

IMAGE-BASED RECOGNITION OF HERBAL PLANTS AND FLOWERS USING CONVOLUTIONAL NEURAL NETWORKS FOR INNOVATIVE LEARNING

Ronald B. Fernandez*, Vivien A. Agustin², Jennifer Contreras³

Universidad de Manila¹, Pamantasan ng Lungsod ng Maynila², Dela Salle University³

*Correspondence Email : rfernandez042176000111@gmail.com , agustin.vivien0406@gmail.com, jennifercontreras@gmail.com

ABSTRACT

In the current era of rapid technological advancements, there is a significant increase in the demand for technology applications, which are evolving at an astonishing pace. Consequently, obtaining appointments for minor illnesses at hospitals became increasingly difficult due to the overwhelming number of COVID-19 cases. However, being resilient as Filipinos are, the majority tried to find alternative ways to treat minor health concerns by using herbal plants. This study aims to determine the key functionalities required in a mobile application to facilitate innovative learning approaches and effectively enhance students' knowledge and understanding of herbal plants, including their applications and uses. Convolutional neural network is used to develop a real-time image-based recognition system for herbal plants and flowers and a dataset of herbal plants and flowers photos were used to train the system. The mobile application system's functionalities were assessed by learners using ISO 25010, and the findings reveal that the system can identify various herbal plants and flowers with high accuracy. It was concluded that the mobile application functionalities (3.92) are the highest consideration in designing the mobile application to achieve innovative learning when it comes to plants as compared to portability (3.86), usability (3.85), reliability (3.80), and maintainability (3.64).

KEYWORDS

Herbal Plants, Convolutional Neural Network, Artificial Intelligence, Image recognition



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INTRODUCTION

In the current era of rapid technological advancements, there is a significant increase in the demand for technology applications, which are evolving at an astonishing pace. This progress allows individuals to benefit from remarkable breakthroughs such as self-driving cars, personalized medicine, and quantum computing. As the field of Artificial Intelligence (AI) relentlessly advances, new machine learning technologies are continuously emerging, equipped with remarkable capabilities to analyze, interpret, and make accurate predictions that have become very useful in healthcare and education.

During the pandemic lockdown, government agencies, private companies, schools, and hospitals faced constraints in providing comprehensive services and ensuring accessibility due to the enforced lockdown measures aimed at preventing the transmission of COVID-19. Consequently, obtaining appointments for minor illnesses at hospitals became increasingly difficult due to the overwhelming number of COVID-19 cases. Additionally, due to the heightened fear of contracting the virus, many individuals are reluctant to visit hospitals, considering the significant number of COVID-19-related deaths. However, being resilient as Filipinos are, the majority tried to find an alternative way to treat minor health concerns by using herbal plants to refrain from going out and acquiring the virus.

The Philippines boasts a rich array of plant and flower species, encompassing thousands of varieties that hold potential applications in traditional medicine. Indeed, the Philippines has a notable tradition of utilizing herbal plants for the treatment of minor health issues, particularly in rural areas. However, a concerning trend persists among Filipinos, especially students, as they lack essential knowledge regarding specific types of herbal plants and flowers, their corresponding benefits, and their practical uses. Insufficient information acts as a deterrent, leading to the widespread oversight of herbal plants and flowers, as individuals struggle to differentiate between herbal and non-herbal varieties. Consequently, there exists a significant knowledge gap concerning the names, uses, benefits, and other relevant information pertaining to herbal plants and flowers. This lack of awareness hinders their potential as effective remedies for various ailments. Moreover, distinguishing between herbal and non-herbal plants and flowers poses a challenge, as certain species may share similar appearances, adding to the confusion.

Moreover, the lack of knowledge about herbal plants and their uses presents an opportunity for innovative learning approaches using mobile applications to aid learners in identifying plants and their proper uses. By integrating innovative learning approaches, students can develop a deeper understanding of herbal medicine, foster critical thinking skills, and cultivate an appreciation for the rich cultural and natural heritage of the Philippines. This study aims to determine the key functionalities required in a mobile application to facilitate innovative learning approaches and effectively enhance students' knowledge and understanding of herbal plants, including their applications and uses. By investigating these research questions, the study aims to delve into the potential of mobile applications as an innovative and effective learning tool. Specifically, the focus is on enhancing learners' knowledge of herbal plants, including their identification and practical applications. The findings of this research will provide valuable insights for Filipinos, enabling them to harness the power of herbal plants more effectively. Moreover, it will contribute to fostering a deeper understanding and appreciation of herbal medicine among individuals, leading to improved healthcare practices and overall well-being.

The development of a mobile application incorporating real-time image-based recognition of herbal plants serves as a valuable tool for users to effortlessly access comprehensive information about various herbs. Through visual identification, users can quickly learn about the scientific background, proper uses, and herbal treatments associated with popular herbs. Moreover, the primary objective of this study is to assist users in accurately identifying plants. To achieve this goal, a user-friendly mobile application was developed using Convolutional Neural Networks (CNN) that empowers a wide range of users to gain a comprehensive understanding of specific herbal plants and their appropriate uses.

RESEARCH METHOD

This study involved a series of steps to create a mobile application for recognizing herbal plants. These steps encompassed the development of a dataset containing images of herbal plants, the construction of CNN models, image processing, training the CNN model, evaluating its performance, and ultimately implementing the model into a mobile application for the recognition of medicinal plants. These advancements reflect the current era's rapid technological progress, where the demand for technology applications is growing rapidly and evolving at an astonishing pace.

The growing interest in the recognition and utilization of herbal plants for their potential benefits and the rich biodiversity of herbal plants in various regions offer a vast resource for traditional medicine and alternative healthcare practices. However, the accurate identification and understanding of herbal plants can be challenging, particularly for individuals lacking expertise in botany and traditional knowledge. To address this challenge, advancements in technology, specifically the development of mobile applications, provide an opportunity to enhance knowledge and accessibility in this domain.

The proposed study is a real time image-based recognition of herbal plants using convolutional neural networks. In order to identify objects, recognize faces, and other things, this study employed CNN for image identification and classification. To understand the Convolutional Neural Network, it is a deep learning algorithm that works by obtaining a picture, giving it a weight depending on the various items in the image, and then separating them from one another. The proponents applied CNN because of its capability to be recognized and classified because of its high accuracy by using multi-channeled visuals and being prompted by loudness. Convolutional Neural Networks are unable to distinguish between width and height-only flat pictures, which humans can perceive. Red-blue-green (RGB) encoding in digital color pictures causes the Convolutional Neural Network to combine those three colors to create the color spectrum that humans can see, such as pictures taken in by a neural network as three distinct color strata piled on top of one another. The width and height of a typical color picture are represented by the number of pixels from those dimensions. Channels are the depth levels in the three layers of RGB colors that Convolutional Neural Networks understand.

A CNN has multiple hidden layers that help extract information from an image.

1. Extract the features of the object on the image locally.
2. All the pixels with a negative value will be replaced by zero.
3. Reduce the dimensionality of the input image to pool the input image, use the maximum value of the feature map.
4. Connect all the neurons from the previous layer to the next layer.

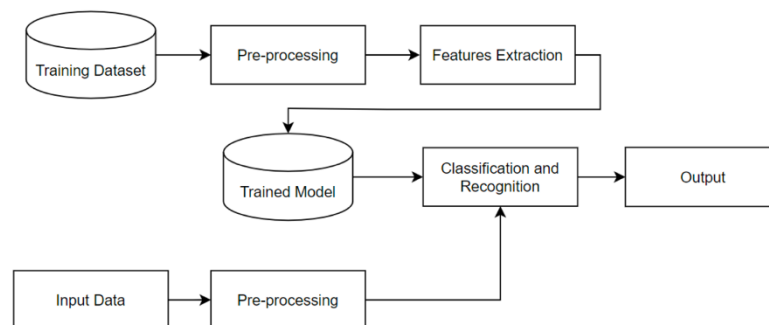


Figure 1. Machine Learning Model Development

The diagram provides a clear visualization of the sequential phases involved in the operation of the model. It begins with the dataset, which consists of a diverse collection of plant images that serve as input for the CNN model.

The preprocessing phase plays a crucial role in preparing the images for classification. In this phase, the images are carefully categorized into distinct classes by assigning appropriate labels. This step ensures that the CNN model can effectively distinguish between different types of plants during the training process. By categorizing the images into specific classes, the model can learn to recognize and differentiate various plant species based on their visual features. This preprocessing step lays the foundation for the subsequent phases, enabling the model to extract meaningful patterns and features from the input images.

The CNN consists of two main components: the feature extraction network and the classifier network. The convolution layer performs convolution operations, capturing essential features from the input images, while the pooling layer reduces the dimensions of the plant image representation. The classifier network utilizes fully connected layers to classify the images based on the outputs obtained from the preceding convolutional and pooling processes. Once the feature extraction from the images is complete, all the extracted features are aggregated and compiled into a model file that can be conveniently downloaded and imported into the application's program.

The classifier network uses fully connected layers to classify the image based on the convolution/pooling process outputs. After the extraction of features from photos, all features are collected and ready for download as a model file to be imported into the program. During the classification and recognition phase, users can take a photo or upload images of plants and flowers that they want to identify, and the name and benefits of the herb will be displayed.

3.1. System Design

To develop a mobile-based identifier application for herbal plants and flowers that can be used by everyone. The researchers use CNN for recognizing, classifying, and differentiating herbal plants and flowers with high accuracy. CNN is a machine learning algorithm that can take in an input image, evaluate various elements and objects inside the image, and distinguish between them. The goal of developing a mobile-based identifier for herbal plants and flowers is to encourage and help users recognize and develop an interest in learning about herbal plants and flowers based solely on an image.

Specifically, the proponents also aim for the following functionalities for their system: First, to develop a mobile based identifier for herbal plants and flowers with a health news section wherein users will be informed of any health issues. Second, to develop an application that has a scanner that will allow users to capture and upload images of the plants and flowers. Third, to develop an application that will provide information about the herbs and also categorize them according to what illness or disease they can be used to treat. And fourth, to develop an application wherein users can add their favorite images of herbal plants and flowers to the favorites section.

The regular plants even on normal days. The customers are always looking for herbals such as sweet basil, peppermint, and serpentina. Lastly, the proponents conducted a survey wherein the questions were based on the popularity of herbal plants and flowers. Also, it includes some questions regarding the effectiveness of herbal products. Based on the results of the survey, some of the respondents believe that herbal products are effective to treat some illnesses. Unfortunately, most people answered that they are not familiar with some herbal plants and flowers, concluding to why they chose to ignore herbal plants and flowers because they are not knowledgeable enough and it is hard for them to distinguish

between herbal and non-herbal. Moreover, the proponents will be using the internet to gather information about herbal plants and flowers. Since the proposed study is health related, the application will be having a news feature, wherein the user will be informed about the latest health news. The proponents sent an approval letter via email to DOH to authorize the proponents to use their website as the source of the latest news.

This section will go through the newly designed system's functionality in accordance with the study's stated objectives.

3.1.1 Plant Information

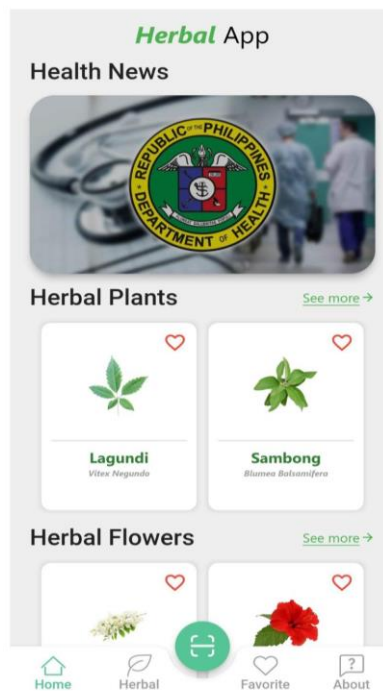


Figure 2. Main screen of the proposed application

Figure 2 provides a visual representation of the main screen of the newly developed application, showcasing essential features and information pertaining to each herbal plant and flower. The user interface prominently displays the details of the identified herbal plants and flowers, allowing users to access comprehensive information about their names, uses, benefits, and other relevant details.

Furthermore, the application offers a direct link to the Department of Health (DOH) website, enabling users to stay updated with the latest health news and relevant information. This feature enhances the user's ability to access credible and current information related to health and herbal medicine.

Figure 2 showcases the main screen of the newly developed application, offering users a comprehensive view of essential features and information related to each herbal plant and flower. The user interface prominently presents the details of identified herbal plants and flowers, providing users with access to vital information such as names, uses, benefits, and other relevant details. This intuitive display empowers users to explore and learn about different herbal plants and flowers effortlessly.

In addition to the herbal plant information, the application's main screen features a direct link to the Department of Health (DOH) website. This integration enables users to stay informed with the latest health news and updates, ensuring access to credible and up-

to-date information. Moreover, the application includes a convenient list of herbals, allowing users to easily navigate through a wide range of options and discover plants of interest based on their preferences and needs. With the inclusion of a "Favorite" button, users can effortlessly save their preferred herbal plants and flowers for future reference, streamlining their access to frequently used information. Lastly, the "About" button offers users additional insights about the application, providing details about the development team and the application's purpose, enhancing transparency and user understanding.

Overall, Figure 2 represents an intuitive and user-friendly main screen interface, presenting crucial features that facilitate seamless navigation and enhance the overall user experience. With its emphasis on accessible information, direct links, and personalized functionality, the application strives to empower users in their exploration and understanding of herbal plants and flowers.

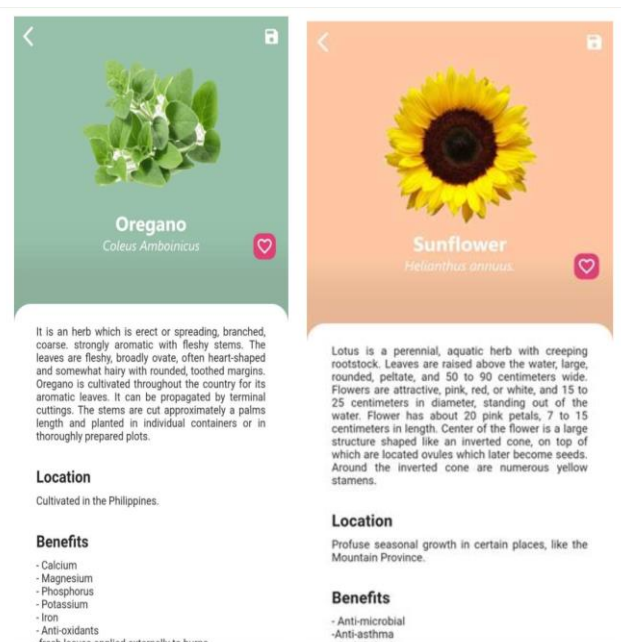


Figure 3. About herbal plants and flowers

The descriptions of each distinct herbal plant and flower are shown in Figure 5.2. It displays information about medicinal plants, flowers, and other related topics.

3.1..2. An application that provides comprehensive information on herbal plants and flowers.

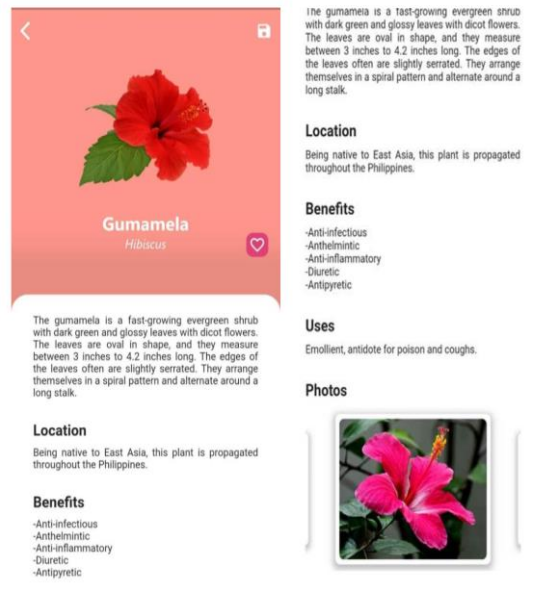


Figure 4. Information of herbal plants and flowers

The names, benefits, and usage of the herbs are all explicitly depicted in Figure 4. Further visuals of the plants and flowers of the various herbs are also included for additional visual references.

3.3 A mobile-based application that displays different kinds of herbal plants and flowers

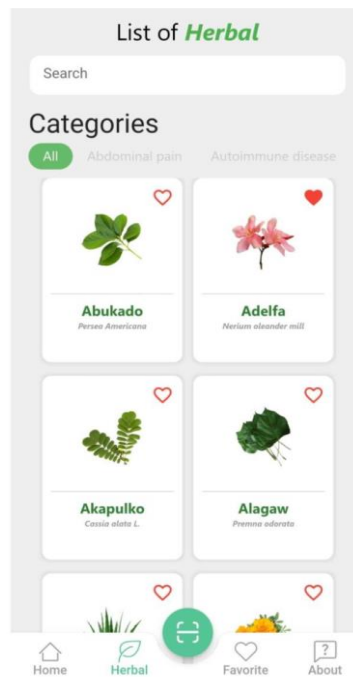


Figure 5. List of different kinds of herbal plants and flowers

Figure 5 shows the list of medicinal plants and flowers. The list is categorized according to what illness it can be used for. You can click the herb to view information on it, which will include its uses, advantages, and location, as well as some images. Users can

look for specific herbs using the search bar, and they can browse the categories by illnesses to identify plants and flowers that are traditionally used to treat those illnesses.

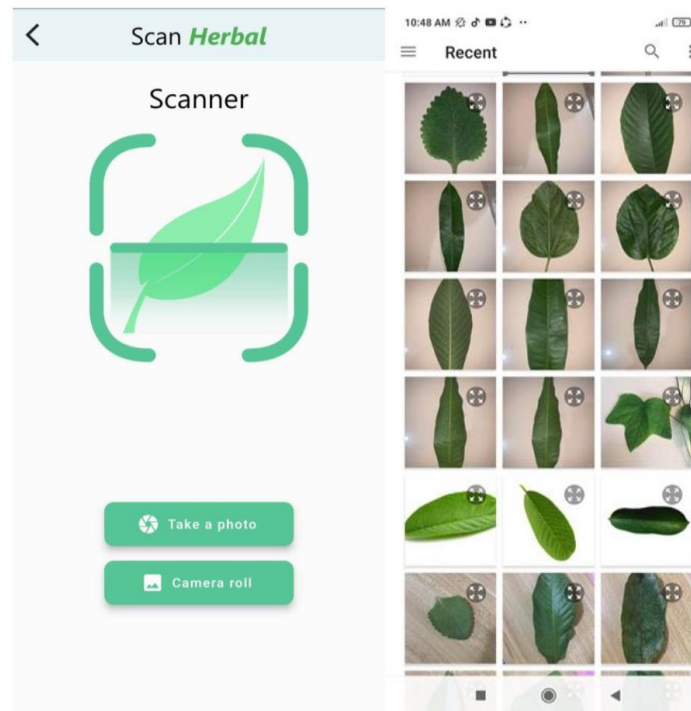


Figure 6. Scanner and Upload button

The figure shows how users can upload photos of flowers and medicinal plants using the camera on their mobile phones. To display information on specific plants and flowers, they can also scan and upload photographs of the plants and flowers.

RESULT AND DISCUSSION

The functionality of the developed system and the results of the evaluation are covered. Every criteria in the survey form is based on ISO 25010 standards, which are Functionality, Usability, Reliability, Maintainability, and Portability. A total of 100 respondents were able to answer the survey questionnaire for the newly developed application to determine how a mobile application will be designed and implemented to aid learners in identifying various herbal plants and understanding their proper uses.

4.1. Evaluation of the Newly Developed System

The evaluation of the newly developed system encompasses various criteria, including functionality, usability, reliability, maintainability, and portability. These criteria adhere to the guidelines set forth by the ISO 25010 standard, ensuring a comprehensive assessment of the system's performance and effectiveness.

- Functionality refers to the system's ability to perform the intended tasks and meet the specified requirements. The evaluation of functionality involves assessing whether the developed system successfully fulfills its intended purpose, such as accurate herbal plant recognition, information retrieval, and user interaction.
- Usability focuses on the ease of use and user experience provided by the system. It involves evaluating factors such as user interface design, navigability, and

intuitiveness to determine how effectively users can interact with the system and accomplish their tasks.

- Reliability measures the system's ability to consistently deliver accurate results and maintain stable performance over time. It involves assessing factors such as error handling, system availability, and the system's ability to handle unexpected situations or exceptions.
- Maintainability evaluates the ease of maintaining and updating the system in the long run. This criterion considers aspects such as code quality, modularity, and documentation to determine the system's ability to undergo future enhancements, bug fixes, and adaptations.
- Portability assesses the system's adaptability and compatibility across different platforms and environments. It involves evaluating whether the system can be seamlessly deployed and run on various devices and operating systems, ensuring its accessibility and availability to a wide range of users.

By employing the ISO 25010 standard and considering these evaluation criteria, a comprehensive assessment of the newly developed system can be conducted. This evaluation provides valuable insights into the system's functionality, usability, reliability, maintainability, and portability, enabling the identification of strengths, weaknesses, and areas for improvement, ultimately ensuring the system's overall effectiveness and success.

A Likert Scale, a commonly used measurement tool in social science research, was employed in this study to assess participants' responses and perceptions. The Likert Scale is a psychometric scale that allows individuals to express their level of agreement or disagreement with a series of statements or items. In interpreting the Likert Scale responses, the following guidelines were used:

Table 1. Verbal Interpretation Reference on Weighted

Scale	Interpretation	Descriptive Equivalent
1	1.00 – 1.49	Needs Improvement
2	1.50 – 2.49	Fair
3	2.50 – 3.49	Satisfactory
4	3.30 – 4.49	Very Satisfactory
5	4.50 – 5.00	Excellent

Table 1 shows the verbal interpretation references for the weighted mean. A weighted mean is a type of average that takes into account the importance or weight of each value in the set. The given scale is used to interpret the result of a weighted mean calculation, where a score in the range of 1.00 to 1.49 means that the performance is in need of improvement; a score in the range of 1.50 to 2.49 means that the performance is fair; a score in the range of 2.50 to 3.49 means that the performance is satisfactory; a score in the range of 3.50 to 4.49 means that the performance is very satisfactory; and a score in the range of 4.50 to 5.00 means that the performance is excellent.

4.1.1 Functionality

Functionality refers to the capabilities and features of a product or system. It is the degree to which a product or system meets its intended purpose or function. In other words, functionality is a measure of how well a product or system does what it is supposed to do. Functionality can be used to evaluate the performance of a wide range of products, including software, hardware, and mechanical devices.

Table 2. Verbal Interpretation Reference on Weighted

Functionality	Weighted Mean	Verbal Interpretation
The application's button is easy to press.	4.95	Excellent
The application's features are functional.	4.95	Excellent
The application operates well.	4.95	Excellent
The application met all of the user objectives and requirements.	4.75	Excellent
General Weighted Mean	3.92	Very Satisfactory

As shown in Table 2, the weighted mean of the first sub-criteria of functionality is 4.95, which indicates that respondents proved that the button of the application is easy to press. The second sub-criteria got 4.95, which indicates that the respondents agreed that the application's features are functional. The third sub-criteria got a 4.95 weighted mean, implying that the application operates well. The fourth sub-criteria got a 4.75 weighted mean, which also indicates that the application met all the objectives and requirements of the user. As a summary of the functionality criteria, the system got a 3.92 general weighted mean, which means that recognition of herbal plants and flowers is well functioning, as proven by the respondents.

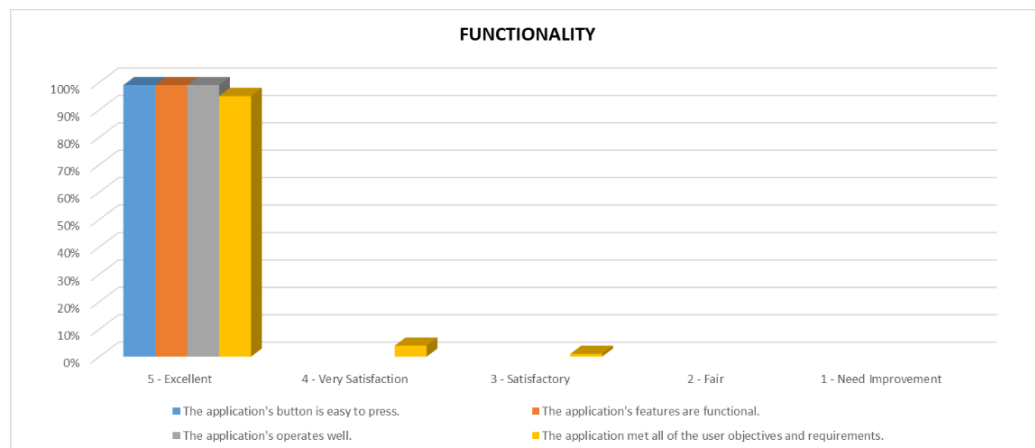


Figure 7. Qualitative Evaluation of Functionality

4..1.2 Usability.

Usability refers to the ease of use and learnability of a product or system. In other words, usability is a measure of how well users can accomplish their tasks using a product. It refers to the ease of use and learnability of a product or system. In other words, usability is a measure of how well users can accomplish their tasks using a product.

Table 3. Verbal Interpretation Reference on Weighted

Functionality	Weighted Mean	Verbal Interpretation
The application is user friendly	4.95	Excellent
By using this application, users become more familiar with herbals.	4.8	Excellent
A user interface enables pleasing and satisfying interactions for the users.	4.75	Excellent
The software meets existing usability standards.	4.75	Excellent
General Weighted Mean	3.85	Very Satisfactory

Table 3 shows the weighted mean of usability criteria. The first sub-criteria receives a score of 4.95, indicating the application is user friendly. The second sub-criteria got 4.8, specifying that by using the application, users become more familiar with herbals.

The third sub-criteria obtained 4.75, indicating that a user interface enables pleasing and satisfying interactions for the users, and last but not least, the last sub-criteria also acquired 4.75, indicating that the software meets existing usability standards. Overall, the average of the usability criteria is 3.85, which means the respondents understand how they use the application and how it works.

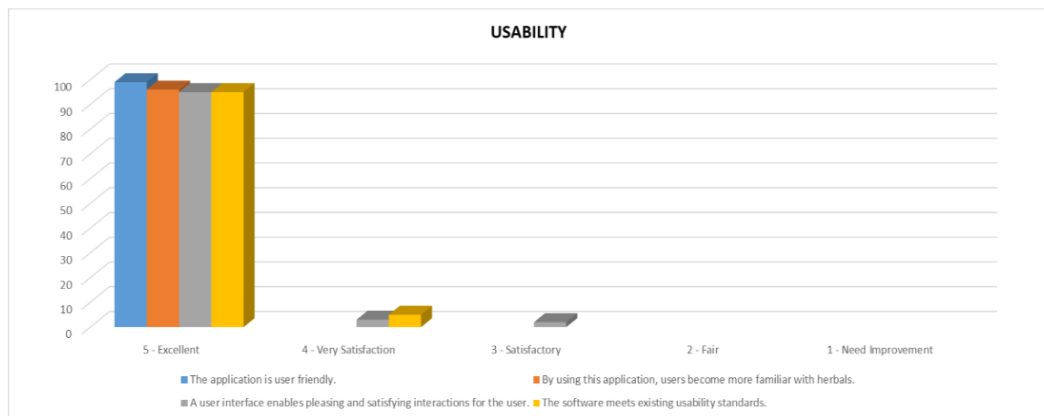


Figure 8. Qualitative Evaluation of Usability

Figure 8 represents the qualitative evaluation of the usability of the newly developed application. The usability criteria have four sub-criteria which are; the application is user friendly, by using this application, users become more familiar with herbals; a user interface enables pleasing and satisfying interactions for the user; and the software meets existing usability standards. Based on the result, the respondents answered excellent, very satisfactory, and satisfactory and got a 3.85 response rate. It concluded that the application is helpful and valuable to a lot of users.

4.1.3 Reliability

Reliability refers to the ability of a product or system to perform its intended function consistently and without failure over a period. It is a measure of how dependable a product or system is, and how well it can be trusted to perform its intended function without malfunctioning. Reliability can be used to evaluate the performance of a wide range of products, including software, hardware, and mechanical devices. It is often used in conjunction with other measures, such as availability and maintainability, to provide a comprehensive assessment of a system's performance.

Table 5. The Weighted Mean on the evaluation of Reliability

RELIABILITY	Weighted Mean	Verbal Interpretation
The information provided in the application is reliable.	4.8	Excellent
The application provides accurate results.	4.8	Excellent
The application is operational and accessible when required for use.	4.8	Excellent
The application rarely experiences errors while being accessed.	4.6	Excellent
General Weighted Mean	3.8	Very Satisfactory

According to Table 5 the first sub-criteria has a verbal interpretation of Excellent and a weighted mean of 4.8. Hence, the respondents agreed that the information provided in the application is reliable. The application gives accurate results, is operational, and is available when needed for usage, as evidenced by the fact that the second and third sub-criteria both received a weighted mean of 4.8 as well. The fourth sub-criteria, however, received an excellent verbal interpretation with a weighted mean of 4.6, indicating that the

application rarely experiences errors while being accessed. Finally, the average of the weighted mean in reliability is 3.8, which is quite excellent for the respondents.

Figure 5.8 is all about the qualitative evaluation on reliability of the newly developed application. Reliability has four sub-criteria and that includes; the information provided in the application is reliable, the application provides accurate results, the application is operational and accessible when required for use and the application rarely experiences errors while being accessed. Based on the graphical representation above, most of the evaluations are excellent while some of them were very satisfactory. Overall, the generated weighted mean of reliability is 3.8 which is equivalent to very satisfactory,

4..1.4 Maintainability

Maintainability refers to the ease with which a product or system can be modified or repaired to correct faults, improve performance, or adapt to changing requirements. It is a measure of how easy it is to keep a product or system in a state where it can perform its intended function. Factors that contribute to maintainability include the design of the system, the use of standardized parts and interfaces, the availability of documentation, and the ease of access to components. Maintainability can be used to evaluate the performance of a wide range of products, including software, hardware, and mechanical devices. It is often used in conjunction with other measures, such as reliability and availability, to provide a comprehensive assessment of a system's performance.

Table 5. The Weighted Mean on the evaluation of Maintainability

RELIABILITY	Weighted Mean	Verbal Interpretation
The application needs to be updated to make it better	4.5	Excellent
Modification are needed to improve the application features	4.5	Excellent
Errors do not occur frequently in the application	4.5	Excellent
The application tested easily	4.7	Excellent
General Weighted Mean	3.64	Very Satisfactory

According to Table 5.5, most of the respondents 4.5 agreed that the application needs to be updated to make it more reliable. Second, 4.5 of respondents acknowledged that modifications are important to improve the application's features. Third, 4.5 of the respondents didn't encounter any error while using the application. Fourth, 4.7 respondents agreed that the application was tested easily. Based on the result, the developers assume the application must be updated from time to time in order to provide a more reliable application to the end users.

Figure 5.9 represents the qualitative evaluation of the maintainability of the newly developed application. Maintainability has four sub-criteria which includes; the application needs to be updated to make it better; modifications are needed to improve the application's features; errors do not occur frequently in the application, the application tested easily. According to the given result by the respondents, most of the sub-criteria got a score of 5 which is equivalent to excellent. In contrast, some of them gave a score of 4 which is equivalent to very satisfactory. Overall, the generated weighted mean of maintainability is 3.64 which is equivalent to very satisfactory,

4..1.3 Portability

Portability refers to the ease with which a product or system can be moved from one operating environment to another. It is a measure of how well a product or system can be adapted to different hardware or software platforms, or how easy it is to move the product or system from one location to another. Factors that contribute to portability include the use of standard interfaces and protocols, the use of open-source technologies, and the ability to run on multiple operating systems or devices. Portability can be used to evaluate the performance of a wide range of products, including software, hardware, and

mechanical devices. It can be especially important for products or systems that are intended to be used in multiple environments or locations.

Tae 5. The Weighted Mean on the evaluation of Portability

PORTABILITY	Weighted Mean	Verbal Interpretation
The application complies with portability standards.	4.7	Excellent
The application can be easily installed	4.95	Excellent
The application works in any version of Android	4.95	Excellent
The application can be used on a variety of existing hardware. (Smartphone, computer, laptop)	4.7	Excellent
General Weighted Mean	3.64	Very Satisfactory

According to certain respondents (4.7) in Table 5.6, the application meets portability standards. 4.95 percent of respondents said it can be installed quickly, and 4.95 percent of respondents said it is appropriate for all Android versions. The disadvantage is that it can't be used on any laptop, computer, or iOS phone. The last sub-criteria got a 4.7 from the respondents, which indicates the application can be used on a variety of existing hardware. Based on the results, the developers concluded that the application could be effective and efficient to the users. It can also be installed, transferred to another environment.

Figure 5.10 represents the qualitative evaluation of portability criteria in a newly developed application. The Portability section has four sub-criteria which include: the application complies with portability standards; the application can be easily installed; and the application works with any version of Android. The application can be used on a variety of existing hardware (smartphone, computer, and laptop).

4..2 Summary of User Evaluation

The majority of the sub-criteria demonstrated excellent performance, as indicated by a score of 5.0. . However, there were a few instances where a score of 4 was obtained, which still reflects a very satisfactory level. In terms of maintainability, the overall evaluation resulted in a weighted mean of 3.64, also considered to be at a very satisfactory level.

The high scores received by the sub-criteria highlight their effectiveness and successful implementation within the system. These scores reinforce the system's overall quality and its ability to meet the specified criteria. Moreover, the weighted mean score for maintainability confirms that the system's maintainability aspects, such as code quality, modularity, and documentation, have been adequately addressed, indicating a commendable level of proficiency.

It is important to acknowledge that these scores are based on the evaluation criteria and their respective rating scales used in this study. The findings provide valuable insights into the system's strengths and areas of success, allowing for informed decision-making and potential enhancements in the future.

Table 5. Summary of User Evaluation

CRITERIA	General Weighted Mean	Verbal Interpretation
Functionality	3.92	Very Satisfactory
Usability	3.85	Very Satisfactory
Reliability	3.80	Very Satisfactory
Maintainability	3.64	Very Satisfactory
Portability	3.86	Very Satisfactory
General Weighted Mean	3.81	Very Satisfactory

As shown in Table 5.7, it summarizes the response rate for overall user evaluation. As shown above in functionality, the respondents answered very satisfactorily, resulting in a 3.92 response rate from the respondents. It indicates that the system is well functioned and operates well. As a summary of functionality criteria, the system got a 3.92 general weighted mean which means that recognition of herbal plants and flowers is well functioning, as proven by the respondents. In usability, the overall response rate is 3.85 wherein the respondents answered very satisfactorily. Overall, the results concluded that the application is helpful and valuable to a lot of users. Reliability got a 3.8 overall response rate from the respondents. It shows that the respondents are very satisfied with usability and indicate that the application rarely experiences errors while being accessed. Finally, the average of the weighted mean in reliability is 3.8, which is quite excellent for the respondents. In maintainability criteria it got a 3.64 overall response rate from respondents. Respondents agreed that the app was tested easily. Based on the result, the developers assumed the application must be updated from time to time to provide a more reliable application to the end users. Portability has a 3.86 response rate. Based on the result, the developers concluded that the application can be effective and efficient to the users. It can also be installed, transferred to the other environment.

THE GENERAL WEIGHTED MEAN OF THE
OVERALL CRITERIA

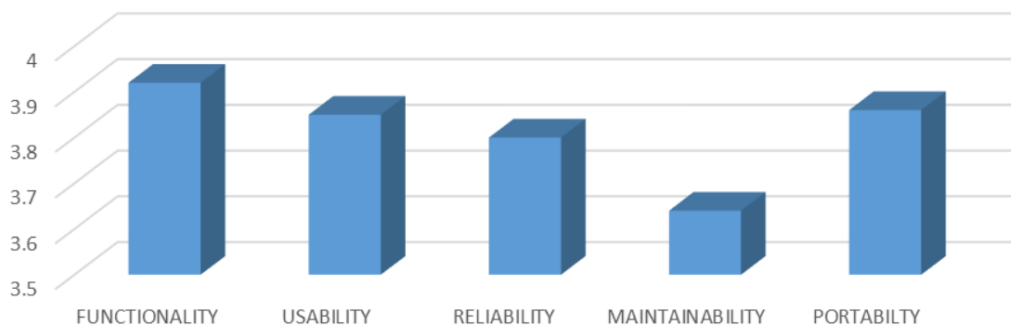


Figure 5.11 shows the result of the general weighted mean of the five (5) criteria, which are functionality, usability, reliability, maintainability, and portability. As shown in the qualitative evaluation, The first criteria which is functionality received the highest weighted mean 3.92, with a verbal interpretation of very satisfactory. This indicates that respondents agreed that the application's features are functioning as intended based on their experience with the application. The second criteria is usability and got a 3.85 weighted mean results of very satisfactory based on the verbal interpretation. Indicating that the application is helpful and valuable to a lot of users. The third criteria is reliability with a 3.8 weighted mean, indicating that the verbal interpretation is very satisfactory, that means the application is reliable and operational. For the fourth criteria, maintainability got a 3.64 weighted mean with a verbal interpretation of very satisfactory. Proven that the application did not encounter any error while using the application. Lastly, the application's portability criteria got a 3.86 weighted mean with a verbal interpretation of very satisfactory which means the application can be easily installed in all android versions.

CONCLUSION

The researchers came up with the conclusion that the application was effective after reviewing the survey respondents' responses. Based on the evaluation analysis of the study, the respondents gave their satisfaction and acceptance to the mobile application. The question is also based on the criteria of ISO which are Functionality, Usability, Reliability, Maintainability, Portability. In Functionality criteria, the system got a 3.92 general weighted mean which suggests that Recognition of herbal plants and flowers is well functioned as proved by the respondents. The overall response rate for usability is 3.85, and the respondents provided excellent responses. Overall, the findings indicated that a large number of users find the program to be beneficial and helpful. A total of 3.8 people responded to the question on reliability. It demonstrates that users of the survey are extremely satisfied with the usability and suggests that accessing the program rarely results in issues. The responders' average weighted mean in reliability has a 3.8 response rate, which includes that the respondents is very satisfactory. It received a 3.64 overall response rate from responders for the maintainability criteria. All respondents acknowledged that it was simple to test the app. Based on the outcome, the developers assumed that regular updates would be necessary to give users a more stable application.

With a 3.86 response rate, portability. The developers came to the conclusion that the application may be useful and beneficial for the users based on the outcome. Additionally, it can be installed and moved to another environment. The respondents believe that the application's interface and functionality are pleasant and that the system responds quickly to user input. Due to their survey responses, the researchers believe that the application is acceptable.

5.1 Conclusion

The following conclusions are made based on the introduction of this study:

1. The proponents were able to develop a mobile application that will help a lot of users
2. to have a good understanding about the specific herbal plant and flower.
3. The proponents successfully developed a mobile application with comprehensive
4. information, such as the advantages and significance of herbal plants and flowers.
5. The proponents were able to develop a mobile application that displays different kinds of herbal plants and flowers which can be used in illnesses. The users can also
6. scan and upload an image of the herbal plants and flowers.
7. The application was successfully developed based on the ISO 25010 standards,
8. which include the functionality, efficiency, dependability, and usability.

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