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VISUALIZATION USING DATA ANALYTICS FOR BARANGAY NEW VISAYAS WEB-BASED BILLING SYSTEM

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Abstract: This study is focused on evaluating the system based on its functionality, reliability, and usefulness. The primary objective of this study was to implement a web-based data analytics billing system, accessible exclusively to bonafide cooperative members, to enhance services and opportunities through modern technology. The system is designed to be user-friendly, allowing administrators to generate and view billing reports seamlessly. Key features include data visualizations such as bar graphs of released consumer bills, reports on disconnections and reconnections, tracking of new and previous consumers, invoice generation, and monthly collection summaries. By automating these processes, the system significantly simplifies cooperative operations. For development, the following technologies were utilized: XAMPP Apache Server for local hosting, PhpMyAdmin for database management, Sublime Text for coding, and PHP for programming. The system was evaluated using the ISO 25010 Software Product Quality Assessment framework, focusing on functional suitability, reliability, and usability. The system achieved an overall rating of 3.8, indicating an "Agree" qualitative assessment, signifying that its features were functional and its interface acceptable. However, it requires further improvements in functionality and performance, particularly in enhancing data visualization capabilities.

Keywords: web-based data analytics, visualization using data analytics, website development

Introduction

Data analytics is the study of analyzing raw data to make inferences about that data. Data analytics is increasingly carried out with the use of specialist software Frankenfield (2021). Data analytics are methods for recording, gathering, and analyzing billing data by source. Furthermore, the data analytics provide a critical challenge as well as a genuine billing potential Akbulut (2018). The data analytics has promising futures, and the advantages they provide to data-driven businesses have a big impact on their ability to operate and innovate Vassakis et al. (2018).

Data technologies should be used in this application domain because of this. On the other hand, fraud detection, maintenance requirements prediction, water/energy user consumption patterns determination, and response generation to variations in demand could all be assisted by applying data analytics and knowledge discovery tools to AMR data in conjunction with other streams of information (data from the billing system, call center service, and meteorological information) Garcia et al. (2017).

There is already a manual billing and collection process which using excel file place in Barangay New Visayas. The organizations are able to effectively visualize the data while using excel files to maintain all billing records, analyze transaction histories, and audit data. When calculating the amount of water used to generate a billing receipt, they use an excel file too. However, the administrators had a tough time locating and encoding consumer data, particularly meter readings of client water consumption, while using an excel file to view the data. Additionally, it may transfer to word files to make reports with complete billing data.

Therefore, the researcher conducted a study to help the barangay to make their billing reports to have an accurate data. The transaction shows and generates a billing statement that details the water billing, and data analytics was included. The billing industry uses data analytics (DA) to increase productivity and operational effectiveness. Data analytics is a developing discipline with the ability to offer the billing system vital information. It is in charge of using and applying the results of the data analytics. The process of implementing the system consists of a range of steps, starting with data production and collection and moving on through analysis, filtration, categorization, preprocessing, computing, and decision-making. The current system's operation will then alter as a result of this proposed system, and its current workforce may be impact.

Conceptual Framework of the Study

A conceptual framework is a set of ideas used to structure the research, a sort of map that may include the research question, the literature review, methods and data analysis. As shown in the conceptual flow describes the information process of Visualization using Data Analytics for Barangay New Visayas Web-Based Billing System. As shown in the figure 2, the researcher employs four features: (1) It added the data analytics wherein the transaction report shows and creates a billing statement. (2) to design a system capable of efficiently tracking, retrieving, updating, and storing data. (3) generates document report and display percentage or graphs. This represents a whole data system, with a focus on how it interacts with eternal entities. The billing data process details display all of the information you require and this is reflected in data analytics. By examining information about the bill and the billing process. Data analytics is producing a data report that will show where data originates from and how it is stored in the system's database, which will be useful to administrator.

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Figure 1. Conceptual Framework of the study

Methodology

Research Design

The figure 2 shows how the Rapid Application Development Model will work in the development of the project. And the process begins with requirements planning, where the user design test and refine the system, the construction where planning the software will be developed and once the software is complete, it is deployed into production in the cutover phase, which involves migrating data, installing the software and training end-users.

The RAD lifecycle framework is thus intended to ensure that developers build solutions for consumers. This four-stage life cycle includes all of the activities and processes required to scope and define business needs, as well as design, develop, and deploy the application system that supports those requirements.

For this study, the RAD approach was chosen as the best software technique for the following reasons: Quick product delivery is possible. It ensures product quality by involving users throughout the product's lifecycle regularly. It places less emphasis on task planning and more emphasis on development and creating a prototype. According to (Venkata, 2020), If you need to build a customer-facing portal or an internal business tool, like an application or website, RAD techniques will help your team deliver a better experience to your end-user at a faster pace.

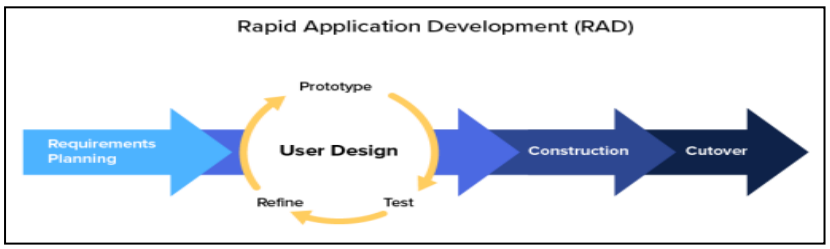

Figure 2. Rapid Application Diagram

System Requirements

Table 1 Software Requirements for System Development.

Software	Specification
Sublime Text	Version 4
Xammp	Version 8.2.12
Windows 10	Version 22H2

The table above shows the following software requirements. The software consumption is ignored, the development of the application will be impossible. As a result, the researcher employs useful and trustworthy software in the development of the system. Other programs require a computer with a Windows 10 (Operating System) operating system because the software will not run on this version without it. Xammp Apache Server is used to localhost the system. PhpMyAdmin are used to develop databases that contain information about. Sublime is used to encode, and test software. Its open-source nature, compatibility, scalability, and security features make it a popular choice for businesses and developers alike.

Table 2. Hardware Requirements for System Development

Hardware	Specification
Laptop	Processor Intel Core (TM) i3-3240
	8GB RAM or Higher
	500 GB HDD

The table above shows the following hardware requirements. The hardware must be in place for the software to run. The programs work smoothly because to the excellent hardware specifications. The researcher develops on mid-range hardware to ensure that the web-based application would work without a hitch. Datasets require at least 8GB of RAM, with 500GB of storage (hard disk) being required as well.

Respondents of the Study

Table 3. Respondents Distribution

Evaluators	No. of Person
Panel members	5
IT experts	6
Administrator	2
Tester	5
Total	18

The above table refers to individuals who participate in surveys, interviews, or provide information utilized in the research project. To identify the data analytics in billing procedures and assess the usability of the generated system, we selected personnel from the Barangay New Visayas Matanao. Sample size in the present project study, five (5) tester, six (6) IT experts, two (2) administrator and fiver (5) panel member personnel wherein to be evaluated the proposed system. A multi-stage sampling technique was adopted to select respondents for the study. Subsequently, descriptive survey questionnaires were distributed to assess the project's utility, reliability, and accuracy.

Survey Instrument of the Study

In evaluating phase, the respondent’s level of satisfaction with the proposed Visualization using Data Analytics for Barangay New Visayas Web-Based Billing System, the respondent’s level of acceptance of the proposed billing data analytics in terms of

usability, functionality, and reliability the developed system, the ISO 9126- International Organization for Standardization were utilized. The researcher also used observation on the existing or current Visualization using Data Analytics Web-Based Billing System, particularly while scanning or reading through documents, forms, and other materials. The Likert scale below was used to collect billing statements and other relevant data for the implementation of the suggested system and the five (5) categories are as follows: strongly agree, very agree, agree, disagree, and strongly disagree.

Table 4 Likert Scale for Functionality

Mean Range	**Descriptive Equivalent**	**Interpretation**
4.51 – 5.00	Excellent (E)	The measure described in the item is excellent and meets all needs.
3.51 – 4.50	Good (G)	The measure described in the item is good and meets most needs, but some room for enhancement.
2.51 – 3.50	Fair (F)	The measure described in the item is satisfactory, but significant room for improvement.
1.51 – 2.50	Poor (P)	The measure described in the item requires significant improvement to meet needs.
1.00 – 1.50	Very Poor (VP)	The measure described in the item will need extensive improvement to meet needs.

The table 4 shows the amount of agreement utilized for statistical analysis in obtaining the verbal description will be graded using the matrix shown above. The evaluation phase, respondents are requested to rate the system's performance based on its functionality using a questionnaire based on the International Standard Organization's (ISO) Software Quality Model 9126 once the development is virtually complete. The scale has a range 1 to 5, with 1 representing the lowest score and 5 is the highest. The score between 4.51 and 5.00 is categorized for “Excellent”, the 3.51 and 4.50 is categorized for “Good”, the 2.51 and 3.50 is categorized for “Fair”, the 1.51 and 2.50 is categorized for “Bad”, the 1.00 and 1.50 is categorized for “Very Poor”.

Table 5 Likert Scale for Reliability.

Mean Range	**Descriptive Equivalent**	**Interpretation**
4.51 – 5.00	Strongly Agree (SA)	The measure described in the item is excellent and no issues or concerns.

3.51 – 4.50	Agree (A)	The measure described in the item is good and only minor issues or concerns.
2.51 – 3.50	Neutral (N)	The measure described in the item is satisfactory, but some significant issues or concerns.
1.51 – 2.50	Disagree (D)	The measure described in the item is significant issues or concerns.
1.00 – 1.50	Strongly Disagree (SD)	The measure described in the item has extensive issues or concerns

The evaluation phase, respondents are requested to rate the system's performance based on its reliability using a questionnaire based on the International Standard Organization's (ISO) Software Quality Model 9126 once the development is virtually complete. The scale has a range 1 to 5, with 1 representing the lowest score and 5 is the highest. The score between 4.51 and 5.00 is categorized for "Strongly Agree", the 3.51 and 4.50 is categorized for "Very Agree", the 2.51 and 3.50 is categorized for "Agree", the 1.51 and 2.50 is categorized for "Disagree", the 1.00 and 1.50 is categorized for "Strongly Agree".

Table 6 Likert Scale for Usability

Mean Range	**Descriptive Equivalent**	**Interpretation**
4.51 – 5.00	Strongly Agree (SA)	The measure described in the item is excellent and very easy to use.
3.51 – 4.50	Agree (A)	The measure described in the item is good and generally easy to use, but some minor areas for improvement.
2.51 – 3.50	Neutral (N)	The measure described in the item is Satisfactory, but some significant difficulties or obstacles in use.
1.51 – 2.50	Disagree (D)	The measure described in the item is difficult or frustrating to use.
1.00 – 1.50	Strongly Disagree (SD)	The measure described in the item is very difficult or even impossible to use.

The table 6 shows the amount of agreement utilized for statistical analysis in obtaining the verbal description will be graded using the matrix shown above. The evaluation phase, respondents are requested to rate the system's performance based on its usefulness using a questionnaire based on the International Standard Organization's (ISO) Software Quality Model 9126 once the development is virtually complete. The scale has a range 1 to 5, with 1 representing the lowest score and 5 is the highest. The score between 4.51 and 5.00 is

categorized for “Strongly Agree”, the 3.51 and 4.50 is categorized for “Very Agree”, the 2.51 and 3.50 is categorized for “Agree”, the 1.51 and 2.50 is categorized for “Disagree”, the 1.00 and 1.50 is categorized for “Strongly Agree”.

Results and Discussion

This chapter of the document presents a detailed explanation of the project's overall content. The results and discussion section of a research paper is an important component that presents the study's findings and provides such in examination of them. The things that this section's final thoughts can establish with suitable support. In this part, the researcher presents a summary of the key results, analyzes the data, and explains the effects of the study. The specific objectives and relevant discussion provided the basis for the outcome’s presentation.

Admin account page that generates released consumer bill

The proponent will implement a billing notice that can provide a consumer bill report. The consumer pays the entire bill regardless of how much water they consumed, according to the copy on the consumer bill. In figure 3 and figure 4, it shows the purpose of billing reports on a released consumer bill.

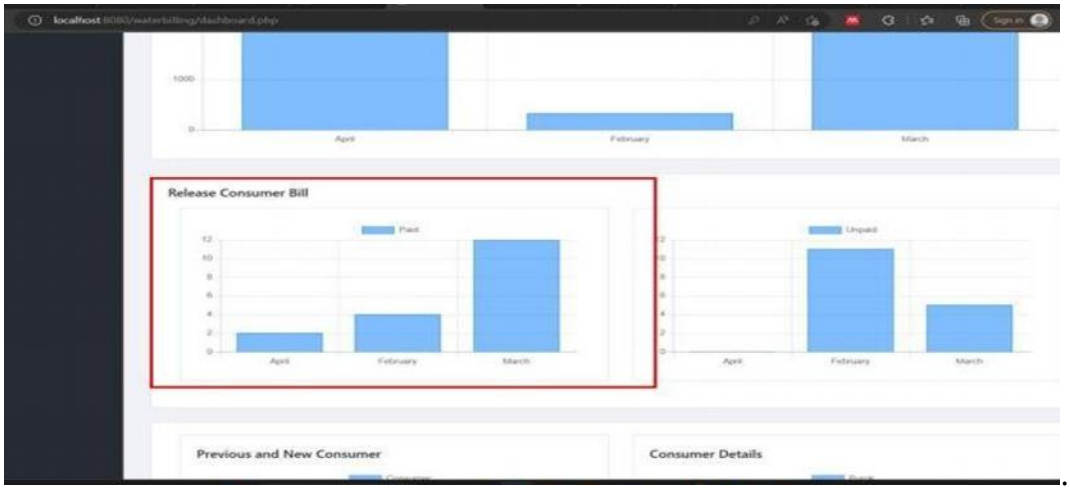

Figure 3. Reports data graph on a Released Consumer Bill



Figure 4. The billing notice reports on a Released Consumer Bill

The purpose of this objective is illustrated in the figure 3 and 4. It is present that the billing notice is for the report on the consumer's use of cubic meters, which can assist the administrator in automatically creating a billing copy and it shown the bar graph of how many consumers bill was released.

Admin account page that generates reports of disconnected and reconnected by water supply

The proponent will implement a dashboard that can provide disconnected and reconnected. The figure 5 and figure 6 shows the propose of disconnected and reconnected by water supply.

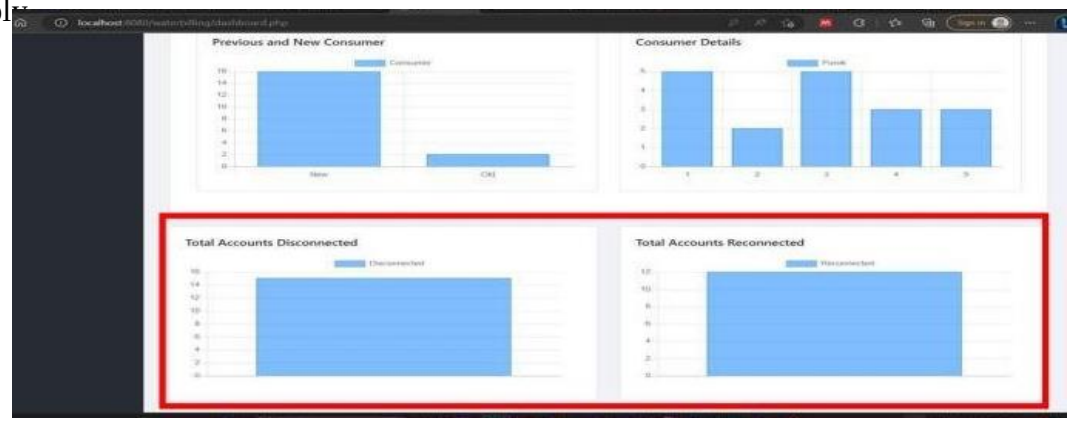

Figure 5. Showing the Disconnected and Reconnected graph

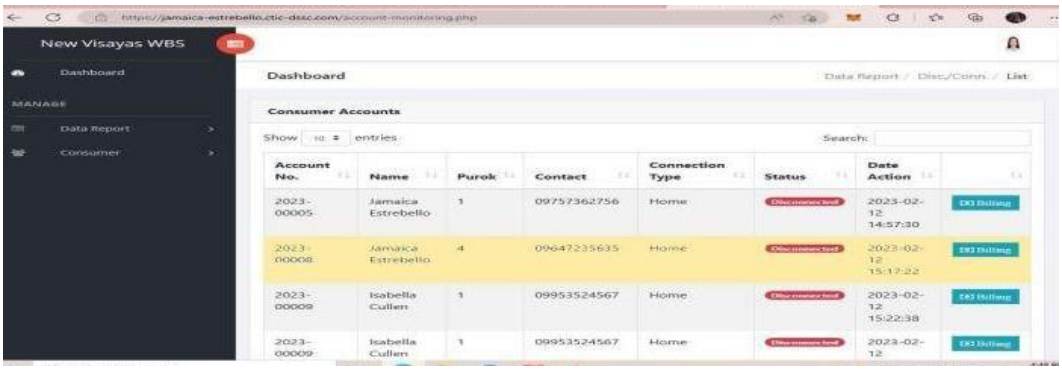

Figure 6. Issuing the Disconnected and Reconnected status

The figure 5 and 6 explains the purpose of this objective. The purpose of displaying the disconnected and reconnected reports is to shown, if the consumer is overdue from not

paying early and pass the one-month due date it will manually disconnect by water supply. And the consumer paid the overdue balance amount the system will be updated to reconnected by water supply. The administrator will manage the disconnected and reconnected reports manually. And it shows the graph report of how many consumers disconnected and reconnected.

Admin account page that generates of Invoice for Consumers

The proponent will implement a dashboard that can provide invoice for consumers. In the figure 7 and 8 shows the propose of invoice for consumers. The purpose of displaying the invoice it helps to administrator to have an invoice copy for the consumers that wants a copy for their billing payment. And indicated with total amount bill consumed, cash and change. And have receipt copy of invoice for consumers.

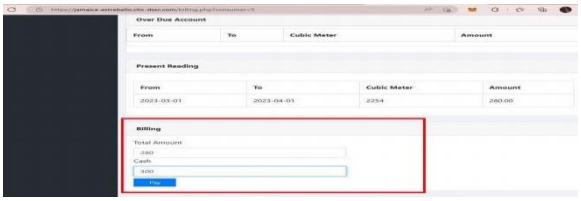

Figure 7. Showing the payment of Invoice for Consumers

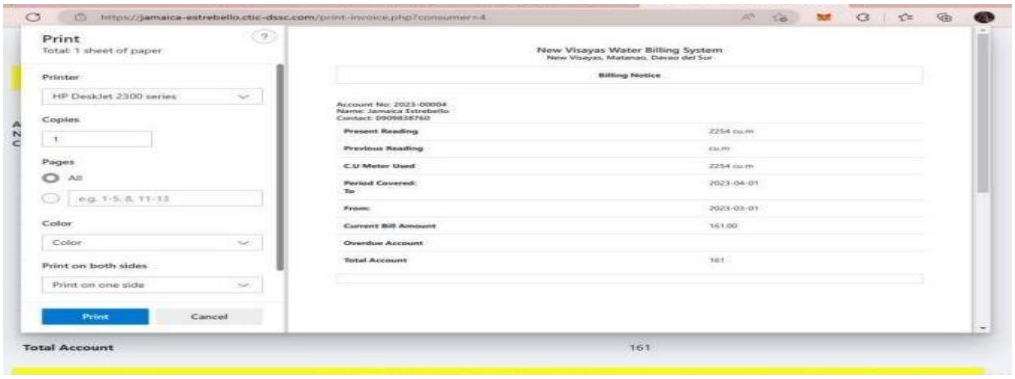

Figure 8. Receipt copy of Invoice for Consumers

Admin account page that generates Consumer Details

The proponent will implement a dashboard that can provide bills and consumer details. The figure 9 shows the propose of bills and consumer details. The figure 9 explains the purpose of this objective. The purpose of displaying bills and consumer details wherein to have a data information of the consumers and to identify. Administrator have access and applicable perform the bills and consumer details to ensure provide insight reports and have appropriate documents.

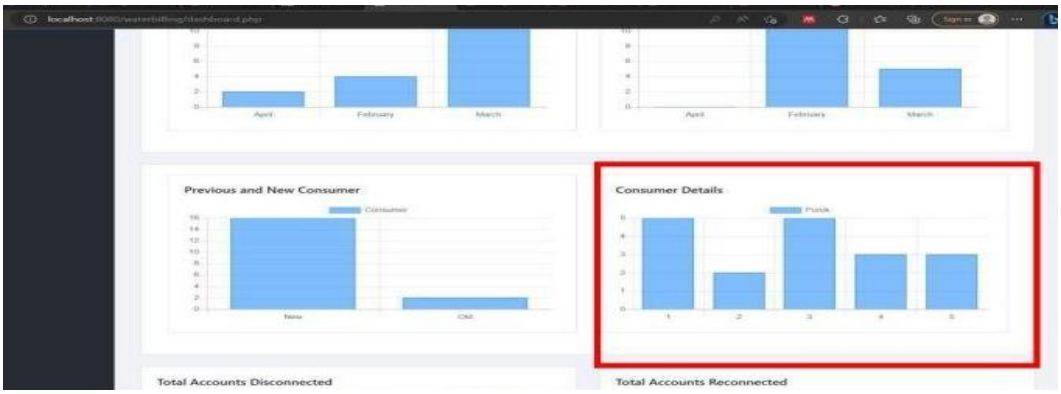

Figure 9. Propose of Consumer Details

Admin account page that generates Monthly Collection

The figure 10 and 11 explains the purpose of this objective. The purpose of displaying the monthly collection wherein can automatically record how much the consumer pay the bill. It shows the total collection every month report. The administrator can manage the system for viewing how they earned money every month or for a whole year collected.

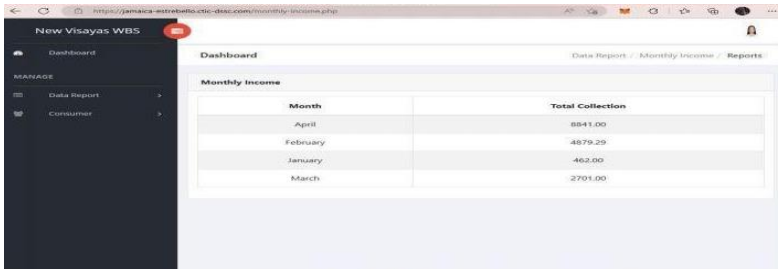

Figure 10. Showing the report of Monthly Collection

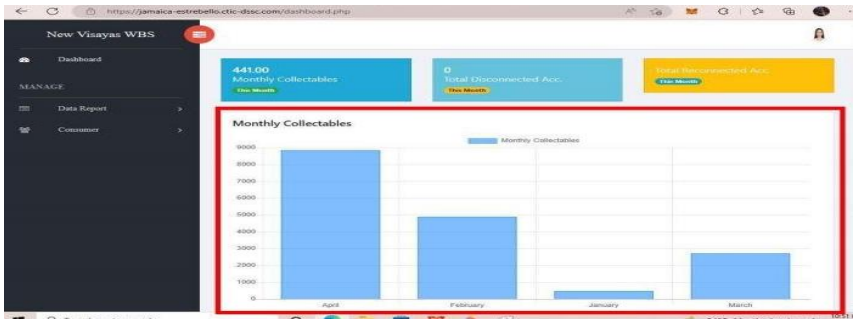

Figure 11. Report graph of Monthly Collection

Table 7 . Descriptive ratings from the respondents in terms of functionality Suitability of the system.

Particular	IT Expert	Panel/Administrator	Guests	Total Mean	Remarks
Released Consumer Bill	4	4	4.2	4.0	Very Agree
Reports of Disconnected and Reconnected	3.8	3.8	4.4	4	Very Agree
Previous and New Consumers	4.1	3.5	3.8	3.8	Agree
Invoice for Consumers	4	3.4	4	3.8	Agree
Consumer Details	3.8	3.5	4.6	3.9	Agree
Monthly Collection	3.8	4	4.4	4.0	Very Agree
Average	3.9	3.7	4.2	3.9	AGREE

As presented in the table 7 shows the descriptive ratings given by the respondents in terms of the systems functionality. As shown in the table, the IT Expert who participated in the survey rated the system of functionality at a total of 3.9 which describe as very agree, indicating that a specific functionality was entirely working. While the survey rating of the panel member and administrator is a total of 3.7 which describe as agree, indicating that the certain system was almost working. Lastly, the guests who participated in the survey rated the system of functionality at a total of 4.2 which describe as very agree, indicating that the certain functionality was working.

Particulars	Administrator	Guests	Mean	Remarks
It just takes a minute to generate a report or a bill	3.4	4.2	3.8	Agree
Does the data available in time	4	3.8	3.9	Agree
Does the bill reflect the previous and present water usage readings	3.5	4.2	3.6	Agree

Estrebello & Origines				
Average	3.6	4.0	3.7	AGREE

Table 8 Descriptive ratings from the respondents in terms of Performance Reliability of the system.

The effectiveness and value of a system can be assessed using the descriptive ratings provided by users. They offer valuable perceptions into the system's strengths and weaknesses, thereby guiding future developments and ensuring that the system satisfies the requirements of its users. The table 11 shows the descriptive ratings given by the respondents in terms of the systems functionality. As shown in the table, the survey rating of the panel member and administrator is a total of 3.6 which describe as agree, indicating that the certain system was almost working. Lastly, the guests who participated in the survey rated the system of functionality at a total of 4.0 which describe as very agree, indicating that the certain reliability was working.

Table 9. Descriptive ratings from the respondents in terms of usability of the system.

Particulars	**IT Expert**	**Panel/ Administrator**	**Guest**	**Total Mean**	**Remarks**
Does these analytics support all billing report	3.8	3.2	4.4	3.8	Agree
Reports can be provided anytime as needed	4.1	3.7	4	3.9	Agree
Utilizing this billing method would make it possible to task completion quickly	3.8	3.8	4	3.8	Agree
This data analytics system contributes more efficiency	3.6	3.5	4.2	3.7	Very Agree
Average	3.8	3.5	4.1	3.8	Agree

The effectiveness and value of a system can be assessed using the descriptive ratings provided by users. They offer valuable perceptions into the system's strengths and weaknesses, thereby guiding future developments and ensuring that the system satisfies the requirements of its users. The table 12 shows the descriptive ratings given by the respondents in terms of the systems functionality. As shown in the table, the IT Expert who participated in the survey rated the system of reliability at a total of 3.8 which describe as very agree, indicating that a specific functionality was entirely working. While the survey rating of the panel member and administrator is a total of 3.5 which describe as agree, indicating that the certain system was almost working. Lastly, the guests who participated in the survey rated the system of functionality at a total of 4.1 which describe as very agree, indicating that the certain reliability was working.

Table 10 Overall ratings of the system.

Particular	Total Mean	Remark
Functionality	3.9	Agree
Reliability	3.7	Agree
Usability	3.8	Agree
Average	**3.8**	**AGREE**

Based on the results of the questionnaire, it was found that the visualization using data analytics for barangay new visayas web-based billing system was highly effective in terms of functionality, reliability, and usefulness, as reported by given a positive rating from the respondents. Specifically, in terms of functionality it has a average result of 3.9 which the system performed satisfactory in the required task. Regarding the reliability, it overall rated the system with a weighted result of 3.7 indicating that they very agree the website passed their reliability standard. Moreover, the usefulness has weighted result of 3.8 indicating that the system is easily accessible and user-friendly. The mean score for their responses was 3.8 out of 5, suggesting a positive overall rating. The functions are working fine according to their purpose, bugs, errors and other problems that will occur as expected. And they found the system to be convenient to use which could attributed the features to that enable quick and easy.

According to Georgakopoulos et al. (2020) The functional outcomes can produce valuable and precise findings that will benefit the research study. By accomplishing the survey and helping to provide the establishment with easy access to the system and by setting each objective. According to Manaloto et al,. (2022) this study developed a water billing system that capable of providing prediction with the accuracy can view better insights into billing management through the visual representation of billing consumption trends.

Conclusions

The conclusion is a brief summary of the main findings and outcomes of the study. Listed below are the conclusions of every functionality:

1. The admin account page can generate data analytics on released consumer bill. Also, it gains a weighted mean of 4.0 from the respondent's evaluation which implies that the page is "Good" in generating data analytics particularly on the counted consumer water bill monthly.
2. The admin account page can generate data analytics on reports of disconnected and reconnected also it gains a weighted mean 4.0 from the respondent's evaluation which implies that the page is "Good" in generating data analytics particularly on the counted how many consumers are disconnected and reconnected of the water supply monthly.
3. The admin account page can generate data analytics on previous and new consumers also it gains a weighted mean 3.8 from the respondent's evaluation which implies that the page is "Fair" in generating data analytics particularly on the display the graph of

previous and new consumer which mean can counted how many consumers are member by water supply.

4. The admin account page can generate data analytics on invoice for consumers also it gains a weighted mean 3.8 from the respondent's evaluation which implies that the page is "Fair" in generating data analytics particularly on the counted released invoice consumer water bill monthly.
5. The admin account page can generate data analytics on consumer details also it gains a weighted mean 3.9 from the respondent's evaluation which implies that the page is "fair" in generating data analytics particularly on display by each purok counted members monthly.
6. The admin account page can generate data analytics on monthly collection also it gains a weighted mean 4.0 from the respondent's evaluation which implies that the page is "Good" in generating data analytics particularly on showing the report graph of monthly collection where also can display how much money collected every month and year.

Based on the conclusion it has been shown that the website can released a graph that visualizing the data of billing process. Hence, the website display identification details and percentage prediction in showing the graph where can counted the released data of the system are generally excellent and meet all needs. Finding the graph that shows how many billings have been released is challenging, especially for those who lack expertise and experience. Additionally, manually identifying and encoding customer data by administrators took a lot of time. To fix the issue with the website, assist the barangay in producing appropriate data for their billing reports. Data analytics were included in the web-based system, and the transaction displays and creates a billing statement that includes information on the water billing. Overall, these insights can help inform future improvement and updates to these functionalities to better meet the needs of users. Therefore, the objectives of the study have been achieved.

Recommendations

Based on the problem identified by the evaluators, the following recommendation may be drawn.

1. Enhancing to generate report of released consumer bill by adding year and display all month in a bar graph.
2. The report disconnected and reconnected should improve the user interface and by adding month and year that can display in the bar graph.
3. Enhancing to generate report of previous and new consumer by adding the display of members in previous and new consumer in water supply every month.
4. Enhancing to generate report of invoice for consumers by adding the invoice bill receipt to show the total amount bill consumed.
5. The report consumer details should improve by adding to display the consumer information in the consumer details.
6. Enhancing to generate report of monthly collection by adding the generate print receipt to have a hardcopy of the money collected

In summary, the future researcher has identified several studies for improvement in the project. It was suggested that the user interface should be enhanced with the objective of improving the system. In order to meet the needs of end users, enhancement and/or

modification must be implemented in order to achieve highly satisfied outcomes. This research contributes to the creation of web-based applications by visualizing data analytics in a billing system. Despite the difficulties encountered, the study findings provide insight into the opportunities of adopting technology for automated information saving.

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