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ANDROID-BASED PRODUCT IDENTIFICATION FOR VISUALLY IMPAIRED INDIVIDUALS

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Abstract

The study aims to develop an Android-based product identification for visually impaired individuals with the following features; provide accurate product details to the user through text-to-speech; utilize a barcode scanner and generate reports, it is purposely made as an assistive tool for different grocery store shoppers who are visually impaired. This study used the descriptive-developmental research method. Mean and standard deviation were used to treat the data. The application was developed using the Rapid Application Design model of the Software System Developmental Life Cycle. Similarly, descriptive research involves the collection of data in order to answer a standardized research instrument. The questionnaire used was based on the standard evaluation instrument using CSUQ with a 7-point Likert scale. To evaluate user satisfaction with the system's usability. The researcher utilized 30 respondents composed of 5 IT experts, 10 grocery store personnel, and 15 visually impaired individuals. The findings of the study revealed that the satisfaction level and the usability were strongly agreed or very high. In the future, the system is hoped to be a catalyst for the visually impaired and hearing-impaired individuals the researchers will try to integrate sign language into the system.

Keywords: Product Identification, Visually Impaired, Text-to-Speech, Android-Based, Barcode Visually Impaired, Android-Based Product Identification for Visually Impaired Individuals.

Introduction

Printed text is everywhere in product details. Globally, it is estimated that approximately 253 million people live with some form of vision impairment and blindness which was released by the Loss Vision Expert Group of Lancet Global Health in their most recent papers. These papers were also used by the World Health Organization as a source of current data in vision impairment (https://www.iapb.org/vision-2020/who-facts/).

Online shopping has significantly transformed the retail landscape with the grocery sector being among the most impacted in recent years. The COVID-19 pandemic further accelerated this shift, leading to a sharp rise in demand for online grocery services (Liaukonytė, J., & Yang, N. (2024). Visual impairment refers to the decreased ability of an individual to see things without the means of eyeglasses or eye lenses. This number is increasing rapidly as the baby boomer generation ages. The ability to identify products such as groceries is very useful and essential. Few devices can provide good access to common hand-held objects with printed texts. There is thus considerable interest among visually impaired persons in barcode readers, which read the product barcodes that uniquely identify commercial products. The ability of people with low vision or have significant visual impairments to read printed labels and product packages will enhance independent living, and foster economic and social self-sufficiency. It is unenviable for visually impaired individuals to identify and distinguish packaged products manually and shop independently. Unlike sighted individuals, these people typically rely on friends, relatives, volunteers, and store employees for help. Some staffers are also unfamiliar with the store layout, others become irritated with long searches and requests to read aloud product ingredients, and still others do not have adequate English skills to read the product details. Therefore, the unavailability of this assistance will cause the postponement or rescheduling of shopping trips just to avoid delays and embarrassment. These difficulties cause blind and visually impaired shoppers to abandon searching for desirable products, settle for distant substitutes, or, in worst case, abandon independent

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shopping. Because of this, the researchers came up with a system that would address the said problem by assisting the user in finding out the description of a packaged good through a product identification app. In this application, the user will be able to access product details through barcode scanning. The application contains a text-to-speech feature which is effective in assisting visually impaired individuals who are having a hard time reading or accessing product details. The system will (1) provide accurate product details to the user through text-to-speech, (2) utilize a barcode scanner, and (3) generate reports.

Methodology

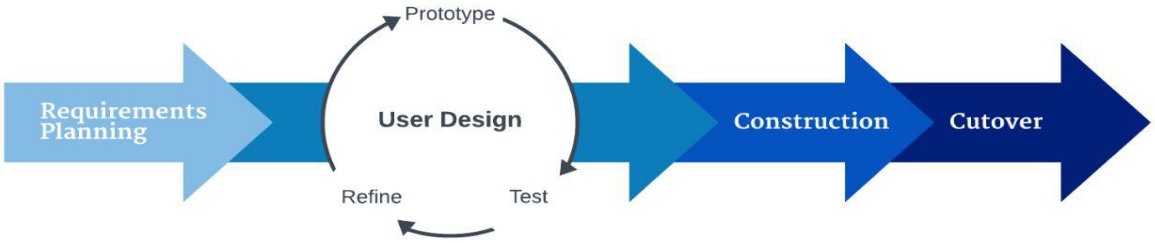

Figure 1: Rapid Application Design

In view of the nature of the study, the researchers used the developmental-descriptive method of research. Developmental research has been defined as the systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet criteria of internal consistency and effectiveness (Seels and Richey., 1994)

The developmental research method was used in the process of establishing the system. The descriptive method was used to determine the service quality of the Android-based product identifier for the visually impaired as to its usability as Rivera stated in his study. The most common descriptive research is a survey, which includes, personal interviews, phone surveys, and normative surveys. Unlike in experimental research, the researcher does not control or manipulate any of the variables, but only observes and measures them.

The researcher chose this research design to get productive and constructive criticism by way of evaluating the study through questionnaires, surveys, and interviews and get some suggestions that could help the researcher develop the system that can address the user's concerns and acquire results that are purely produced through survey materials.

Requirements

Research Design

To attain the objectives of the proposed study, the proponents used the Rapid Application Design (RAD) model is a type of agile project management strategy in the software development life cycle, mainly intended for helping developers build a project that can adapt to transforming requests quickly. So, the most important endeavor for developing the RAD model is to make easy and rapid project achievement. This SDLC is used by many developers in terms of flexibility and quick advance of agile methods, based on the ISO 9001 to RAD software development.

In this phase, diagrams such as the three-tier architecture were then created. This diagram is needed in developing the foundation of the system in terms of database, process flow, and architecture. In addition, the rough draft of the system was drawn as one of the basis of the system's appearance and form arrangements. It ensures the well-order of the development.

Designing

In this phase, the database design, and process design are created. During this phase, the researcher also designs and develops user interfaces that are suited for the end-user.

Development

One of the fundamental phases is when the programmers write the codes based on the requirements the development will be based on the design, diagrams, features, and functionalities of the end-users. It comes with a test script to ensure that the direction of the development was indeed within the scope of the requirements. Any changes in terms of the user interface (UI), the appearance of the design phase, and the technical features were carried over and implemented during this phase.

Test and Deployment

The testing phase consists of Initial Testing. The functionality of the Android-based product Identification for Visually Impaired Individuals based on its technical features was tested using test

cases, and the Final Testing wherein the system's usability was tested by using a standard Computer System Usability Questionnaire.

The Initial phase covers the testing of functionalities of the Android-based product Identification for Visually Impaired Individuals in accordance with its features. The test cases were used to test the system functionalities. It is composed of test ID, test scenario, test steps, test data, and the expected result. Each of its functions will be validated and scored as passed or failed.

In the final testing, the usability of the Android-based product Identification for Visually Impaired Individuals was tested using the Computer System Usability Questionnaire (CSUQ). The summary of mean scores on the level of usability of the application in terms of System usefulness, Information quality, Interface quality, and overall usability, was evaluated by 5 IT experts, 10 grocery store personnel, and 15 visually impaired individuals total of 30 respondents since the major respondents are visually impaired they were assisted by their relatives and friends whom present during the testing and evaluation these respondents are all voluntary with no any pressure to test and evaluate the study. For the purpose of the testing, the following procedure will be adopted to analyze the data gathered for this development. The study used a Likert-type Seven-point scale where 1 is the highest with an interpretation of "Strongly Agree" and 7 is the lowest interpreted as "Strongly Disagree".

Groupings	Frequency	Percentage
IT Experts	5	16%
Store and Grocery Personnel	10	34%
Visually impaired individuals	15	50%
TOTAL	30	100%

Table 1: Respondents of the Study

Tools and Equipment

The researcher utilized the Three (3) Tier architecture Web Application Development for the Android-Based Product Identifier for Visually Impaired Individuals using PostgreSQL as a database. The first tier is the presentation tier, in which the client side or the front end of the program can be found. The researchers used HTML, CSS, Javascript, Ajax, and Android Converter to develop the client side. The second tier is the logic tier wherein the back end of the program is developed. The back end handles the business logic or the functionality which is operated by the Ruby on Rails framework. These languages accept input from the client side it is also used to query the data from the database which can be found in the third tier.

The researcher used PostgreSQL to protect data integrity build a fault-tolerant environment and help the developers manage the data no matter how big or small the dataset is. (Rambal, 2019)

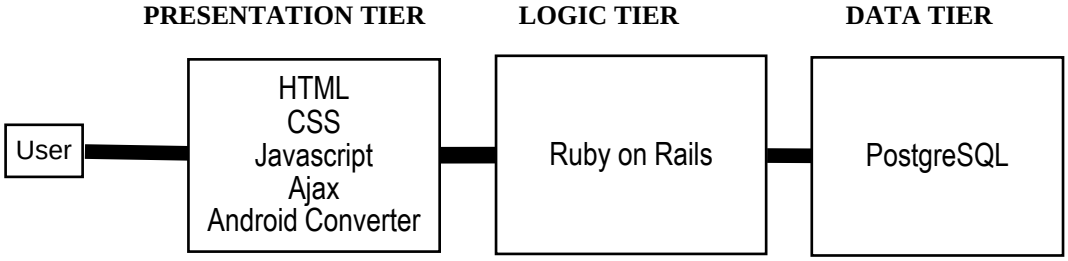

Figure 2: Three (3) Tier Architecture Web Application Development

Data Gathering Procedure

The respondents were asked to fill out the information needed; the survey instrument contained questions that assessed the overall usability of the system. The system will be evaluated based on its criteria in terms of system usability, Information quality, interface quality, and overall usability.

CSUQ Criteria	Mean
System Usefulness	1.36
Information Quality	1.49
Interface Quality	1.24
Overall Usability	1.38

Table 2: Summary of the System Usability Result

Data Analysis

After the survey questionnaires were collected from the respondents, the same were tabulated, tallied, analyzed, interpreted, and presented in a tabular form. This part presents the mean scores of the usability of the system. The majority of the respondents rated the System's Usefulness strongly agree with the mean score of 1.36. The mean score for the Information Quality was 1.49 also interpreted as strongly agree. The Interface Quality was also interpreted as strongly agree as the mean score was 1.24 due to its user-friendly interface majority of the users find it as easy to use and the Overall Usability mean score was 1.38. The CSUQ version 3 result serves as the basis of the acceptability of the system

Results and Discussion

This chapter encapsulates the presentation, analysis, and interpretation of data that were gathered based on the objective of the study

The CSUQ version 3 is a CSUQ Mean score database that is collated from other systems. The standard provides a comparison reference to the System being studied if their product is comparable or better than the rest (with a 99 percent confidence interval). To conform to the industry requirements, the mean achieved by the System should be within the specified mean ranges in the CSUQ (Original)

	PSSUQ (Current)			*PSSUQ (Original)*			*CSUQ (Original)*		
Item	*Lower Limit*	*Mean*	*Upper Limit*	*Lower Limit*	*Mean*	*Upper Limit*	*Lower Limit*	*Mean*	*Upper Limit*
Q1	2.60	**2.85**	3.09	3.36	**4.00**	4.64	3.12	**3.30**	3.48
Q2	2.45	**2.69**	2.93	3.40	**4.02**	4.64	3.36	**3.54**	3.72
Q3	2.58	**2.85**	3.11	3.07	**3.73**	4.40	2.73	**2.91**	3.09
Q4	2.86	**3.16**	3.45	3.53	**4.15**	4.76	3.09	**3.27**	3.45
Q5	2.79	**3.06**	3.34	3.37	**3.98**	4.59	3.05	**3.23**	3.41
Q6	2.40	**2.66**	2.91	2.75	**3.41**	4.07	2.77	**2.95**	3.13
Q7	2.07	**2.27**	2.48	2.92	**3.57**	4.22	3.61	**3.82**	4.03
Q8	2.54	**2.86**	3.17	na	**na**	na	3.40	**3.61**	3.82
Q9	3.36	**3.70**	4.05	4.38	**4.93**	5.48	4.58	**4.79**	5.00
Q10	2.93	**3.21**	3.49	3.64	**4.18**	4.73	3.82	**4.03**	4.24
Q11	2.65	**2.96**	3.27	3.87	**4.48**	5.09	3.94	**4.15**	4.36
Q12	2.79	**3.09**	3.38	3.42	**4.02**	4.63	4.11	**4.32**	4.53
Q13	2.37	**2.61**	2.86	3.15	**3.79**	4.43	3.95	**4.13**	4.31
Q14	2.46	**2.74**	3.01	2.81	**3.43**	4.04	3.70	**3.88**	4.06
Q15	2.41	**2.66**	2.92	3.02	**3.55**	4.08	3.43	**3.61**	3.79
Q16	2.06	**2.28**	2.49	2.32	**2.91**	3.51	3.01	**3.19**	3.37
Q17	2.18	**2.42**	2.66	2.37	**2.92**	3.47	3.02	**3.20**	3.38
Q18	2.51	**2.79**	3.07	2.44	**3.00**	3.56	3.47	**3.68**	3.89
Q19	2.55	**2.82**	3.09	3.10	**3.69**	4.29	3.13	**3.31**	3.49
SysUse	2.57	**2.80**	3.02	3.26	**3.81**	4.36	3.19	**3.34**	3.49
InfoQual	2.79	**3.02**	3.24	3.58	**4.06**	4.54	3.95	**4.13**	4.31
IntQual	2.28	**2.49**	2.71	2.42	**2.93**	3.43	3.17	**3.35**	3.53
Overall	2.62	**2.82**	3.02	3.30	**3.76**	4.22	3.43	**3.61**	3.79

Table 3: CSUQ - (Means and 99% Confidence Level Interval)

Criteria	Mean
Overall, I am satisfied with how easy it is to use this system.	1.23
It is simple to use this system.	1.33
I am able to complete my work quickly using this system.	1.50
I feel comfortable using this system.	1.47
It was easy to learn to use this system.	1.30
I believe I could become productive quickly using this system.	1.33
The system gives error messages that clearly tell me how to fix problem.	1.53
Whenever I make a mistake using the system, I recover easily and quickly.	1.43
The information (such as online help, on-screen messages, and other documentation) provide with this system is clear.	1.60
It is easy to find the information I needed.	1.33
The information provided with the system is effective in helping me complete my work.	1.50
The organization of information on the system screens is clear.	1.53
The interface of the system is pleasant.	1.27
I like using the interface of this system.	1.23
This system has all the functions and capabilities I expected it to have.	1.23
Overall, I am satisfied with this system	1.30
Total Mean Score as a whole	1.38

Table 4: Usability of Android-based Product Identifier for Visually Impaired Individuals

Table 4 shows the results of the survey from the respondents. After computing the mean of the different criteria, the variance of whether the system is accepted was then normalized to the CSUQ shown in Table 3.

Criteria	Mean
Overall, I am satisfied with how easy it is to use this system.	1.23
It is simple to use this system.	1.33
I am able to complete my work quickly using this system.	1.50
I feel comfortable using this system.	1.47
It was easy to learn to use this system.	1.30
I believe I could become productive quickly using this system.	1.33
System Usefulness	**1.36**

Table 5: System Usefulness

Table 5 shows the summary mean score of the system usefulness from items 1 to 6 with a score of 1.36 compared to the required standard in the industry which is 3.34

Criteria	Mean
The system gives error messages that clearly tell me how to fix problem.	1.53
Whenever I make a mistake using the system, I recover easily and quickly.	1.43
The information (such as online help, on-screen messages, and other documentation) provide with this system is clear.	1.60
It is easy to find the information I needed.	1.33

The information provided with the system is effective in helping me complete my work.	1.50
The organization of information on the system screens is clear.	1.53
Information Quality	**1.49**

Table 6: Information Quality of the System

Items 7 to 12 shows the information quality of the system acquired a 1.49 mean score which means it is higher on the required standard of 4.13 based on the CSUQ.

Criteria	***Mean***
The interface of the system is pleasant.	*1.27*
I like using the interface of this system.	*1.23*
This system has all the functions and capabilities I expected it to have.	*1.23*
Overall, I am satisfied with this system	*1.30*
Interface Quality	***1.26***

Table 7: Interface Quality of the System

Items 13 to 16 shows the interface quality of the system acquired a 1.26 mean score; this is higher than the required standard based on the CSUQ than the required industry standard of 3.35. In this criterion, the respondents commented "Please make it straightforward and remove unnecessary modules and icons in the dashboard"

After some iterations in the application, the researchers changed some of its interface to align with the user's request to be more useful. The design was changed to make it a straightforward approach per the users' request. We enhance the size of the login page such as the login details and login button.

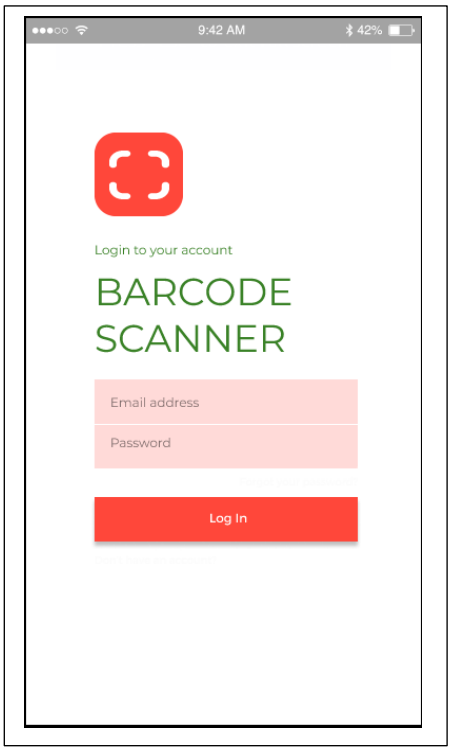

Figure 4: Login page

The researcher also enhanced the landing page after logging in it will go to the scanning page to make it as straightforward as most of the respondents' requests.

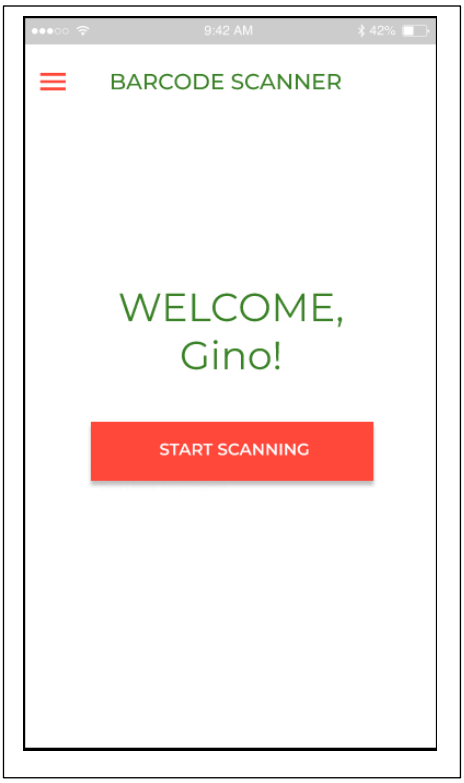

Figure 5: Scanning page

The user needs to aim the camera or scanner at the barcode of the product, once the product is successfully scanned, its details will show and the user can click the speak button for the speech feature to read the details of the product.

Figure 6: Application Product Scanning

The researchers also provide options for the users in case they have to edit their Profile, check their purchase history, and search for available products. This will be found in the scanning page as a burger icon.

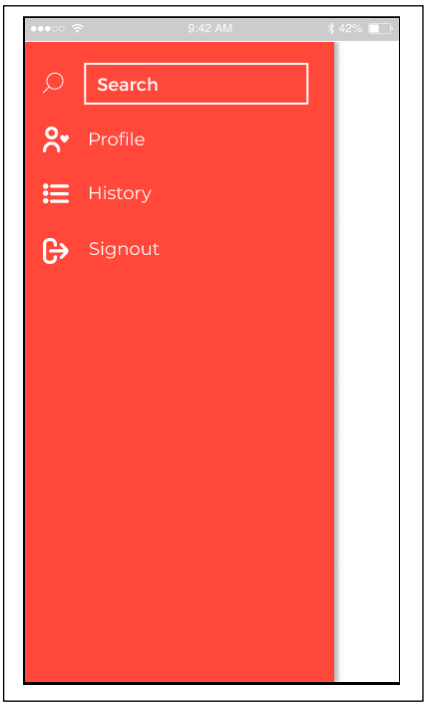

Figure 7: Option page

Discussion

After digging into the different foreign-related studies, the proponents observed that the insights and purpose of the researchers were somewhat related to the features of the Android-based Product Identifier for the Visually Impaired Individual. Based on their studies, a barcode scanner has been a great help when it comes to product identification, integrating it with the mobile device as an application benefits the visually impaired individual in dealing with his/her day-to-day grocery shopping. With this conclusion, the features of the application will serve as an assistive tool containing text-to-speech features that would narrate the needed information for the user with difficulty in reading (which might be due to poor eyesight) and product identification through barcode ID. The group also realized that upon implementation of the project after its completion, it will serve as an assistive tool not just for visually impaired individuals but also for normal people who can install the application on their mobile devices. Nevertheless, all the related systems have contributed to the research, not concise and fully integrated altogether but helpful for the improvement of the Product Identifier for the Visually Impaired Individual. It has anchored the study by providing information on how this application operates. As a result, the study received a high acceptability rate that mostly addressed the gap that other studies have with this rate the results imply great potential in assisting the direct and indirect beneficiaries of the study. However, there might be a little bit of confusion in terms of the function, as stated in this study this application was only for the visually impaired but some individuals had an additional impairment such as hearing impairment and other related disabilities connecting to hearing, having this kind of impairment are not covered in this study. Nonetheless, the researchers will try to add this feature for future improvements and to cater to additional beneficiaries.

Based on the results of this study receiving very high acceptability the researchers believe that the need for this study is imperative that the community of visually impaired individuals was very satisfied with the application and helpful in their daily work. Thus, it gave us the implication that we need more study like this, we have to create and develop more applications and improve them for others who are less fortunate in their physical aspect as well as financial. Helping these kinds of communities makes the study more achievable, inclusive, and effective this development creates another breakthrough in terms of technological advancement in the field of Information Technology. In future improvements the researcher suggests further study of the offline notification features to address underlying issues brought by internet-dependent notification as Rivera stated in his study the offline push notification could be very significant in every business this will bring awareness and market to both beneficiaries the user and the business sector.

The Android-based Product Identifier for Visually Impaired Individuals is responsible for checking the descriptions and suggested retail prices. This aims to ease, convenience, and efficiency in this figure the proponents designed a guide that serves as a

direction to input information and how the application works.

Figure 8 shows the Admin Page account where the product is being entered, this page shows, the list of the products that are present or available in the system. On this page also the admin generates reports for sales and Inventory.

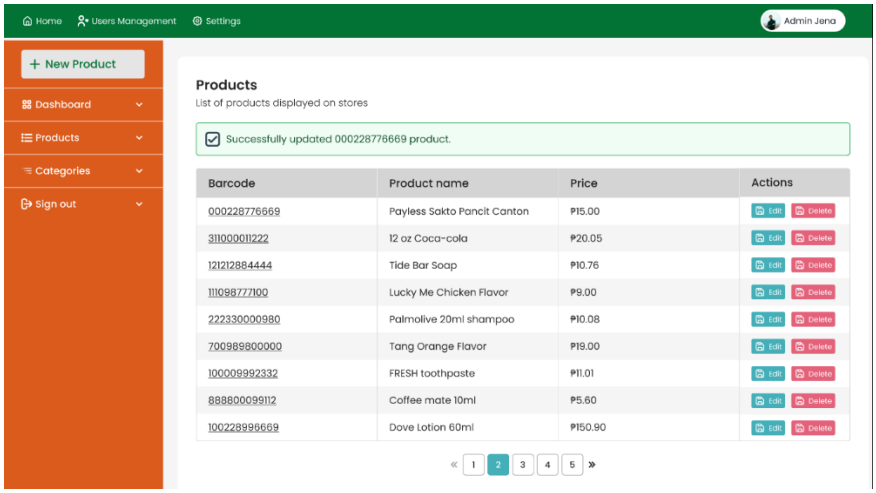

Figure 8: Admin Dashboard

Figure 9 shows the edit entry form of a product, clicking the edit button on the Figure 4 page will bring you to the edit page on this page you can customize the details of the product change its descriptions and other related information about the product.

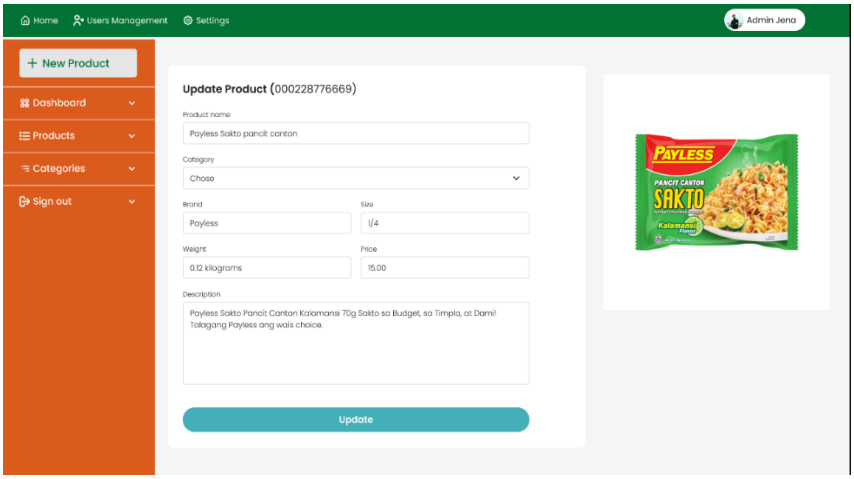

Figure 9: Edit Entry Form

Conclusion

Based on the findings of the study, the following conclusions were formulated:

- The Android-based Product Identifier for Visually Impaired Individuals using PostgreSQL is technically capable of being installed in any hand-held Android device (Delioglani, D., & Karakostas, 2023). It provides significant assistance and accurate product details to the user through a text-to-speech feature. It also utilizes a barcode scanner and the report generated by the system is also effective as it is archiving recent products that the user scans for future references of the products that the user purchases.
- The acceptability dimension of the Android-based Product Identifier for Visually Impaired Individuals was acceptable in terms of System Usefulness, Information Quality, Interface Quality, and Overall Usability.
- The study also identifies some factors that could apply to Natural Language Processing Research the study's output may be used to analyze language patterns, develop new algorithms, and enhance existing Natural Language Processing. It is also possible for Artificial Intelligence researchers to utilize our output to benchmark

algorithms and develop new AI architectures or improve existing models by studying new patterns in the generated text.

Ethical Consideration

The ethical implications of the applications are being discussed more than ever now, as new technologies have always been required. (Kaddoura & Husseiny, 2023)

Since major of our respondents are visually impaired, they were assisted by their family and friends in filling out the questionnaire. Respondents were also guided in using the application by the same relatives, The researchers created a voluntary participation consent for the respondents to be fully informed about the nature, purpose, and potential risk of the research before they agreed to participate and without pressure to take part or to provide certain responses. Additionally, the respondents are free to withdraw at any time without any penalty the proponents also strictly protect the privacy of the respondents by ensuring that data is kept confidential and their identities are not disclosed.

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