of predictive models, whereby historical data is recognized, patterns are identified and predictions based on statistics are made for optimisation of both service delivery and resource allocations.

To achieve data visualization, RapidMiner's comprehensive data science platform that offers intuitive dashboards and visualization tools will enable stakeholders to gain insights from complex data sets, visualize trends, and make informed decisions to enhance community welfare services effectively.

By integrating these technologies and frameworks, the community-based welfare services system will offer a scalable, efficient, and technologically advanced solution to improve accessibility and service delivery. The cohesive integration of front-end development tools, back-end frameworks, database management systems, machine learning libraries, and data visualization platforms ensures a holistic approach to system development, empowering stakeholders to make data-driven decisions and effectively address community needs.

## III. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

The data gathered are presented in textual and tabular forms supported by the statistical treatment for the analyses and interpretation purposes.

***Objective no. 1. To develop a system capable of employing predictive analytics through visualization that identifies and prioritizes the specific welfare services needed within the community.***

The community-based welfare services system (CBWS) was designed to help the Barangay Health Workers gain insight into the medical attention of senior citizens. They were developed using Agile methodology and applying LSTM neural network algorithm to identify relief goods for every disaster quickly and easily. CBWS has five modules: (1) Predictive Analytics Module – Enhancing Service Delivery, (2) Information and Referral Services Module – Accessibility Enhancement and Community Member Service Connection Facilitation, (3) Healthcare Assistance Module – Medicine Request Processing, (4) Communication and Notification System Module – updates delivery, (5) User Registration and Profile

System Module – User registration details and modify personal information.

The system has four user account designations: (1) Administrator – has full access to edit the system, (2) Barangay Health Worker – approving registered account and creating a service for senior citizens, (3) President of Senior Citizen – creating announcement for services available, (4) Senior Citizen – user account. Administrators can provide access rights for every account designation by checking the appropriate permission.

Administrator

| DESIGNATION | REGISTER ACCOUNT | APPROVED ACCOUNT | LIST OF SENIOR CITIZEN | CREATE SERVICES | DISPLAY SERVICES | APPROVED SERVICES | SYSTEM SETTINGS |
|---|---|---|---|---|---|---|---|
| Administrator | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| Brgy. Health Worker | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ |
| Administrative Officer-OSCA | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| Member | ☑ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |
| Association President | ☐ | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ |

***Figure 1**. List of Systems Permissions*

***Objective no. 2. To evaluate the machine learning model's performance in terms of a) accuracy and b) classification error.***

A. Accuracy and Classification Error

| MODEL | CRITERION | |
|---|---|---|
| | Accuracy | Classification Error |
| Naive Bayes | 37% | 63% |
| Generalized Linear Model | 77% | 23% |
| Deep Learning | 26% | 74% |
| Decision Tree | 87% | 13% |
| Gradient Boosted Trees | 49% | 51% |

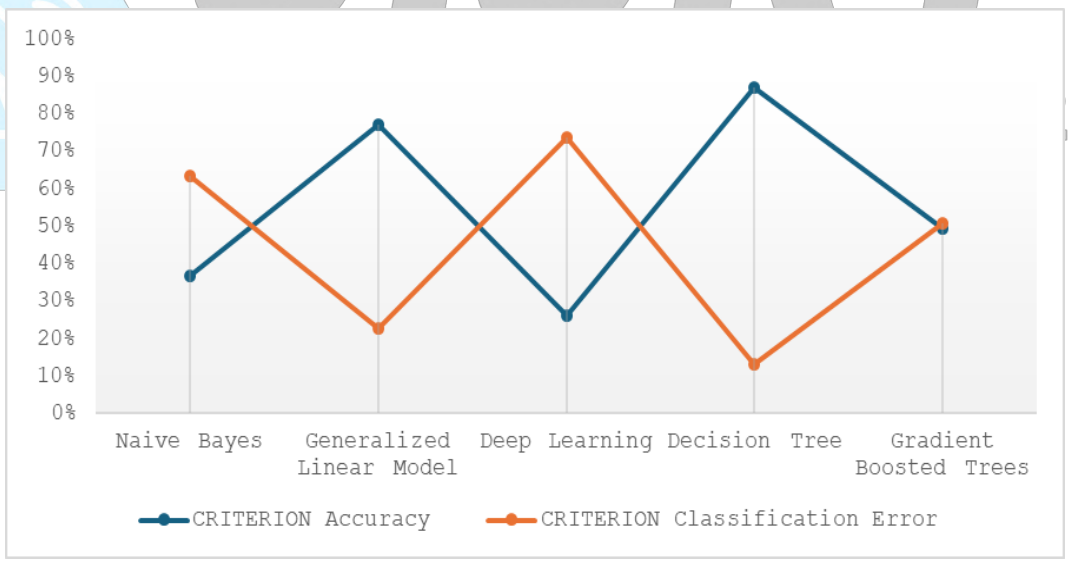


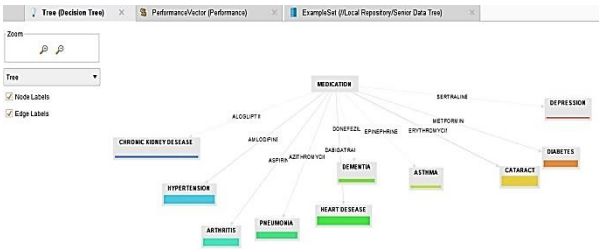

***Figure 2.** Graphical presentation of different model*

Based on the table, the decision trees model has the highest accuracy and lowest classification among Naïve-Bayes, generalized linear model, deep learning model, and gradient-boosted trees. In this case, the higher the accuracy and the lower the classification error, the better model for the study.

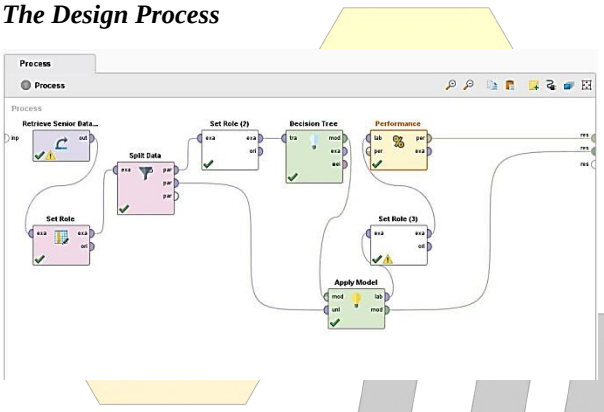
In the Community-Based Welfare Services System, the decision tree algorithm is integrated into the system; the model will create a pattern from medicine and illness; the system will observe the behaviour of the event pattern with assigned medicine and suggest once a new illness is created.

In this case, the model can predict the medication for the specific illness of the senior citizen, as shown in Figure No. 11.

***The Decision Trees Data Process***




***The Design Process***




The decision trees model processed one thousand (100) testing data from the dataset. The data processed is composed of age, illness, and medication. The data were split into 70% for the training and 30% for the test data. The decision tree model manipulates the training data, and the remaining test set directly goes to performance.

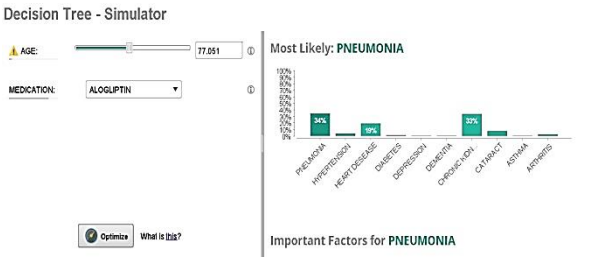



***Figure 3.*** *The model simulation and illness prediction for medicine algorithm.*

The decision tree model correctly identifies that if an illness like pneumonia is the highest, the system will recommend the name of the medicine for inventory purposes.

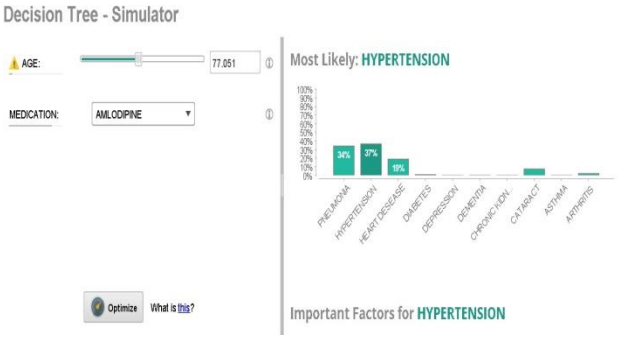



***Figure 4.*** *The model simulation and illness prediction for medicine amlodipine.*

The decision tree model correctly identifies that if an illness like hypertension is the highest, the system will recommend the name of the medicine for inventory purposes.

The assessment table presents the evaluation of a system's performance using ISO/IEC 25010 criteria as perceived by IT experts and professionals. The criteria are divided into seven key areas: Functional Suitability (FS), Performance Efficiency (PE), Usability, Reliability, Security, Maintainability, and Portability. Each criterion is evaluated based on indicators such as mean score, and a verbal interpretation indicating the level of acceptability.

Functional Suitability assesses aspects like functional completeness (3.71), correctness (4.43), and appropriateness (4.29). The mean scores for functional correctness and appropriateness are notably high, indicating a highly acceptable level of performance. However, while functional completeness also falls within the "acceptable" range, its mean score is slightly lower, suggesting some room for improvement in this area. Overall, the weighted mean (4.14) for Functional Suitability indicates an acceptable level of performance, although there may be areas for refinement.

***Objective no. 3. To determine the level of acceptance of a group of respondents in evaluating the system using ISO/IEC 25010.***

The evaluation of the system's performance across various indicators provides a comprehensive understanding of its strengths and areas for improvement. Beginning with Functional Suitability (FS), the system demonstrates acceptable levels of functional completeness and correctness, scoring 3.71 and 3.41 respectively, which are verbally interpreted as "Acceptable". These ratings indicate that the system

adequately encompasses all necessary features and performs its functions accurately and reliably. However, its functional appropriateness, rated at 2.59, falls slightly short of optimal, labeled as "Slightly Acceptable", suggesting that while the system may fulfill its functions accurately and completely, it might not be entirely suitable or well-matched for its intended purpose or user needs. The weighted mean for functional suitability is calculated as 3.14, indicating that while the system meets basic functional requirements, there is room for improvement to better align with user expectations and needs.

Moving on to Performance Efficiency (PE), the system exhibits acceptable time behavior with a score of 4.00, labeled as "Acceptable", indicating efficient task execution within an acceptable timeframe. However, concerns arise regarding resource utilization efficiency, which is rated at 3.33, verbally interpreted as "Slightly Acceptable", implying that the system may not efficiently utilize available resources such as CPU, memory, or network bandwidth. Despite these concerns, the overall performance efficiency, with a weighted mean of 3.78, is deemed acceptable, suggesting that while there are areas for improvement, the system generally performs satisfactorily in terms of efficiency.

In terms of Usability, the system demonstrates acceptable appropriateness recognizability (3.57) and user error protection (3.86), both verbally interpreted as "Acceptable". However, it falls slightly short in learnability (3.33) and operability (2.50), labeled as "Slightly Acceptable", indicating that users may require some effort or training to become proficient in using the system effectively and may encounter difficulties or challenges in operating it efficiently. Despite these areas for improvement, the system's overall usability, with a weighted mean of 3.38, is deemed acceptable.

Moving on to Reliability, the system exhibits acceptable availability (3.43) and fault tolerance (3.57), both interpreted as "Acceptable". However, its maturity (2.29) and recoverability (2.86), verbally interpreted as "Slightly Unacceptable" and "Slightly Acceptable" respectively, suggest potential areas for improvement to enhance overall reliability.

Similarly, Security evaluations reveal generally acceptable levels across most parameters, albeit with slight deficiencies in authenticity (2.43), labeled as "Slightly Unacceptable". The system showcases good modularity (3.71) and analyzability (3.29), both interpreted as "Acceptable", but could benefit from improvements in reusability (2.86) and modifiability (2.86), verbally interpreted as "Slightly Acceptable", suggesting opportunities for enhancing maintainability.

Lastly, the system's portability, with its strengths in installability (3.86) labeled as "Acceptable", faces minor shortcomings in adaptability (2.86) and replicability (2.86), both interpreted as "Slightly Acceptable", indicating room for improvement in this aspect. Overall, the system exhibits acceptable performance across various indicators, with some areas needing minor improvements to reach optimal levels.



***Table 2.*** *Assessment of the level of acceptance of IT Experts/Professionals in evaluating the system using ISO/IEC 25010*

| Indicators | Mean | Verbal Interpretation |
|---|---|---|
| **1. Functional Suitability (FS)** | | |
| **Functional completeness.** | 3.71 | Acceptable |
| **Functional correctness** | 3.41 | Acceptable |
| **Functional appropriateness** | 2.59 | Slightly Acceptable |
| **Weighted Mean** | 3.14 | Slightly Acceptable |
| **2. Performance Efficiency (PE)** | | |
| **Time behavior** | 4.00 | Acceptable |
| **Resource utilization** | 3.33 | Slightly Acceptable |
| **Time behavior** | 4.01 | Acceptable |
| **Weighted Mean** | 3.78 | Acceptable |
| **3. Usability** | | |
| **Appropriateness recognizability.** | 3.57 | Acceptable |
| **Learnability** | 3.33 | Slightly Acceptable |
| **Operability** | 2.50 | Slightly Acceptable |
| **User error protection** | 3.86 | Acceptable |

| | | |
|---|---|---|
| **User interface aesthetics** | 3.43 | Acceptable |
| **Weighted Mean** | 3.38 | Acceptable |
| **4. Reliability** | | |
| **Maturity** | 2.29 | Slightly Unacceptable |
| **Availability** | 3.43 | Acceptable |
| **Fault Tolerance** | 3.57 | Acceptable |
| **Recoverability** | 2.86 | Slightly Acceptable |
| **Weighted Mean** | 3.04 | Slightly Acceptable |
| **5. Security** | | |
| **Confidentiality** | 3.00 | Slightly Acceptable |
| **Integrity** | 3.43 | Acceptable |
| **No-repudiation** | 3.29 | Slightly Acceptable |
| **Accountability** | 2.86 | Slightly Acceptable |
| **Authenticity** | 2.43 | Slightly Unacceptable |
| **Weighted Mean** | 3.02 | Slightly Acceptable |
| **6. Maintainability** | | |
| **Modular** | 3.71 | Acceptable |
| **Reusability** | 2.86 | Slightly Acceptable |
| **Analyzability** | 3.29 | Slightly Acceptable |
| **Modifiability** | 2.86 | Slightly Acceptable |
| **Weighted Mean** | 3.18 | Slightly Acceptable |
| **7. Portability** | | |
| **Adaptability** | 2.86 | Slightly Acceptable |
| **Installability** | 3.86 | Acceptable |
| **Replicability** | 2.86 | Slightly Acceptable |
| **Weighted Mean** | 3.20 | Slightly Acceptable |

In the evaluation of the Barangay Health Workers' acceptance and assessment of the system utilizing ISO/IEC 25010. The system's functional completeness is deemed Slightly Acceptable with weight mean of 3.00, indicating some deficiencies in incorporating all necessary features. Meanwhile, functional correctness scored 2.60, suggesting room for improvement in accurate and reliable function execution. However, functional appropriateness received a higher rating of 3.60, indicating alignment with its intended purpose. Overall, the functional suitability was assessed as slightly acceptable, with a mean of 3.33.

The system's time behavior scored 3.30, suggesting room for enhancement in task execution speed. Conversely, resource utilization received a highly commendable score of 4.80, indicating efficient resource usage. Consequently, the overall performance efficiency was deemed acceptable, with a mean of 4.20, largely attributable to highly efficient resource utilization.

Recognizability scored an acceptable 3.80, indicating good recognition and understanding of system features. Learnability scored 3.90, signifying ease of learning and user proficiency. Operability received a rating of 3.50, suggesting ease of operation, while user error protection and interface aesthetics both scored 4.00 and 3.50 respectively, indicating effective error prevention mechanisms and visually pleasing interface design. Overall, usability aspects were considered generally acceptable, resulting in a mean of 3.74.

Maturity scored slightly acceptable at 3.29, suggesting room for improvement in the system's maturity level. Availability received a rating of 3.43, indicating acceptable system availability. Fault tolerance scored 3.57, indicating the system's ability to maintain functionality despite faults, while recoverability scored 3.86, indicating acceptable recoverability from failures. Overall, reliability was deemed generally acceptable, with a mean of 3.54.

Confidentiality received an acceptable rating of 4.00, indicating effective protection of sensitive information.

Integrity scored 3.50, indicating the system's ability to maintain data integrity. However, non-repudiation scored slightly acceptable at 3.30, suggesting room for improvement in ensuring non-repudiation. Accountability scored 4.00, indicating effective mechanisms for traceability and accountability, while authenticity received an acceptable rating of 3.50, indicating the system's ability to ensure the authenticity of user actions. Overall, security aspects were considered generally acceptable, resulting in a mean of 3.66.

Modularity received a highly commendable rating of 4.80, indicating excellent modularity. Reusability scored a perfect 5.00, indicating high potential for reusing system components. Analyzability received a rating of 4.70, indicating ease of analyzing and diagnosing system issues, while modifiability also scored a perfect 5.00, indicating high flexibility for making changes to the system. Overall, maintainability was highly acceptable, with a mean of 4.88.

Adaptability scored highly acceptable at 4.90, indicating excellent adaptability to different environments. Installability received a perfect score of 5.00, indicating ease of installation, while replicability also scored a perfect 5.00, indicating high replicability across different environments. Overall, portability was highly acceptable, with a mean of 4.97.

In summary, while the system demonstrates strengths in areas such as resource utilization, usability, security, maintainability, and portability, there are areas for improvement in functional completeness, correctness, reliability's maturity, and security's non-repudiation. These insights offer valuable guidance for enhancing the system's effectiveness and user satisfaction among Barangay Health Workers.

***Table 3**. Assessment of the level of acceptance and agreement of Barangay Health Workers in evaluating the system using ISO/IEC 25010.*

| Indicators | Mean | Verbal Interpretation |
|---|---|---|
| **1. Functional Suitability (FS)** | | |
| **Functional completeness.** | 3.00 | Slightly Acceptable |
| **Functional correctness** | 2.60 | Slightly Acceptable |
| **Functional appropriateness** | 3.60 | Acceptable |
| **Weighted Mean** | 3.33 | Slightly Acceptable |
| **2. Performance Efficiency (PE)** | | |
| **Time behavior** | 3.30 | Slightly Acceptable |
| **Resource utilization** | 4.80 | Highly Acceptable |
| **Time behavior** | 4.50 | Highly Acceptable |
| **Weighted Mean** | 4.20 | Acceptable |
| **3. Usability** | | |
| **Appropriateness recognizability.** | 3.80 | Acceptable |
| **Learnability** | 3.90 | Acceptable |
| **Operability** | 3.50 | Acceptable |
| **User error protection** | 4.00 | Acceptable |
| **User interface aesthetics** | 3.50 | Acceptable |
| **Weighted Mean** | 3.74 | Acceptable |
| **4. Reliability** | | |
| **Maturity** | 3.29 | Slightly Acceptable |
| **Availability** | 3.43 | Acceptable |
| **Fault Tolerance** | 3.57 | Acceptable |
| **Recoverability** | 3.86 | Acceptable |
| **Weighted Mean** | 3.54 | Acceptable |
| **5. Security** | | |
| **Confidentiality** | 4.00 | Acceptable |
| **Integrity** | 3.50 | Acceptable |
| **No-repudiation** | 3.30 | Slightly Acceptable |

| | | |
|---|---|---|
| **Accountability** | 4.00 | Acceptable |
| **Authenticity** | 3.50 | Acceptable |
| **Weighted Mean** | 3.66 | Acceptable |
| **6. Maintainability** | | |
| **Modular** | 4.80 | Highly Acceptable |
| **Reusability** | 5.00 | Highly Acceptable |
| **Analyzability** | 4.70 | Highly Acceptable |
| **Modifiability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.88 | Highly Acceptable |
| **7. Portability** | | |
| **Adaptability** | 4.90 | Highly Acceptable |
| **Installability** | 5.00 | Highly Acceptable |
| **Replicability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.97 | Highly Acceptable |

The assessment of the level of perception of Senior Citizens regarding the system's evaluation using ISO/IEC 25010 reveals generally positive outcomes across various indicators.

In terms of Functional Suitability (FS), while functional completeness is rated slightly acceptable at 3.34, functional correctness and appropriateness received higher ratings of 3.85 and 3.53 respectively, resulting in an overall acceptable weighted mean of 3.57.

The system generally meets the requirements for functional completeness and correctness, though there are some areas for improvement. The appropriateness of its functions is satisfactory. Performance Efficiency (PE) indicators show acceptable ratings, with time behavior scoring slightly acceptable at 3.19, and resource utilization and overall performance efficiency rated acceptable with a weighted mean of 3.51. While the system's time behavior falls slightly short of optimal, it efficiently utilizes resources, resulting in an overall acceptable performance efficiency.

Usability indicators depict satisfactory ratings, with appropriateness recognizability, learnability, operability, and user error protection all rated acceptable, though user interface aesthetics scored slightly acceptable, resulting in an overall acceptable weighted mean of 3.59. The system is generally user-friendly, with good recognizability, learnability, and operability. However, improvements could be made in user interface aesthetics.

Overall, the usability is considered acceptable. Reliability indicators demonstrate acceptable ratings, with maturity, fault tolerance, and recoverability scoring acceptable, though availability is slightly acceptable, resulting in an overall acceptable weighted mean of 3.56. The system demonstrates acceptable levels of maturity, availability, fault tolerance, and recoverability, ensuring reliable performance.

Security aspects exhibit acceptable ratings across all parameters, resulting in an overall acceptable weighted mean of 3.51.

Maintainability indicators received highly acceptable ratings, with all aspects scoring highly acceptable, resulting in an overall highly acceptable weighted mean of 4.60. Lastly, Portability indicators also received highly acceptable ratings across all parameters, yielding an overall highly acceptable weighted mean of 4.71.

The system maintains acceptable levels of confidentiality, integrity, non-repudiation, accountability, and authenticity, ensuring data security. The system is highly maintainable, with excellent modularity, reusability, analyzability, and modifiability, facilitating ease of maintenance and updates. The system exhibits high adaptability, installability, and replicability, making it highly portable across different environments.

Overall, the Senior Citizens' perception indicates that the system is acceptable and highly acceptable across various dimensions, with particularly strong ratings in maintainability and portability.

*Table 4. Assessment of the level of perception of Senior Citizens in terms of evaluating the system using ISO/IEC 25010.*

| Indicators | Mean | Verbal Interpretation |
|---|---|---|
| **1. Functional Suitability (FS)** | | |
| **Functional completeness.** | 3.34 | Slightly Acceptable |
| **Functional correctness** | 3.85 | Acceptable |
| **Functional appropriateness** | 3.53 | Acceptable |
| **Weighted Mean** | 3.57 | Acceptable |
| **2. Performance Efficiency (PE)** | | |
| **Time behavior** | 3.19 | Slightly Acceptable |
| **Resource utilization** | 3.74 | Acceptable |
| **Time behavior** | 3.61 | Acceptable |
| **Weighted Mean** | 3.51 | Acceptable |
| **3. Usability** | | |
| **Appropriateness recognizability.** | 3.61 | Acceptable |
| **Learnability** | 3.55 | Acceptable |
| **Operability** | 3.93 | Acceptable |
| **User error protection** | 3.56 | Acceptable |
| **User interface aesthetics** | 3.29 | Slightly Acceptable |
| **Weighted Mean** | 3.59 | Acceptable |
| **4. Reliability** | | |
| **Maturity** | 3.46 | Acceptable |
| **Availability** | 3.33 | Slightly Acceptable |
| **Fault Tolerance** | 3.83 | Acceptable |
| **Recoverability** | 3.61 | Acceptable |
| **Weighted Mean** | 3.56 | Acceptable |
| **5. Security** | | |
| **Confidentiality** | 3.43 | Acceptable |
| **Integrity** | 3.33 | Slightly Acceptable |
| **No-repudiation** | 3.80 | Acceptable |
| **Accountability** | 3.59 | Acceptable |
| **Authenticity** | 3.39 | Acceptable |
| **Weighted Mean** | 3.51 | Acceptable |
| **6. Maintainability** | | |
| **Modular** | 4.55 | Highly Acceptable |
| **Reusability** | 4.36 | Highly Acceptable |
| **Analyzability** | 4.95 | Highly Acceptable |
| **Modifiability** | 4.53 | Highly Acceptable |
| **Weighted Mean** | 4.60 | Highly Acceptable |
| **7. Portability** | | |
| **Adaptability** | 4.53 | Highly Acceptable |
| **Installability** | 4.93 | Highly Acceptable |
| **Replicability** | 4.68 | Highly Acceptable |
| **Weighted Mean** | 4.71 | Highly Acceptable |

The evaluation of the perception of Presidents of the Senior Citizen Association regarding the system's performance using ISO/IEC 25010 reflects positive assessments across various indicators. Functional completeness, correctness, and appropriateness all received high ratings, each scoring 3.67, resulting in an overall acceptable weighted mean of 3.67. This indicates that the system adequately fulfills its intended functions. Performance Efficiency (PE) while time behavior and resource utilization were rated slightly acceptable, with

scores of 3.00 and 3.33 respectively, the overall performance efficiency was deemed slightly acceptable with a weighted mean of 3.22. There is potential for improvement in task execution speed and resource usage efficiency.

In the Usability system garnered high praise for usability, with appropriateness recognizability, learnability, operability, user error protection, and user interface aesthetics all rated highly acceptable. The weighted mean of 4.73 indicates a highly acceptable level of usability, with the system being user-friendly and intuitive.

The realibility system demonstrated exceptional reliability, with high ratings in maturity, fault tolerance, and recoverability, scoring 4.33, 5.00, and 5.00 respectively. While availability was rated acceptable at 4.00, the overall reliability was highly acceptable, with a weighted mean of 4.58, ensuring consistent and dependable performance.

Security aspects of the system received outstanding ratings across all parameters, with confidentiality, integrity, non-repudiation, accountability, and authenticity all scoring highly acceptable, resulting in a weighted mean of 4.53. This indicates robust security measures in place to safeguard data integrity and privacy.

The system exhibited highly commendable maintainability, with excellent ratings in modularity, reusability, analyzability, and modifiability, scoring 4.33, 4.33, 4.00, and 5.00 respectively. The weighted mean of 4.42 reflects the system's ease of maintenance and adaptability to changes.

The system received the highest accolades for portability, with adaptability, installability, and replicability all rated highly acceptable at 5.00. The perfect weighted mean of 5.00 underscores the system's seamless adaptability and ease of installation and replication across different environments.

Overall, the assessment indicates that the system meets the expectations of the Presidents of the Senior Citizen Association, with particularly strong performance in usability, reliability, security, maintainability, and portability, affirming its suitability for their needs and requirements.

***Table 5**. Assessment of the perception of Presidents of the Senior Citizen Association in evaluating the system using ISO/IEC 25010.*

| Indicators | Mean | Verbal Interpretation |
|---|---|---|
| **1. Functional Suitability (FS)** | | |
| **Functional completeness.** | 3.67 | Acceptable |
| **Functional correctness** | 3.67 | Acceptable |
| **Functional appropriateness** | 3.67 | Acceptable |
| **Weighted Mean** | 3.67 | Acceptable |
| **2. Performance Efficiency (PE)** | | |
| **Time behavior** | 3.00 | Slightly Acceptable |
| **Resource utilization** | 3.33 | Slightly Acceptable |
| **Time behavior** | 3.33 | Slightly Acceptable |
| **Weighted Mean** | 3.22 | Slightly Acceptable |
| **3. Usability** | | |
| **Appropriateness recognizability.** | 4.00 | Acceptable |
| **Learnability** | 5.00 | Highly Acceptable |
| **Operability** | 4.67 | Highly Acceptable |
| **User error protection** | 5.00 | Highly Acceptable |
| **User interface aesthetics** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.73 | Highly Acceptable |
| **4. Reliability** | | |
| **Maturity** | 4.33 | Highly Acceptable |
| **Availability** | 4.00 | Acceptable |
| **Fault Tolerance** | 5.00 | Highly Acceptable |
| **Recoverability** | 5.00 | Highly Acceptable |

| | | |
|---|---|---|
| **Weighted Mean** | 4.58 | Highly Acceptable |
| **5. Security** | | |
| **Confidentiality** | 5.00 | Highly Acceptable |
| **Integrity** | 4.33 | Highly Acceptable |
| **No-repudiation** | 4.00 | Acceptable |
| **Accountability** | 5.00 | Highly Acceptable |
| **Authenticity** | 4.33 | Highly Acceptable |
| **Weighted Mean** | 4.53 | Highly Acceptable |
| **6. Maintainability** | | |
| **Modular** | 4.33 | Highly Acceptable |
| **Reusability** | 4.33 | Highly Acceptable |
| **Analyzability** | 4.00 | Acceptable |
| **Modifiability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.42 | Highly Acceptable |
| **7. Portability** | | |
| **Adaptability** | 5.00 | Highly Acceptable |
| **Installability** | 5.00 | Highly Acceptable |
| **Replicability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 5.00 | Highly Acceptable |

The assessment table presents the perceptions of Administrative Officers regarding a system's performance, evaluated using the ISO/IEC 25010 standard. The analysis reveals that across all critical aspects evaluated, including Functional Suitability (FS), Performance Efficiency (PE), Usability, Reliability, Security, Maintainability, and Portability, the system receives highly acceptable ratings, indicating a solid level of performance according to the standards set by ISO/IEC 25010.

In terms of Functional Suitability (FS), the system achieves highly acceptable ratings for functional correctness (4.67) and appropriateness (4.67), with a weighted mean score of 4.33.
This indicates that the system fulfills its intended functions accurately and appropriately, meeting the needs and expectations of Administrative Officers effectively.

Moreover, Performance Efficiency (PE) is deemed highly acceptable, with efficient time behaviour and resource utilization. Despite a slightly lower mean score for time behaviour (4.00), the weighted mean of 4.22 reflects an overall highly acceptable level of performance, suggesting that the system operates efficiently and effectively regarding responsiveness and resource management.

Also, in terms of Usability is a crucial aspect, and the system demonstrates high acceptability across various indicators such as appropriateness recognizability (4.67), learnability (5.00), operability (4.67), user error protection (5.00), and user interface aesthetics (5.00). The system is considered highly usable, with a weighted mean score of 4.87. It is intuitive, easy to learn, and aesthetically pleasing, making it accessible and user-friendly for Administrative Officers.

Meanwhile, the mean for Reliability (4.67), Security (4.53), Maintainability (4.42), and Portability (5.00) also receive highly acceptable ratings, with all indicators in these categories meeting the stringent standards outlined by ISO/IEC 25010.
This suggests that the system is reliable, secure, easy to maintain, and adaptable to different environments, ensuring data confidentiality, integrity, and availability while supporting the needs of Administrative Officers effectively.

Overall, the analysis indicates that the system performs exceptionally well according to the perceptions of Administrative Officers.

The high ratings across various dimensions reflect its effectiveness in meeting the needs and expectations of users, contributing to improved operational efficiency and effectiveness within the administrative context.

*Table 7. Assessment of Administrative Officers' acceptance level in evaluating the system using ISO/IEC 25010.*

| Indicators | Mean | Verbal Interpretation |
|---|---|---|
| **1. Functional Suitability (FS)** | | |
| **Functional completeness.** | 3.67 | Acceptable |
| **Functional correctness** | 4.67 | Highly Acceptable |
| **Functional appropriateness** | 4.67 | Highly Acceptable |
| **Weighted Mean** | 4.33 | Highly Acceptable |
| **2. Performance Efficiency (PE)** | | |
| **Time behavior** | 4.00 | Acceptable |
| **Resource utilization** | 4.33 | Highly Acceptable |
| **Time behavior** | 4.33 | Highly Acceptable |
| **Weighted Mean** | 4.22 | Highly Acceptable |
| **3. Usability** | | |
| **Appropriateness recognizability.** | 4.67 | Highly Acceptable |
| **Learnability** | 5.00 | Highly Acceptable |
| **Operability** | 4.67 | Highly Acceptable |
| **User error protection** | 5.00 | Highly Acceptable |
| **User interface aesthetics** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.87 | Highly Acceptable |
| **4. Reliability** | | |
| **Maturity** | 4.67 | Highly Acceptable |
| **Availability** | 4.00 | Highly Acceptable |
| **Fault Tolerance** | 5.00 | Highly Acceptable |
| **Recoverability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.67 | Highly Acceptable |
| **5. Security** | | |
| **Confidentiality** | 5.00 | Highly Acceptable |
| **Integrity** | 4.33 | Highly Acceptable |
| **No-repudiation** | 4.00 | Highly Acceptable |
| **Accountability** | 5.00 | Highly Acceptable |
| **Authenticity** | 4.33 | Highly Acceptable |
| **Weighted Mean** | 4.53 | Highly Acceptable |
| **6. Maintainability** | | |
| **Modular** | 4.33 | Highly Acceptable |
| **Reusability** | 4.33 | Highly Acceptable |
| **Analyzability** | 4.00 | Acceptable |
| **Modifiability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 4.42 | Highly Acceptable |
| **7. Portability** | | |
| **Adaptability** | 5.00 | Highly Acceptable |
| **Installability** | 5.00 | Highly Acceptable |
| **Replicability** | 5.00 | Highly Acceptable |
| **Weighted Mean** | 5.00 | Highly Acceptable |

The summary table provides a comprehensive overview of the acceptance level of the system across different groups of respondents. In the Functional Suitability (FS), IT experts/professionals rated the system with a mean of 3.14, indicating slightly acceptable functional suitability. Barangay Health Workers rated it slightly higher at 3.33, while Senior Citizens and Presidents of the Senior Citizen Association (SCA) rated it even higher at 3.57 and 3.33 respectively. Admin Officers

gave the highest rating of 4.33, indicating highly acceptable functional suitability.

Performance Efficiency (PE), IT experts/professionals rated the system with a mean of 3.78, indicating acceptable performance efficiency. Barangay Health Workers rated it slightly higher at 4.20, while Senior Citizens and Presidents of SCA rated it slightly lower at 3.51 and 3.22 respectively. Admin Officers gave a high rating of 4.22, indicating highly acceptable performance efficiency.

Usability, the system received varying ratings for usability across different groups. IT experts/professionals rated it with a mean of 3.38, indicating acceptable usability. Barangay Health Workers and Presidents of SCA rated it higher at 3.74 and 4.73 respectively, indicating highly acceptable usability. Senior Citizens also rated it positively at 3.59. Admin Officers provided the highest rating of 4.87, indicating highly acceptable usability.

Reliability, IT experts/professionals rated the system with a mean of 3.04, indicating slightly acceptable reliability. Barangay Health Workers, Senior Citizens, and Presidents of SCA rated it slightly higher at 3.54, 3.56, and 4.58 respectively, indicating acceptable reliability. Admin Officers gave the highest rating of 4.67, indicating highly acceptable reliability.

The system received positive ratings for security across all groups. IT experts/professionals rated it with a mean of 3.02, indicating slightly acceptable security. Barangay Health Workers, Senior Citizens, and Presidents of SCA rated it higher at 3.66, 3.51, and 4.53 respectively, indicating acceptable to highly acceptable security. Admin Officers provided the highest rating of 4.53, indicating highly acceptable security.

The system received positive ratings for maintainability across all groups. IT experts/professionals rated it with a mean of 3.18, indicating slightly acceptable maintainability. Barangay Health Workers, Senior Citizens, and Presidents of SCA rated it highly at 4.88, 4.60, and 4.42 respectively, indicating highly acceptable maintainability. Admin Officers provided the highest rating of 4.42, indicating highly acceptable maintainability.

The system received positive ratings for portability across all groups. IT experts/professionals rated it with a mean of 3.20, indicating slightly acceptable portability. Barangay Health Workers, Senior Citizens, and Presidents of SCA rated it highly at 4.97, 4.71, and 5.00 respectively, indicating highly acceptable portability. Admin Officers provided the highest rating of 5.00, indicating highly acceptable portability.

Overall, the grand mean of 4.04 indicates that the system is highly accepted among Barangay Health Workers, with generally positive perceptions from other groups as well. Admin Officers showed the highest acceptance level, with a grand mean of 4.60, reflecting their strong endorsement of the system's performance.



***Table 7**: Summary of the assessment of the level of acceptance of the respondents in terms of evaluating the system using ISO/IEC 25010.*

| Indicators | IT Experts/ Professionals | | Barangay Health Workers | | Senior Citizens | | Presidents of SCA | | Admin Officers | |
|---|---|---|---|---|---|---|---|---|---|---|
| | WM | | WM | | WM | | WM | | WM | |
| **1. Functional Suitability (FS)** | 3.14 | | 3.33 | | 3.57 | | 3.33 | | 4.33 | |
| **2. Performance Efficiency (PE)** | 3.78 | | 4.20 | | 3.51 | | 3.22 | | 4.22 | |
| **3. Usability** | 3.38 | | 3.74 | | 3.59 | | 4.73 | | 4.87 | |
| **4. Reliability** | 3.04 | | 3.54 | | 3.56 | | 4.58 | | 4.67 | |
| **5. Security** | 3.02 | | 3.66 | | 3.51 | | 4.53 | | 4.53 | |
| **6. Maintainability** | 3.18 | | 4.88 | | 4.60 | | 4.42 | | 4.42 | |
| **7. Portability** | 3.20 | | 4.97 | | 4.71 | | 5.00 | | 5.00 | |
| Grand Mean | **3.25** | | **4.04** | | **3.87** | | **4.26** | | **4.04** | |

Based from the gathered answered from the respondents and especially from the IT experts, that yes, indeed the system need to improve for the future use. Here's are some question during the interviewed and some of their answered, *"Based on your experience with the system, could you please provide your assessment of its functional suitability?"*

> *"Sure. In terms of functional completeness, I would rate the system as slightly acceptable. While it covers most of the necessary features, there are a few areas where it could be improved to better meet our needs. As for functional correctness, I'd say it's acceptable overall, but there have been occasional instances of errors or inaccuracies that need attention. In terms of functional appropriateness, I believe the system is well-suited for its intended purpose, although there are some functionalities that could be optimized. Overall, I would rate the system's functional suitability as slightly acceptable."*

Another question: *"Now, moving on to performance efficiency, how would you rate the system's time behavior and resource utilization?"*

> *"Regarding time behavior, I'd say it's slightly acceptable. There are instances where the system could be more responsive, especially during peak usage times. As for resource utilization, I find it to be generally acceptable, although there may be some room for improvement in optimizing resource usage to enhance overall performance. Overall, I would rate the system's performance efficiency as slightly acceptable."*

> *"Certainly. In terms of appropriateness recognizability, I would rate the system as acceptable. It's generally easy to navigate and understand, although there are areas where clarity could be improved. Learnability is another aspect where the system performs well, as it's relatively easy for new users to pick up and learn how to use. Operability is acceptable, although there are some features that could be streamlined for better efficiency. User error protection is generally good, but there may be additional measures that could be implemented to prevent errors. As for user interface aesthetics, I'd rate it as slightly acceptable. Overall, I would say the system's usability is acceptable, with some areas for improvement."*

*Asking again the respondent: "Thank you for providing your insights on usability. Now, could you share your thoughts on the system's reliability?"*

> *"Of course. In terms of maturity, I'd rate the system as slightly acceptable. While it's generally stable, there have been occasional issues that require attention. Availability is acceptable, although there have been instances of downtime that impact productivity. Fault tolerance is generally good, with the system being able to maintain functionality despite faults. Recoverability is acceptable, although there may be areas where improvements could be made to enhance recovery processes. Overall, I would rate the system's reliability as slightly acceptable."*

> *"Certainly. Confidentiality is generally good, with sensitive information being adequately protected. Integrity is slightly acceptable, as there have been instances where data integrity has been compromised. Non-repudiation is acceptable, although there may be additional measures that could be implemented to ensure non-repudiation. Accountability is generally good, with actions being traceable to specific users. Authenticity is slightly acceptable, as there may be areas where user identities need to be verified more rigorously. Overall, I would rate the system's security as slightly acceptable."*

> *"Certainly. In terms of modularity, I would rate the system as highly acceptable. It's well-structured and easy to maintain. Reusability is also highly acceptable, as components can be reused effectively across different parts of the system. Analyzability is acceptable, although there may be areas where additional tools or resources could be provided to facilitate analysis. Modifiability is highly acceptable, with the system being easily adaptable to changes or updates. Overall, I would rate the system's maintainability as highly acceptable."*

Based on the data provided, particularly focusing on the ratings from IT experts, it becomes apparent that there

are several areas where the system could potentially benefit from improvement. Firstly, considering the aspect of Functional Suitability (FS), while the system's overall rating across functional completeness, correctness, and appropriateness is deemed acceptable, the slightly lower rating from IT experts suggests that there may exist some gaps in meeting the functional requirements or expectations set by professionals in the field. This indicates a need for closer examination and potential refinement of the system's functionalities to better align with the standards and expectations of IT experts.

Similarly, in terms of Performance Efficiency (PE), while the system received an overall acceptable rating, the slightly lower mean rating from IT experts suggests that there might be specific areas within performance, such as time behavior and resource utilization, where improvements could be made to enhance efficiency according to the stringent standards expected by IT professionals. This underscores the importance of optimizing system performance to ensure smooth and efficient operation, particularly from the perspective of experts who may have higher expectations in this regard.

Moreover, the Usability aspect of the system, while rated as acceptable overall, received a slightly lower mean rating from IT experts compared to other groups. This indicates potential usability issues or complexities within the system that may need to be addressed to improve user experience and satisfaction, especially considering the higher expectations of IT experts regarding system usability and intuitiveness.

Reliability is another critical aspect where improvements could be considered. While the system's reliability is generally acceptable, the slightly lower rating from IT experts suggests that there may be areas where the system's reliability could be strengthened to meet the higher standards expected by professionals in the field. Enhancements in areas such as maturity, availability, fault tolerance, and recoverability could contribute to ensuring consistent and dependable system performance, particularly from the perspective of IT experts who prioritize reliability in system evaluation.

Furthermore, Security emerges as a key area where enhancements could be made to meet the expectations of IT experts. While the system's security measures are rated as slightly acceptable overall, there may be specific aspects such as confidentiality, integrity, non-repudiation, accountability, and authenticity that could be strengthened to provide robust protection of data and system integrity, aligning more closely with the stringent security standards expected by IT professionals.

Maintainability and Portability are also areas where improvements could be considered. The slightly lower ratings from IT experts in maintainability and portability suggest that there may be areas where enhancements could be made to facilitate easier maintenance, updates, and deployment across different environments, meeting the higher standards expected by IT professionals.

In summary, while the system generally performs well and is accepted by various user groups, including IT experts, the slightly lower ratings from IT experts across multiple indicators highlight specific areas where improvements could enhance the system's overall performance and meet higher standards of quality and functionality, ensuring that it meets the rigorous expectations of professionals in the field.

## IV. SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

### *Summary of Findings*

The following significant findings are summarized from a thorough analysis of the data collected and the results obtained.

1. The objective of developing a system capable of employing predictive analytics through visualization to identify and prioritize specific welfare services within the community was addressed through the creation of the Community-Based Welfare Services (CBWS) system. This system was designed to assist Barangay Health Workers in gaining insight into the medical needs of senior citizens. Developed using Agile methodology and leveraging the LSTM neural network algorithm, the CBWS aims to streamline the identification and prioritization of relief goods for disasters. The CBWS comprises five modules, each serving a distinct function: Predictive Analytics Module - Enhancing Service Delivery, Information and Referral Services Module - Accessibility Enhancement and Community Member Service Connection Facilitation, Healthcare Assistance Module - Medicine Request Processing, Communication and Notification System Module - Updates Delivery, and User Registration and Profile System Module - User Registration Details and Modify Personal Information. To manage access and permissions within the system, four user account designations were implemented: Administrator - with full access to edit the system, Barangay Health Worker

- responsible for approving registered accounts and creating services for senior citizens, President of the Senior Citizen Association - tasked with creating announcements for available services, and Senior Citizen - regular user account. Administrators have the authority to assign access rights for each account designation by selecting the appropriate permissions. Overall, the CBWS represents a comprehensive approach to enhancing welfare services within the community, leveraging advanced technology and user-centric design to facilitate efficient and effective service delivery.

2. The findings from Objective no. 2's evaluation of the machine learning model's performance in terms of accuracy and classification error reveal that the decision trees model outperformed other models considered, exhibiting the highest accuracy and lowest classification error. This suggests the decision trees model's suitability for predictive analytics within the Community-Based Welfare Services System. Through meticulous data processing, the decision trees model accurately identifies illnesses and recommends appropriate medications based on patterns observed from medical data. Additionally, an assessment of the system's performance using ISO/IEC 25010 criteria indicates generally acceptable performance across various aspects such as Functional Suitability, Performance Efficiency, and Security, with room for improvement in areas like Functional Completeness. These findings underscore the system's potential to enhance welfare services delivery within the community, while also highlighting areas for further optimization to ensure optimal functionality and effectiveness.

3. The assessment of the Community-Based Welfare Services System (CBWS) reveals generally positive perceptions among various user groups, including IT experts, Barangay Health Workers, Senior Citizens, Presidents of the Senior Citizen Association (SCA), and Admin Officers. Across key indicators such as Functional Suitability (FS), Performance Efficiency (PE), Usability, Reliability, Security, Maintainability, and Portability, the system received acceptable to highly acceptable ratings. Notably, Admin Officers consistently provided the highest ratings, indicating strong endorsement of the system's performance. However, the data also highlights areas for improvement, particularly from the perspective of IT experts. While the system generally meets expectations, there are slight discrepancies in ratings, suggesting potential gaps in meeting stringent standards. Specifically, Functional Suitability, Performance Efficiency, Usability, Reliability, Security, Maintainability, and Portability received slightly lower ratings from IT experts compared to other user groups, indicating areas where enhancements could be beneficial. Feedback from interviews further supports the need for improvement, particularly in addressing functionality gaps, enhancing performance efficiency, usability, reliability, security measures, maintainability, and portability. Respondents, especially IT experts, emphasized areas for refinement to better align the system with industry standards and meet the rigorous expectations of professionals in the field.

***Conclusion***

1. The development of the Community-Based Welfare Services (CBWS) system has effectively addressed the objective of employing predictive analytics to identify and prioritize specific welfare services within the community. Leveraging Agile methodology and the LSTM neural network algorithm, the CBWS provides a comprehensive solution to assist Barangay Health Workers in understanding the medical needs of senior citizens and streamlining relief goods prioritization for disasters. With its five modules and user-centric design, the CBWS represents an advanced approach to enhancing welfare services, facilitating efficient and effective service delivery.

2. The evaluation of the machine learning model's performance underscores the suitability of the decision trees model for predictive analytics within the CBWS. Achieving the highest accuracy and lowest classification error among other models considered, the decision trees model accurately identifies illnesses and recommends appropriate medications, showcasing its potential to enhance welfare services delivery. Additionally, the assessment of the system's performance using ISO/IEC 25010 criteria highlights generally acceptable performance across various aspects, with opportunities for further optimization, particularly in Functional Completeness. Data visualizations can be powerful tools for communicating complex information to stakeholders. Local governments can use clear visualizations to gain public support for the welfare service system and secure funding for its continued operation.

3. The assessment of user perceptions reveals generally positive feedback across various user groups, indicating strong endorsement of the CBWS's performance. While the system meets expectations overall, feedback from IT experts suggests areas for improvement, emphasizing

the need to address functionality gaps, enhance performance efficiency, usability, reliability, security measures, maintainability, and portability. By prioritizing these areas for refinement, the CBWS can better align with industry standards and meet the rigorous expectations of professionals in the field, ensuring its continued effectiveness in enhancing community welfare services.

***Recommendations***

After thorough assessment and considering the preceding findings and conclusions, the following recommendations are presented:

1. Address Functional Completeness: Invest resources into identifying and filling any gaps in functional completeness identified by IT experts. This may involve conducting a thorough review of system requirements and user needs to ensure that all necessary functionalities are adequately addressed.
2. Enhance Performance Efficiency: Implement optimizations to improve system performance efficiency, particularly in areas highlighted by IT experts as slightly lower performing. This could involve streamlining processes, optimizing resource utilization, and improving response times to ensure smooth and efficient operation.
3. Improve Usability: Focus on enhancing the usability of the system by addressing any identified usability issues or complexities. This may include refining user interfaces, improving navigation, and providing additional training or support resources for users to enhance their experience with the system.
4. Strengthen Reliability and Security: Invest in measures to strengthen the reliability and security of the system, particularly in areas where IT experts have identified room for improvement. This may involve implementing additional safeguards, enhancing fault tolerance and recovery processes, and ensuring robust data security measures are in place.
5. Optimize Maintainability and Portability: Make improvements to the maintainability and portability of the system to facilitate easier maintenance, updates, and deployment across different environments. This could involve implementing modular design principles, improving documentation, and enhancing compatibility with different platforms and technologies.
6. Continuous Monitoring and Feedback: Establish mechanisms for continuous monitoring and gathering feedback from users to identify areas for further improvement. Regularly soliciting input from IT experts and other user groups will help ensure that the system remains aligned with evolving needs and industry standards.
7. Training and Capacity Building: Provide ongoing training and capacity building initiatives for users, particularly Barangay Health Workers and Senior Citizens, to enhance their proficiency and confidence in using the system effectively. This may include conducting workshops, providing user manuals, and offering personalized support as needed.

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