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Original Research

PGMI.Vision: A Mobile Application for Breast Mammographic Image Quality Evaluation with Usability Analysis

Syakirah Athirah Abdulla Hamid[1], Wan Siti Khadijah Wan Mustaffa Fikr[1], Fatin Liyana Khairi[1], Mahdi Osman Abdille[1], Aulia Salma[1], Nur Afifah Zahidah Jais[1], Turki Salem Ahmed al-Babakri[1], Aqilah Hannani Anil Husna[1], Nur Farisha Hanna Hamizun[1], Mariaulpa Sahalan[1, 2*]

[1] *Department of Biomedical Engineering and Health Sciences, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, Johor Bahru, 81310, Malaysia.*
[2] *Advanced Diagnostics and Progressive Human Care Group, Department of Biomedical Engineering and Health Sciences, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.*

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ABSTRACT

The PGMI classification approach is used in Malaysia to assess mammography quality. However, the PGMI criteria lack objectivity and clear definitions, leading to inconsistent evaluations by different readers. This challenge ensures that all mammography facilities fulfil the basic quality criteria. This study aims to develop a mobile application for objective mammography quality assessment and usability evaluation. Figma was utilized as a design tool for this project to create the PGMI mobile application, called PGMI.Vision, due to its interactive design capabilities and collaborative features. The app includes two important mammography views: craniocaudal (CC) and mediolateral oblique (MLO) each breast, resulting in a set of four images. The study involved 27 participants and used the Usefulness, Satisfaction, and Ease of Use (USE) Questionnaire for evaluation. Usability testing showed the average score for Usefulness was 81.67%, Ease-of-Use was 81.82%, Ease of Learning was 80.93%, and Satisfaction was 79.68%. The overall average score was 81.02%, which exceeds typical benchmarks in USE Questionnaire studies, indicating high user satisfaction and usability. These high scores suggest PGMI.Vision is user-friendly and exhibit significant potential for future use.

INTRODUCTION

Inappropriate breast positioning remains the most common cause of mammographic imaging failure, even with advanced imaging equipment (Albeshan et al., 2022; Brahim et al., 2022; Pape et al., 2022; Yeom et al., 2019). Current acceptance criteria for positioning that include mammary gland structures are visually and qualitatively evaluated. Therefore, proper positioning is critical for capturing all breast tissue (Watanabe et al., 2023). Various classification systems have been developed to assess mammogram quality effectively. The EAR (Excellent, Acceptable, Repeat) system, commonly used for screen-film mammography, categorizes images into three classes: "Excellent" for optimal images, "Acceptable" for those with minor issues, and "Repeat" for images requiring retakes due to significant deficiencies (Moreira et al., n.d.). In comparison, the PGMI (Perfect, Good, Moderate, Inadequate) system offers a more detailed classification suitable for digital mammography. PGMI evaluates mammograms based on the visibility of all breast tissue, proper positioning, adequate compression, absence of artifacts, and accurate image identification. Images are graded as Perfect (meeting all criteria without any issues), Good (minor issues not hindering diagnosis), Moderate (deficiencies requiring careful interpretation), and Inadequate (severe issues making the image unusable) (Haouimi & Pacifici, 2013). Complying with these

* Mariaulpa Sahalan (mariaulpa@utm.my)

Advanced Diagnostics and Progressive Human Care Group, Department of Biomedical Engineering and Health Sciences, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.

guidelines generally results in high-quality images, essential for accurate evaluation and diagnosis (Haouimi & Pacifici, 2013).

A breast screening classification approach known as Perfect, Good, Moderate, Inadequate (PGMI) approach is presently employed in Malaysia to assess the quality of mammography pictures. However, the PGMI criteria lack objectivity and clear definitions, leading to inconsistent evaluations by different readers. Studies have shown that this leads to subjectivity in the evaluation process and can impact the accuracy of image quality assessments. For example, research indicates that the reliance on visual assessment within the PGMI system results in inter-observer variability, with different readers often providing inconsistent evaluations of the same images (Alukić et al., 2023). This inconsistency presents a challenge in ensuring that all mammography facilities fulfill the basic quality criteria. To address these inconsistencies, there is a need for a more objective and consistent method for assessing the quality of mammography images. A potential solution is the development of a mobile application that provides detailed instructions on the PGMI criteria, uses reference images for quality ratings, and incorporates automated image analysis methods. Hence, the development of a mobile application, PGMI.Vision, is proposed.

PGMI.Vision will follow the established PGMI criteria, utilizing high-quality images to ensure visibility of all breast tissue and proper compression (Waade et al., 2021). It will serve as a reference, showing various mammography quality ratings with labels illustrating anatomical landmarks and key structures such as the pectoral muscle. A study outlines that, to enhance the accuracy of identifying and evaluating breast tissue characteristics according to PGMI standards, a key criterion is image clarity, particularly the visibility of the pectoral muscle, which aids in assessment using basic CC and MLO projections (Feigin, 2023). The app will also include educational resources, such as in-app guides and reference materials explaining the PGMI criteria and providing examples of different image qualities to improve user understanding (Spuur et al., 2018). By providing direct links or references, users will have immediate access to supporting evidence and guidelines that inform the app's functionality. The application will offer real-time image quality assessments before the patient exits the screening unit, potentially reducing recalls due to poor image quality. However, the system will continue to rely on human observations to create reference standards for image quality criteria and thresholds, which will have an impact on the final evaluation outcomes.

Several existing software solutions, such Volpara TruPGMI and B-rayZ, provide automated techniques for assessing mammography quality. Volpara TruPGMI, analyzes breast placement and compression parameters across various imaging modalities, classifies images according to PGMI criteria, and provides radiographers with interactive dashboards to improve their performance (Gennaro et al., 2024; Johnston et al., n.d.). Similarly, B-rayZ is a start-up AI-powered software designed to assist with real-time mammography assessments, analyzing image quality, breast density, detecting early-stage lesions, and providing PGMI-based classifications (Health Trends, 2023). While these tools improve diagnostic accuracy, PGMI.Vision seeks to provide a more intuitive, user-friendly mobile platform, focusing on educating users and providing quick feedback during mammography screenings. Inspired by user-friendly health apps like "Know Your Lemons" and "Keep A Breast", PGMI.Vision will prioritize accessibility and usability. These apps, designed to teach users about breast health and cancer awareness, provide useful guidelines for designing the mobile app's interface to ensure it is both entertaining and practical (Keep A Breast Foundation, 2020; Yen et al., 2023).

The aim of this research is to develop PGMI.Vision, a mobile application implementing the PGMI method for evaluating mammographic image quality. The app's goal is to provide a consistent and reliable reference tool for determining mammographic image quality, as well as conducting usability testing to verify its simplicity and practicality. By offering real-time feedback, PGMI.Vision seeks to save radiographers time while improving the consistency of image quality assessments.

MATERIALS AND METHOD

Literature-Informed Design

In designing the app, the process deeply involved the insights derived from existing literature on mammogram assessment, especially the PGMI criteria assessment. This foundation is to ensure that our approach is aligned with the established fundamentals in the field. Synthesizing the key ideas from relevant literature, we thoroughly translated the literature findings into functional elements within the app. Every aspect of the app represents a careful application of literature-informed design principles, from the assessment components to including a mammography image. This approach will establish the app as a reliable and effective tool in the field of mammography assessment.

Prototype Development

Various web apps were evaluated to meet the study's key objectives before being used to construct PGMI.Vision prototypes. Figma was chosen as the major tool because of its user-friendly interface, extensive collaborative features, and ability to create interactive application prototypes efficiently (Hariyadi et al., 2023). Unlike other tools like Adobe XD and Sketch, Figma is entirely web-based, making it more accessible across platforms and avoiding the need for program installation (Estrella, 2024). This option allows multiple team members to be involved at the same time, resulting in seamless collaboration and rapid development.

The PGMI.Vision prototype develops by translating the application's primary objectives into an intuitive, functional design. This ensures that the app meets its objectives of improving the image quality evaluation, training users on PGMI criteria, and making it accessible to radiographers and technicians. What distinguishes PGMI.Vision from other solutions, such as Volpara TruPGMI and B-rayZ, is its emphasis on user education and accessibility (Health Trends, 2023; Johnston et al., n.d.). While other tools focus on diagnostic precision, PGMI.Vision provides in-app education, real-time feedback during screenings, and a user-friendly layout inspired by user-centric health apps such as "Know Your Lemons" (Yen et al., 2023). These characteristics offer PGMI.Vision a comprehensive solution for improving image quality assessments while increasing user comprehension and involvement.

In creating the PGMI.Vision application, the choice of pink theme serves as thematic purpose. Pink color is closely linked to breast cancer awareness while at the same time conforming to the subject matter, fits well in the app. The PGMI.Vision logo is in the form of a heart and breast cancer ribbon. The breast cancer ribbon represents courage, hope, responsibility, empathy, and the right to talk about breast cancer. In the splash screen page, the component displayed the PGMI.Vision Application logo. It also displays the objective of this application. Figure 1, shows the Splash Screen of PGMI.Vision Application.

Fig. 1 Splash Screen of PGMI.Vision Mobile Application.

The home page displays three buttons with corresponding icons. Each button on this page serves to navigate to a specific section of the app. The "App Tutorial" button leads to the PGMI.Vision app tutorial page and displays the disclaimer. The "Screening Guidelines" button redirects users to a link containing screening guidelines for breast screening and mammography quality assurance in Malaysia. Lastly, the "PGMI" button provides detailed information about PGMI assessment, including its key parameters and the CC and MLO projection views.

The PGMI page presents the key parameters for PGMI assessment and PGMI images, which include the CC and MLO projection views. On the key parameters page, several PGMI parameters are outlined, such as the criteria for image assessment, specific positioning criteria, CC and MLO image classification, and the recommended quality standard percentages, as shown in Figure 3. This page offers a well-structured explanation of the content.

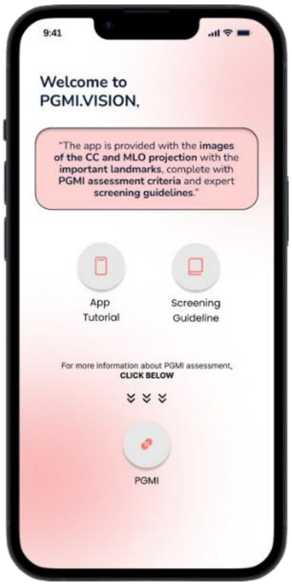
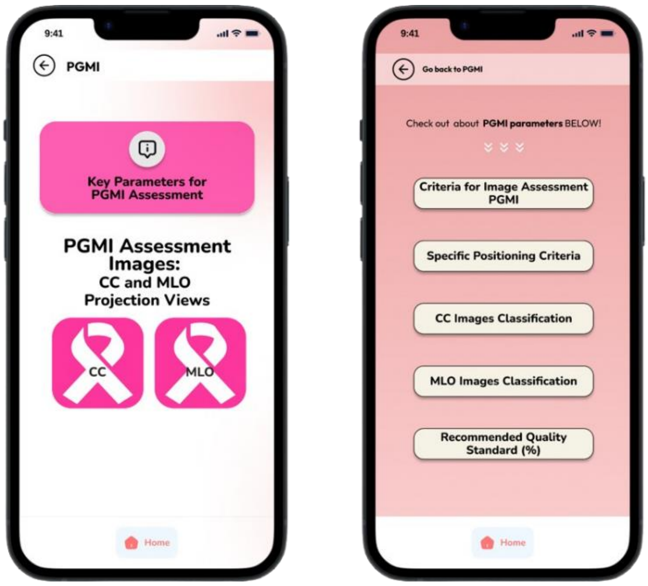


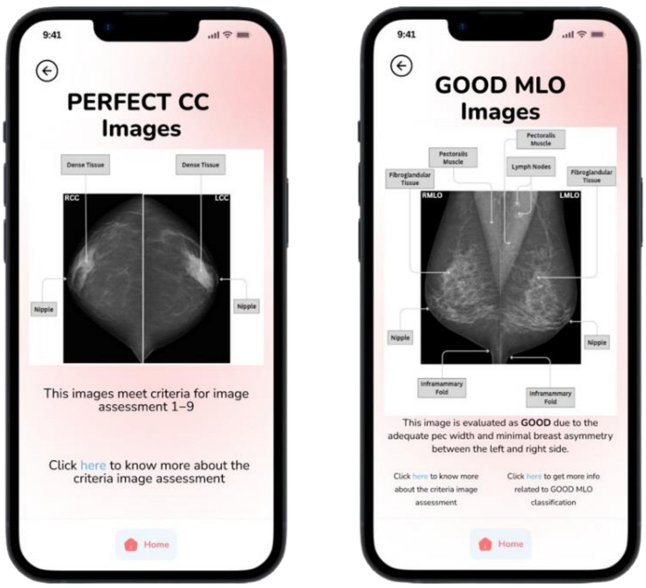
Fig. 2 Home Page of PGMI.Vision Mobile Application.

For each of the CC and MLO projection views, the images are categorized into four quality levels: Perfect, Good, Moderate, and Inadequate. This categorization allows users to analyze the image quality of the breast. Each image includes annotations of anatomical structures along with explanations of why it is classified as Perfect, Good, Moderate, or Inadequate. As shown in Figure 4, examples of each category in PGMI, Perfect, Good, Moderate, and Inadequate are provided. The annotated anatomical structures on each image assist users in understanding and identifying the fundamental parameters required for PGMI classification for both CC and MLO image views. Figure 4(a) illustrates a Perfect category example for the CC view, while Figure 4(b) shows an example of the Good category for the MLO image view.



(a) (b)

Fig. 3 PGMI Image Quality Page (a) optional image views on CC and MLO while (b) selection on the PGMI parameters.



(a) (b)

Fig. 4 (a) PGMI of Perfect category for CC view, (b) Good category for MLO view of mammographic breast images.

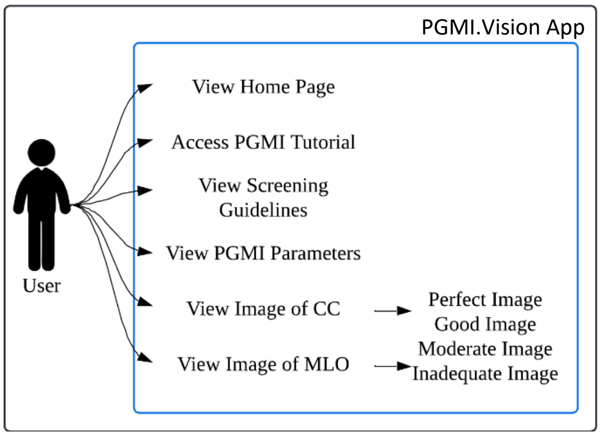


Fig. 4 Use Case Diagram.

App Performance Analysis

System Evaluation

After designing the application, a testing phase was carried out throughout the implementation stage to validate the software's accuracy and minimize errors. The black box testing approach was used to assess system functionality by inspecting the system's input-output behavior instead of analyzing its internal code structure (Chen & Poon, 2004; Williams, 2006). This technique is commonly used in software testing to ensure that a system's functional requirements are met (Chen & Poon, 2004; Williams, 2006). Black box tests are conducted from the perspective of the user, as this helps to discover inconsistencies (Jampani et al., 2016). Test cases were created based on the application's functional specifications and visualize using Use Case Diagram as in Figure 5, demonstrating user interactions such as accessing the app tutorial, navigating screening guidelines, and analyzing PGMI parameters through CC and MLO projection. Scenarios included traveling between pages (Home, PGMI, and Guidelines) and confirming accurate data in CC and MLO views.

In addition, a flowchart as in Figure 6 was developed to illustrate the steps taken during black box testing. For example, the Home Page Test Case evaluated to see if each button appropriately redirected users to the intended destinations. The flowchart shows the process where the user clicks on the "App Tutorial" button (input), expects to be routed to the tutorial page (anticipated output), and the system completes the redirection with no issues (actual output). This step-by-step visual representation demonstrates how the testing process guarantees that the system performs as intended from the user's perspective. The same procedures are used for the other test case.

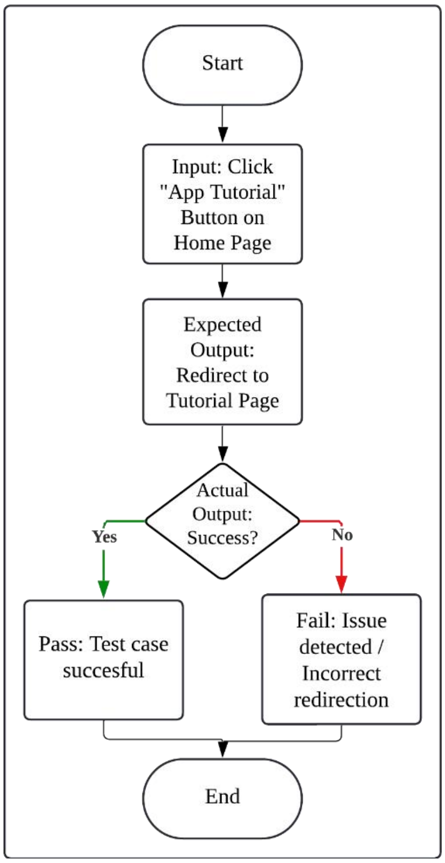


Fig. 5 Flowchart outlining test cases and expected vs. actual outcomes.

Research Instrument

The primary research instrument used in this study was the USE Questionnaire, selected for its comprehensive ability to evaluate system usability in terms of effectiveness, efficiency, and user satisfaction (Arifin & Maharani, 2021). This questionnaire consists of 30 statements grouped into four parameters: Usefulness, Satisfaction, Ease of Use, and Ease of Learning. Respondents rated their agreement with these statements on a 5-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree." Table 1 provides a detailed breakdown of the USE Questionnaire’s structure and parameters.

The questionnaire was adapted to align with the specific requirements of this study, ensuring relevance to the usability evaluation of PGMI.Vision. Google Forms was utilized as the platform for data collection, with the form divided into five sections, a Demographic Section and four sections corresponding to the parameters of the USE Questionnaire (Usefulness, Satisfaction, Ease of Use, and Ease of Learning). The demographic section gathered respondent characteristics such as gender, occupation, and years of experience in the field. A total of 27 responses were collected, with all respondents completing every section of the questionnaire.

To analyze the collected data, Google Sheets was employed, enabling systematic evaluation of the responses. The USE Questionnaire results provided valuable insights into the usability of PGMI.Vision, highlighting areas for potential improvement in system design and functionality. This instrument's structured approach allowed for a thorough assessment of user perceptions and preferences, ensuring alignment with the study's objectives.

Table 1 The questionnaire using the USE approach

Usefulness	
1	It helps me be more effective
2	It helps me be more productive
3	It is useful
4	It gives me more control over the activities in my life
5	It makes the things I want to accomplish easier to get done
6	It saves me time when I use it
7	It meets my needs
8	It does everything I would expect it to do
Ease of Use	
9	It is easy to use
10	It is simple to use
11	It is user-friendly
12	It requires the fewest steps possible to accomplish what I want to do with it
13	It is flexible
14	Using it is effortless
15	I can use it without written instructions
16	I don't notice any inconsistencies as I use it
17	Both occasional and regular users would like it
18	I can recover from mistakes quickly and easily
19	I can use it successfully every time
Ease of Learning	
20	I learned to use it quickly
21	I easily remember how to use it
22	I easily remember how to use it
23	I quickly became skillful with it
Satisfaction	
24	I am satisfied with it
25	I would recommend it to a friend
26	It is fun to use
27	It works the way I want it to work
28	It is wonderful
29	I feel I need to have it
30	It is pleasant to use

Usability Testing and Analysis

Usability testing for PGMI.Vision was conducted through remote unmoderated testing, where participants receiving tasks via online platforms such as WhatsApp or Telegram. This approach was chosen for its flexibility, allowing participants to perform activities at their own pace without direct supervision (Relawati et al., 2022; Rizal et al., 2020). Participants accessed the PGMI.Vision mobile app from a provided link, explored its different features, and submitted feedback using a Google Form questionnaire. The activities focused on specific app features, such as navigating the Home Page, accessing the PGMI tutorial, reviewing screening rules, analyzing PGMI parameters, and assessing image examples. Feedback was also acquired on usability and overall user experience. Remote unmoderated testing was chosen over in-person or moderated testing because it involved a bigger, diverse group of participants, avoided interviewer bias, and allowed users to interact with the app in a natural, real-world situation for more realistic feedback. However, it has limitations, such as the inability to clarify confusion or follow up on responses in real time (Relawati et al., 2022; Rizal et al., 2020).

The collected data was systematically and automatically analyzed and calculated using Google Sheets. The percentage scores for each parameter in the USE questionnaire were calculated using the formula provided in Equation (1)(Rizal et al., 2020):

$$Percentage = \frac{Amount\ Filled}{Total\ Number} \times 100\% \quad [1]$$

"Amount Filled" refers to the total mean score filled for all questions in a parameter by all respondents, and "Total Number" represents the total expected score for all questions in that parameter. This calculation method helped to quantify user satisfaction, usability, and other key metrics. No statistical analysis was performed on the demographic data itself, but the inclusion of this data was crucial to assess the diversity of participants and ensure that their feedback was relevant to the target user base.

Study Participants

The study included a diverse group of participants to ensure that the sample properly reflected the desired user base. Participants included radiographers, technicians, medical imaging students, and healthcare professionals with varying levels of breast imaging experience or general imaging knowledge. Participants required basic medical imaging knowledge and access to mobile devices. Those with limited knowledge of breast imaging or medical imaging were excluded from the study. Participants' demographic information included age, gender, professional background, and years of field experience. This data was used to assess the sample's representativeness and to ensure that the information presented was diverse.

RESULTS AND DISCUSSION

Software Performance

The PGMI.Vision application underwent a black box testing phase, as shown in Figure 5, to validate its functionality and ensure minimal errors. Criteria for success were predefined and included accurate redirection of users, appropriate data display, and error-free performance during simulated user interactions. Table 2 summarizes the black box testing results, which revealed that most components performed as expected.

Table 2 PGMI.Vision Mobile Application Component Testing

Test Components	Test Components	Result	Remark
App Tutorial Button	To show another page	The system displays the app tutorial page	Succeed
Screening Guideline Button	To show another page	The system displays the screening guideline page	Succeed
PGMI Button	To show another page	The system displays the PGMI page	Succeed
CC Projection View Button	To show another page	The system displays the PGMI CC Images (Perfect, Good, Moderate and Inadequate)	Succeed
MLO Projection View button	To show another page	The system displays the PGMI MLO Images (Perfect, Good, Moderate and Inadequate)	Succeed
Key Parameters for PGMI Assessment Button	To show another page	To show another page The system displays the key parameter page	Succeed
Home Button	To exit the app to Home Page	The system automatically goes back to the home page	Succeed

Minimal error was determined based on two factors, the absence of major functionality failures such as incorrect page redirection or missing data and the system's ability to handle user interactions without crashing or producing incorrect outputs. The results showed that all tested components met these criteria, ensuring a reliable and seamless user experience.

The findings confirmed that the application fulfilled its functional requirements, providing a dependable and user-friendly experience.

Usability Analysis

Demographic Analysis

The demographic of the respondents was classified into three demographic questions, which are gender, occupation and years of experience in the field.

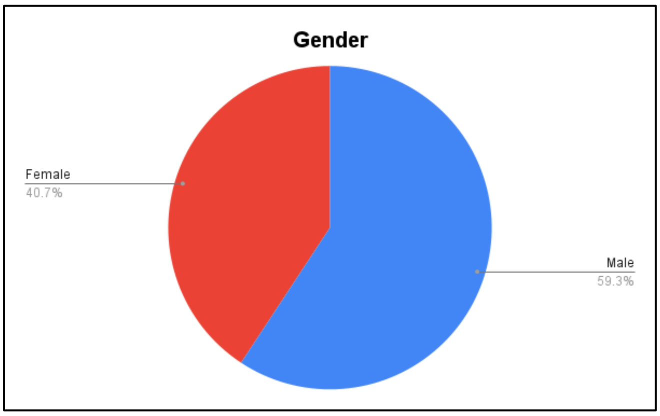


Fig. 6 The gender of the respondents.

As illustrated in Figure 5, it becomes apparent that the predominant user demographic comprises males, constituting a notable 59.3% of the respondents. This statistic implies that 16 male respondents demonstrated a heightened interest in the mobile application. Conversely, the remaining 40.7% of respondents were identified as females, indicating that 11 female respondents engaged with the mobile application. This demographic breakdown provides valuable insights into the gender-based utilization patterns of the PGMI.Vision mobile application among the surveyed participants.

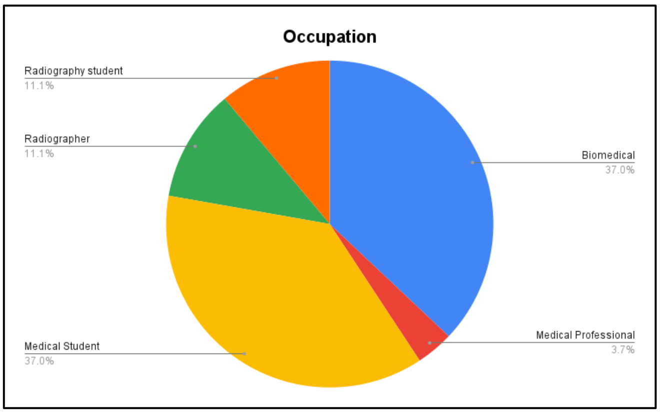


Fig. 7 Occupation of the respondents.

This study targets five distinct respondent groups, radiography students, radiographers, medical professionals, medical students, and biomedical engineers or technicians. Figure 6 reveals that two occupations stand out with the highest percentage of respondents, namely medical students and biomedical engineers/technicians, each comprising 37% of the total respondents. This percentage translates to 10 respondents in each of these groups. Additionally, the occupations of radiographers and radiography students each account for 3 respondents, contributing to 11.1% of the overall respondents. Lastly, the medical professional category has only 1 respondent, constituting 3.7% of the total respondents. Based on these findings, it can be concluded that this study successfully

Table 3 Usefulness parameter analysis result

I. Usefulness								
Question	1	2	3	4	5	6	7	8
Mean Score	3.9	3.89	4.19	4.11	4.22	4.15	4.11	4.07
Total Mean Score	32.67							
Percentage	81.67%							

obtained feedback from each designated respondent group, laying the groundwork for subsequent usability testing analyses.

According to Figure 7, it is observed that 48.1% (n=13) possess experience ranging from one to five years in their respective fields. Additionally, 37% (n=10) of respondents, have less than one year of experience in their field. Moreover, there is a distribution of 7.4% of respondents, with two individuals each falling into five to 10 years and above 10 years of experience in their respective fields.

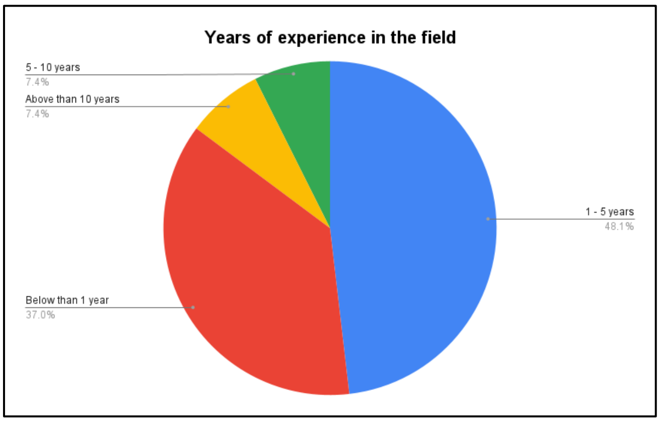


Fig. 8 Years of experience in respondents' respective field

meeting user needs. According to Table 3, the average value for the Usefulness parameter is 81.67%, signifying a high value that closely approaches the maximum. This outcome suggests that PGMI.Vision holds significant potential to support medical professionals or related occupations by serving as a valuable reference for evaluating mammographic image quality based on PGMI parameters.

Table 4 presents the outcomes for the Ease-of-Use parameter from the USE questionnaire, which evaluates how easily a system can be used (Hariyanto et al., 2020). The Ease-of-Use score reached 81.82%, indicating a high usability level due to its closeness to the maximum score. This aligns with Hariyanto et al. (2020) findings, which highlighted the importance of intuitive interfaces for enhancing user satisfaction. The current study reinforces this by demonstrating that PGMI.Vision offers a user-friendly experience, effectively meeting the usability expectations of its target audience.

Table 5 presents the analysis results for the Ease-of-Learning parameter, a dimension in the USE questionnaire that evaluates a user's ability to quickly acquire knowledge and skills to interact with the system effectively (Hariyanto et al., 2020). The Ease-of-Learning score reached 80.93%, a high value close to the maximum, indicating that the PGMI.Vision application enables users to become proficient even on their first use.

Table 3 Ease of use parameter analysis result

II. Ease of Use											
Question	9	10	11	12	13	14	15	16	17	18	19
Mean Score	4.04	4.41	4.37	4.15	4.00	4.37	4.19	3.70	3.89	3.93	3.96
Total Mean Score	45.00										
Percentage	81.82%										

Usability Data Analysis

Sections 2 to 4 of the Google Form encompass the USE questionnaire, with each section dedicated to a specific parameter: Usefulness, Ease of Use, Ease of Learning, and Satisfaction. Respondents answered these questionnaires based on their experiences with the PGMI.Vision mobile application.

Table III presents the analysis results for the Usefulness parameter. Within the USE questionnaire, Usefulness evaluates the perceived effectiveness of a system in achieving its intended purpose, as the extent to which users believe utilizing a specific system would positively enhance their job performance (Hariyanto et al., 2020). This parameter is a key dimension in the usability assessment, gauging the system's effectiveness in

Table 5 Ease of learning parameter analysis result

III. Ease of Learning				
Question	20	21	22	23
Mean Score	4.04	3.89	4.15	4.11
Total Mean Score	16.19			
Percentage	80.93%			

Qualitative feedback from participants further supports these findings. Users consistently noted that the app was easy to use and understand, with a compact design and clear input features. More experienced participants highlighted the potential for improvement by incorporating diverse mammogram images for every projection to enhance usability for various cases. Overall, the app demonstrates user-friendliness, particularly for first-time users or those with minimal technical expertise, while providing opportunities for refinement in future iterations.

Table 6 displays the results of the analysis for Satisfaction parameters. This parameter delves into the user's emotional response and overall satisfaction with the system, playing a vital role in evaluating alignment with user needs, expectations, and predicting future usage likelihood. The average value of the Satisfaction parameter is 79.68%, also considered high as it is in proximity to the maximum value. This implies that the PGMI.Vision mobile application has the potential for future use, meeting users' needs effectively.

characteristics, which could affect their exposure to different cases. Moreover, the app may not allow a comprehensive assessment of the quality of mammograms, as it only shows one example for each criterion, which could miss some subtle variations. Furthermore, the app may limit the educational value of the PGMI evaluation, as the users only learn from one example for each category, which could reduce their understanding of the PGMI criteria.

To address the limitation of providing only one mammogram image for each PGMI criterion, future app versions may implement some mitigation strategies. A potential strategy is to incorporate a larger image from the database that can display a wider range of cases for each criterion. Another potential strategy is to gather user feedback on the appropriateness of the images and refine them based on their opinions. A last strategy would be to enhance the app regularly with more images to increase the learning value and the quality of assessments.

Table 6 Satisfaction parameter analysis result

IV. Satisfaction							
Question	24	25	26	27	28	29	30
Mean Score	3.93	4.04	4.00	3.93	4.07	4.00	3.93
Total Mean Score	27.89						
Percentage	79.68%						

The average value for the parameters of Usefulness, Ease of Use, Ease of Learning, and Satisfaction is 81.02% (Table 7). This value serves as the comprehensive result of the PGMI.Vision mobile application's overall usability analysis based on these four parameters. The notably high average value, closely approaching the maximum, suggests that the PGMI.Vision mobile application has successfully fulfilled its intended purpose. It is deemed to be user-friendly and exhibits significant potential for future use, effectively meeting the needs of its users.

Table 7 Usability testing overall result

	Average Score Percentage
Usefulness	81.67%
Ease of Use	81.82%
Ease of Learning	80.93%
Satisfaction	79.68%
Average	**81.02%**

Limitation and Challenges

Although the PGMI.Vision app aims for precision and consistency, one of the main limitations of the PGMI. Vision app only provides one mammogram image for each PGMI criterion, covering both the CC and MLO projections. This means that the users may not see enough variation in the image

CONCLUSION

In conclusion, our journey to enhance mammogram assessment through the PGMI Vision app has been a significant stride towards addressing the challenges faced by the conventional PGMI classification in Malaysia. The introduction of a mobile application provides a precise and consistent framework for implementing PGMI evaluation criteria, overcoming the hurdles of objectivity and clarity.

Usability testing has been instrumental in refining the app, ensuring it aligns seamlessly with user expectations. The pre-testing surveys laid the foundation for understanding user perspectives and have been crucial in tailoring the app to meet diverse needs.

This project is pivotal in revolutionizing mammography image quality evaluation, promising a more standardized and efficient approach. The PGMI. Vision app stands as a testament to innovation in healthcare technology, offering a user-friendly interface for accurate parameter assessment.

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