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(RESEARCH ARTICLE)

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Development and evaluation of web-based barangay profiling and issuance system using regression analysis

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Abstract

The quick development of technology has made it possible to create effective and user-friendly systems to support the management of local government entities, such as barangays. Regression analysis is a primary analytical tool used in this research to show the development and evaluation of a Web-based Barangay Profiling and Issuance System (BPIS). The main objective of the system is to optimize the issuance of certificates, permits, and other documents while enhancing the process of gathering, organizing, and evaluating essential data pertaining to barangay residents.

The system is designed to address the following key functions: gathering, storing, analyzing, and issuing certificates and permits. The study provides important insights into the effects of data-driven decision support tools and shows how web-based systems and regression analysis can improve the efficiency of barangay governance. These outcomes highlight the significance of utilizing technology and data analysis to enable local communities to make better-informed and responsive decisions, hence promoting the general welfare and development of the residents.

In conclusion, the results of this study highlight how the Web-Based Barangay Profiling and Issuance System (BPIS) combined with regression analysis can be a game-changer for barangays. It's like a powerful tool that helps barangays make things smoother, make smarter decisions, be more open and accurate with their data, and issue certificates and permits more efficiently. It's a user-friendly website that makes life easier for both barangay officials and residents. It gives barangay officials a special window to see what their community needs and where it's headed. All of this means that the governance becomes more effective, which leads to a better life for the people living there.

Keywords: Barangay Profiling System; Web-Based System; Regression Analysis; Certificate and Permit Issuance; Data-Driven Decision Support; Local Government Efficiency

1. Introduction

The rapid advancement of technology, including smartphones, computers, and iPads, has significantly influenced various industries, streamlining tasks for individuals across society. Computers have played a crucial role in enhancing services, benefiting students, parents, employees, and the community. According to The Local Government Code of the Philippines (Chapter 1, Section 384) Role of the Barangay, the Barangay serves as the primary political unit in the forum where the aggregate opinions of the people may be voiced, crystallized, and taken into consideration, and where disagreements may be amicably resolved. The primary planning and implementing unit of government policies, plans, programs, projects, and activities in the community.

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The study focuses on developing a web-based platform that can address current issues in the barangay by managing information and issuing documents more efficiently and conveniently for both the residents and barangay officials. The Web-based Barangay Profiling and Issuance System aims to improve transparency and accountability in barangay governance. The study aims to assess the feasibility and effectiveness of using a web-based platform to enhance service delivery and barangay governance. This system enables officials to have a centralized database that can aid in improving service delivery and planning processes, such as identifying priority areas for infrastructure development or social services.

A Web-based Barangay Profiling and Issuance System is a digital platform where barangay officials can collect, manage, process, and store important information about their constituents, including personal details like name, age, address, and contact details, as well as employment status, income, and health information. and able to facilitate the issuance of barangay certificates and clearances to residents in well-time and accurate reports. This system employs a statistical approach to examine deeply the involved dynamics of resident demographics and community needs, converting raw data into actionable insights.

1.1. Statement of the Problem

Problem #1: Lack of a centralized database resulting in difficulties in accessing and retrieving information, duplication of effort that relies on accurate and up-to-date information, and limited data analysis.

Problem #2: Inaccuracy and inconsistencies of information about residents lead to inadequate data collection in the issuance of important documents, such as IDs or certificates, as the information collected may not be accurate or complete.

Problem #3: Ineffective gathering and analyzing information for barangay service delivery results in inefficient resource allocation such as the number of residents in need of assistance during emergencies or the prevalence of certain health conditions in the community.

Problem # 4: The current barangay system is not amenable to regression analysis as a means of evaluation.

1.2. Objectives of the Study

1.2.1. General Objectives

The Web-based Barangay Profiling and Issuance aims to provide a central repository of information to organize residents' records. This will help to systematize the requests in the Barangay. By storing the information electronically, it will help to avoid data loss that results in discrepancies. Additionally, it will increase transparency and accountability in the Barangay operations.

1.2.2. Specific Objectives

To design a web-based system that will provide a centralized database for accessing and retrieving information that will prevent data duplication for Barangay Residence.

To develop a system that will offer consistent resident information that considers the technical, security, and usability aspects of the system. By implementing appropriate measures to ensure data accuracy and security such as restrictions, verification, and validation. The system can provide reliable and up-to-date resident information that meets the needs of its users.

To implement a system that will enhance service delivery accurately identify the needs of their constituents and prioritize the allocation of resources towards the most pressing issues. These can improve more efficient and effective service delivery, particularly in document issuance and medical assistance.

To test and evaluate the proposed system, a thorough evaluation will be conducted following the ISO 25010 standard, such as Functional Suitability, Performance Suitability, Compatibility, Usability, Security, and Portability, and predict the variance of variables using Regression Analysis

2. Methodology

The researcher used the descriptive statistics method as the instrument to get the information and data needed for this study. The goal of conducting interviews is to get first-person narratives and viewpoints from people who have seen the system under study firsthand or who are active in it.

Additionally, interviews give researchers the possibility to dig deeper into usability issues and identify areas in need of improvement. Direct interaction allows the researchers to quickly gather feedback, suggestions, and ideas from potential users, which can aid in system development. This user-centered approach enables the research team to consider the viewpoints of those who will ultimately use the system and modify it to their needs and preferences.

The researchers will develop a system according to the needs of the barangay and according to their capabilities. This system will only cover the residents where the system itself is deployed, and only specified documents, such as barangay clearance, barangay I.D., barangay indigency, cedula, and health cards, will be accepted.

3. Results and discussion

The results depicted in figure 1.0 provide an overview of the system's performance. Functional Suitability, with a rating of 4.79, assesses the project's ability to effectively carry out its intended functions, indicating a high level of functionality with minimal operational issues. Performance Efficiency, achieving a 4.75, quantifies how well the project performs in terms of speed and its efficient use of computational resources, signifying optimal operational efficiency. Compatibility, rating 4.74, reflects the project's capacity to seamlessly integrate with various systems and software, enhancing its overall usability. Usability, rated at 4.73, places significant emphasis on the user experience, highlighting the importance of a user-friendly and intuitively designed interface.

Reliability, marked with a rate of 4.71, measures the project's dependability, with higher ratings suggesting fewer errors and system crashes. Security, earning a rating of 4.73, emphasizes the project's robust protection against unauthorized access and data breaches. Portability, achieving a rate of 4.78, underlining the project's adaptability to different platforms and environments. Collectively, these results provide valuable insights into the project's overall quality and its readiness for real-world deployment, a crucial factor in determining user acceptance.

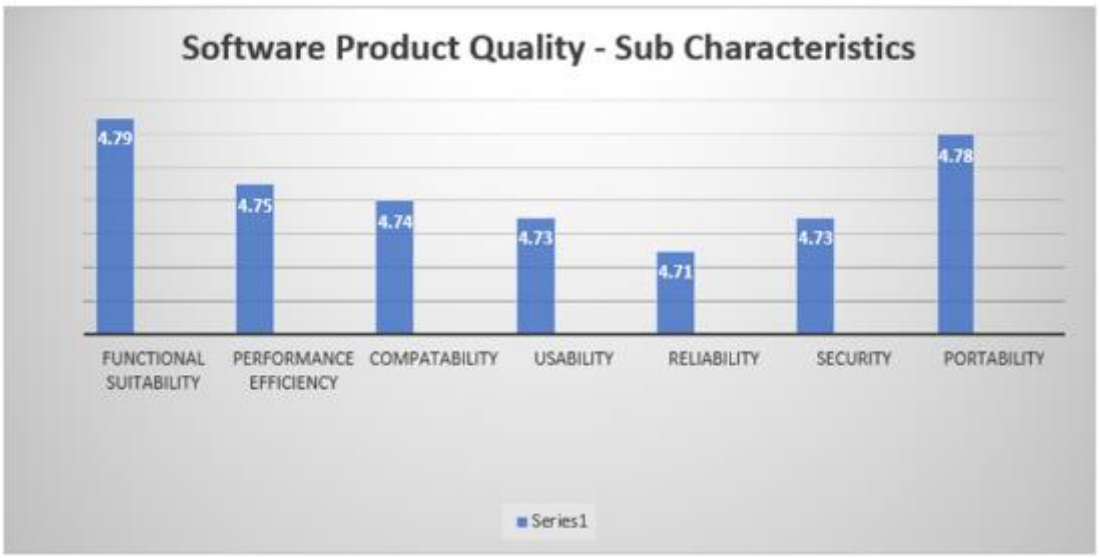

Figure 1 Software Product Quality – Sub Characteristics

Vigilant monitoring and continual improvement of these results throughout the project's lifecycle are essential to ensure a successful and high-quality final deliverable.

3.1. System Evaluation Result

- 5 – Strongly Agree
- 4 – Agree

- 3 – Fair
- 2 – Disagree
- 1 – Strongly Disagree

Table 1 System Evaluation Results

FUNCTIONAL SUITABILITY	**SA**	**A**	**U**	**D**	**SD**	**Sub- Characteristics**	**Weighted Mean**
	5	4	3	2	1		
The system covers all the specified tasks and user objectives.	42	7	3	0	0	Functional Completeness.	4.79
The system provides the correct results with the needed degree of precision.	42	8	2	0	0	Functional Correctness.	
The system facilitates the accomplishment of specified tasks and objectives.	46	5	1	0	0	Functional Appropriateness.	
PERFORMANCE EFFICIENCY	SA	A	U	D	SD	Sub- Characteristics	Weighted Mean
	5	4	3	2	1		
The system's response and processing times and throughout rates when performing its functions, meet requirements.	39	9	2	2	0	Time Behavior.	4.75
The system's amounts and types of resources used when performing its functions, meet requirements.	47	2	3	0	0	Resource Utilization	
The system's maximum limits of parameter meet requirements.	45	4	2	1	0	Capacity	

Table 2 System Evaluation Results (Continuation)

COMPATABILITY	**SA**	**A**	**U**	**D**	**SD**	**Sub-Characteristics**	**Weighted Mean**
	5	4	3	2	1		
The system can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.	41	8	4	0	0	Co-existence	4.74
The system can exchange information and use the information that has been exchanged.	42	7	6	0	0	Interoperability	
USABILITY	SA	A	U	D	SD	Sub- Characteristics	Weighted Mean
	5	4	3	2	1		
The system allows users to recognize if it is appropriate for their needs.	40	8	3	1	0	Appropriateness Recognizability	4.73
The system can be used by specified users to achieve specified goals of learning to use the application with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.	41	7	4	1	0	Learnability	
The system has attributes that make it easy to operate and control.	44	5	3	2	0	Operability	

The system protects users against making errors.	41	5	6	2	0	User Error Protection	
The system's user interface enables pleasing and satisfying interaction for the user.	46	1	4	1	0	User Interaction Aesthetics	
The system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.	42	9	1	1	0	Accessibility	

Table 3 System Evaluation Results (Continuation)

RELIABILITY	**SA**	**A**	**U**	**D**	**SD**	**Sub-Characteristics**	**Weighted Mean**
	5	4	3	2	1		
The system meets the need for reliability under normal operation.	39	9	4	0	0	Maturity	4.71
The system is operational and accessible when required for use.	41	8	3	0	0	Availability	
The system operates as intended despite the presence of hardware or software faults.	44	3	5	0	0	Fault Tolerance	
The system can recover the data directly affected and re-establish the desired state.	41	7	4	0	0	Recoverability	
SECURITY	SA	A	U	D	SD	Sub-Characteristics	Weighted Mean
	5	4	3	2	1		
The system ensures that data are accessible only to those authorized to have access.	41	6	4	1	0	Confidentiality	4.73
The system prevents unauthorized access to, or modification of, computer programs or data.	43	8	1	0	0	Integrity	
The system can be proven to have taken place, so that the events or actions cannot be repudiated later.	40	9	3	0	0	Non-repudiation	
Are strong password policies implemented, including requirements for length, complexity, and regular password changes?	41	6	5	0	0	Authenticity	
Are individuals or teams responsible for maintaining accountability in the organization properly trained and equipped to handle security incidents?	44	6	1	1	0	Accountability	

Table 4 System Evaluation Results (Continuation)

PORTABILITY	**SA**	**A**	**U**	**D**	**SD**	**Sub-Characteristics**	**Weighted Mean**
	5	4	3	2	1		
Is the software installation process well-documented and easy to follow?	47	2	2	1	0	Installability	4.78

Can the system be easily replaced or upgraded to newer versions without significant disruptions to the organization's security posture?	42	7	3	0	0	Replaceability	

3.2. Summary output

Table 5 Regression Statistics

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.475728505
R Square	0.226317611
Adjusted R Square	0.103231776
Standard Error	3.563253746
Observations	52

Table 6 ANOVA

	df	**SS**	**MS**	**F**	**Significance F**
Regression	7	163.4187	23.34553	1.838697	0.10364
Residual	44	558.6582	12.69678		
Total	51	722.0769			

Table 7 Multiple Linear Regression Analysis Table

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	51.8268414	11.99272	4.321526	8.72E-05	27.65711	75.99658	27.65711	75.99658
FUNCTIONAL SUITABILITY	-6.58784104	2.043433	-3.22391	0.002385	-10.7061	-2.46957	-10.7061	-2.46957
PERFORMANCE EFFICIENCY	0.089041046	1.550976	0.05741	0.954479	-3.03675	3.214828	-3.03675	3.214828
COMPATABILITY	0.097217348	1.282881	0.07578	0.939937	-2.48826	2.682694	-2.48826	2.682694
USABILITY	-1.49704193	2.078744	-0.72017	0.475231	-5.68647	2.69239	-5.68647	2.69239
RELIABILITY	0.336236707	1.728487	0.194527	0.846659	-3.1473	3.819774	-3.1473	3.819774
SECURITY	2.135967515	1.706807	1.251441	0.217387	-1.30388	5.575811	-1.30388	5.575811
PORTABILITY	-0.32220769	1.605497	-0.20069	0.841866	-3.55787	2.913458	-3.55787	2.913458

The multiple R (correlation coefficient) measures the strength and direction of the linear relationship between the independent variables and the dependent variable. The Multiple R of 0.4757 indicates a moderately positive linear relationship between the variables. Additionally, R^2, also known as the coefficient of determination, explains the proportion of the variance in the dependent variable explained by the independent variables. R^2 is 0.2263, meaning that approximately 22.63% of the total variance in the dependent variable is accounted for by the independent variables. In

addition, the adjusted R^2 is similar to R^2 but considers the number of independent variables, suggesting that the model's fit has not significantly improved.

On the other hand, the standard error quantifies the accuracy of the model's predictions, with an outcome of 3.563. Lower values are preferred because they indicate that the model's predictions are closer to the actual data points. Additionally, this statistic represents the number of data points or observations used to fit the regression model, and in this case, there are 52 observations.

The Anova table offers valuable insights into the significance of the regression model. To elaborate, "df" represents degrees of freedom, which quantifies the number of values free to vary in the analysis. The ANOVA table is composed of three rows: "Regression," "Residual," and "Total," with the "df" value in each row denoting the degrees of freedom associated with that particular aspect of the analysis. Furthermore, "SS" indicates the sum of squares, measuring the overall variation within the data. In the "Regression" row, the sum of squares (163.4187) vividly demonstrates the extent to which the regression model explains the total variation.

Moreover, "MS," short for mean square, is derived by dividing the sum of squares (SS) by the degrees of freedom (df). It serves as a measure of the average variation within that segment of the analysis. The F-statistic, on the other hand, gauges how effectively the regression model aligns with the data. It is computed by taking the ratio of the mean square for regression (MS of Regression) to the mean square for the residual (MS of Residual). Lastly, the significance F, commonly known as the p-value, indicates whether the F-statistic holds statistical significance. In the "Regression" row, the p-value registers at 0.10364.

In summary, these results display the potential for improvement. The multiple R indicates a moderately positive linear relationship between the variables, suggesting opportunities to enhance this relationship. While R^2 explains approximately 22.63% of the variance, efforts can increase the proportion of variance explained by the independent variables. Although the adjusted R^2 currently shows no significant improvement, there may be opportunities to refine the model. The standard error, at 3.563, leaves room for increasing the accuracy of the model's predictions, aiming for lower values to achieve even closer alignment with actual data points.

3.3. Evaluation

Scheme: weka.classifiers.trees.RandomTree -K 0 -M 1.0 -V 0.001 -S 1

Relation: Result-survey

Instances: 54

Attributes: 9

- Gender
- Age
- Functional Suitability
- Performance Efficiency
- Compatability
- Usability
- Reliability
- Security
- Portability

Test mode: evaluate on training data

=== Classifier model (full training set) ===

RandomTree

==========

USABILITY < 4.92

| FUNCTIONAL SUITABILITY < 4.83

| | SECURITY < 4.2

| | | FUNCTIONAL SUITABILITY < 4.33 : 26 (1/0)

| | | FUNCTIONAL SUITABILITY >= 4.33 : 20 (1/0)

| | SECURITY >= 4.2

| | | RELIABILITY < 4.13

| | | | Gender < 0.5

| | | | | COMPATABILITY < 4.75 : 25 (1/0)

| | | | | COMPATABILITY >= 4.75 : 22 (1/0)

| | | | Gender >= 0.5

| | | | | PERFORMANCE EFFICIENCY < 4.33 : 29 (1/0)

| | | | | PERFORMANCE EFFICIENCY >= 4.33 : 26 (1/0)

| | | RELIABILITY >= 4.13

| | | | FUNCTIONAL SUITABILITY < 4.5

| | | | | USABILITY < 4.08 : 28 (1/0)

| | | | | USABILITY >= 4.08

| | | | | | Gender < 0.5 : 30 (2/0)

| | | | | | Gender >= 0.5

| | | | | | | PERFORMANCE EFFICIENCY < 4.83 : 30 (1/0)

| | | | | | | PERFORMANCE EFFICIENCY >= 4.83 : 28 (1/0)

| | | | FUNCTIONAL SUITABILITY >= 4.5

| | | | | Gender < 0.5 : 22 (1/0)

| | | | | Gender >= 0.5

| | | | | | COMPATABILITY < 4.75

| | | | | | | USABILITY < 4.67 : 30 (1/0)

| | | | | | | USABILITY >= 4.67 : 25 (1/0)

| | | | | | COMPATABILITY >= 4.75

| | | | | | | RELIABILITY < 4.88 : 29 (1/0)

| | | | | | | RELIABILITY >= 4.88

| | | | | | | | SECURITY < 4.9 : 29 (1/0)

| | | | | | | | SECURITY >= 4.9 : 30 (1/0)

| FUNCTIONAL SUITABILITY >= 4.83

| | SECURITY < 4.5

| | | SECURITY < 4.3

| | | | RELIABILITY < 4.13 : 19 (1/0)

| | | | RELIABILITY >= 4.13

| | | | | PERFORMANCE EFFICIENCY < 4.5 : 21 (1/0)

| | | | | PERFORMANCE EFFICIENCY >= 4.5

| | | | | | PORTABILITY < 4.5 : 23 (1/0)

| | | | | | PORTABILITY >= 4.5 : 25 (1/0)

| | | SECURITY >= 4.3 : 18 (1/0)

| | SECURITY >= 4.5

| | | Gender < 0.5

| | | | PORTABILITY < 4.75 : 21 (1/0)

| | | | PORTABILITY >= 4.75

| | | | | USABILITY < 4.75 : 24 (1/0)

| | | | | USABILITY >= 4.75

| | | | | | SECURITY < 4.9

| | | | | | | SECURITY < 4.7 : 20 (1/0)

| | | | | | | SECURITY >= 4.7 : 22 (1/0)

| | | | | | SECURITY >= 4.9

| | | | | | | PERFORMANCE EFFICIENCY < 4.83 : 26 (1/0)

| | | | | | | PERFORMANCE EFFICIENCY >= 4.83 : 24 (2/9)

| | | Gender >= 0.5

| | | | PERFORMANCE EFFICIENCY < 4.83

| | | | | PORTABILITY < 4.75 : 26 (2/0)

| | | | | PORTABILITY >= 4.75 : 28 (1/0)

| | | | PERFORMANCE EFFICIENCY >= 4.83 : 23 (1/0)

USABILITY >= 4.92

| RELIABILITY < 4.88

| | FUNCTIONAL SUITABILITY < 4.83 : 27 (1/0)

| | FUNCTIONAL SUITABILITY >= 4.83

| | | Gender < 0.5 : 22 (1/0)

| | | Gender >= 0.5

| | | | PERFORMANCE EFFICIENCY < 4.5 : 22 (1/0)

| | | | PERFORMANCE EFFICIENCY >= 4.5 : 24 (1/0)

| RELIABILITY >= 4.88

| | PORTABILITY < 4.75

| | | PERFORMANCE EFFICIENCY < 4.83 : 27 (1/0)

| | | PERFORMANCE EFFICIENCY >= 4.83 : 24 (1/0)

| | PORTABILITY >= 4.75

| | | COMPATABILITY < 4.75

| | | | FUNCTIONAL SUITABILITY < 4.83 : 19 (1/0)

| | | | FUNCTIONAL SUITABILITY >= 4.83 : 21 (1/0)

| | | COMPATABILITY >= 4.75

| | | | SECURITY < 4.8

| | | | | Gender < 0.5 : 23 (1/0)

| | | | | Gender >= 0.5 : 28 (1/0)

| | | | SECURITY >= 4.8

| | | | | Gender < 0.5 : 21.4 (5/6.24)

| | | | | Gender >= 0.5

| | | | | | FUNCTIONAL SUITABILITY < 4.67 : 18 (1/0)

| | | | | | FUNCTIONAL SUITABILITY >= 4.67 : 22.33 (3/22.89)

Size of the tree: 85

Time taken to build model: 0 seconds

=== Evaluation of training set ===

Time is taken to test the model on training data: 0 seconds

=== Summary ===

- Correlation coefficient 0.9147
- Mean absolute error 0.5718
- Root mean squared error 1.5055
- Relative absolute error 17.4507 %
- Root relative squared error 40.4021 %
- Total Number of Instances 52
- Ignored Class Unknown Instances 2

The researchers evaluated the system using the RandomTree algorithm from Weka to analyze a dataset comprising 54 instances and nine attributes related to gender, age, functional suitability, performance efficiency, compatibility, usability, reliability, security, and portability. The RandomTree model constructed a decision tree structure to make predictions and reveal patterns within the data. The tree's decision-making process unfolds as it begins by evaluating the "USABILITY" attribute, dividing the instances based on this criterion. The tree further branches into sub-conditions, including assessments of "FUNCTIONAL SUITABILITY," "SECURITY," "RELIABILITY," "COMPATIBILITY," "PERFORMANCE EFFICIENCY," "PORTABILITY," and "GENDER." Each condition represents a distinctive criterion that the model uses to classify the data.

The model's performance metrics are notably promising, with a high correlation coefficient of 0.9147, indicating a ironclad linear relationship between the features and the target variable. The mean absolute error of 0.5718 demonstrates that the model's predictions are close to the actual values, and the root mean squared error of 1.5055 further confirms prediction accuracy. The relative absolute error (17.45%) and root relative squared error (40.40%) metrics offer a relative perspective on prediction accuracy within the dataset. With a decision tree comprising 85 nodes, this model provides valuable insights into the dataset's structure and relationships. Notably, the model was evaluated on the same training data it was built upon.

4. Conclusion

In conclusion, this Random Tree model demonstrates a strong capacity to analyze and predict outcomes within the given dataset, with high correlation and relatively low prediction errors. It provides a clear structure for decision-making and pattern identification. This evaluation is based on the analysis of 52 instances, with two instances being ignored due to class unknown conditions.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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Authors short bioavailability

	**Mark Jholan G. Ballaran**, 21, is a driven and ambitious individual currently navigating the challenging world of academia as a 4th-year student at Global Reciprocal College. Mark served as an auditor in the esteemed Gsite Leadership, showcasing his keen attention to detail and analytical skills. This experience not only honed his abilities in scrutinizing data but also instilled in him a strong sense of discipline and precision. He has set his sights on becoming a proficient full-stack developer.
	**Mark Joven Marcoso Donaire**, 22, is a trailblazing Information Technology student at Global Reciprocal Colleges, specializing in back-end programming and web development. Beyond the realms of code, Mark is a creative force, showcasing his talents as a freelance video editor, videographer, and photographer. His leadership shines as the former CCS Gsite President (2022-2023) at Global Reciprocal Colleges, where he navigated the intersection of technology and community building. With an exceptional blend of technical expertise and artistic flair, Mark is

	carving a unique path in both the tech and creative spheres, leaving an indelible mark on every project he undertakes.
	**Reynalyn M. Singzon,** 21, is a dedicated student currently in her 4th year pursuing a Bachelor of Science in Information Technology at Global Reciprocal Colleges. Focused on honing her skills, she specializes in web UI/UX design. In the academic year 2022-2023, she served as the treasurer of Gsite, showcasing her leadership and financial acumen. Reynalyn is driven by a passion for technology and aspires to make a meaningful impact in the field of web development.
	**Sarahlyn M. Naz is a dedicated** 22-year-old student at Global Reciprocal Colleges, currently in her 4th year pursuing a Bachelor of Science in Information Technology. With a passion for documentation and graphic design, she excels in her professional pursuits while maintaining a strong focus on her academic journey. Sarahlyn's commitment to mastering the intricacies of IT reflects her drive and determination in both her studies and professional endeavors.