Barangay Decision Support and Mapping System

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Abstract - The Barangay Decision Support and Mapping System aims to address the needs of the barangay for efficient information and decision processing. It allows the record of all the barangay residents and enables the user to create and edit the barangay map using the generally-accepted symbols or icons. It automates the barangay clearances, and permits. It allows the storage and retrieval of barangay-approved ordinances, meetings and resolutions. It records environmental problems and the solutions provided. The system also records cases of domestic violence, disputes and the actions taken by the concerned officials. Moreover, the system provides the necessary reports that can be used by the barangay officials for their barangay planning activities. The system's functionality was tested by the Barangay Officials of San Miguel, Guimaras as respondents of the study. The respondents strongly agree that the system's functionality conforms to their needs and requirements. With regards to the ease of use of the system as perceived by the respondents, the respondents agreed that the study is easy to use and the interface of the system is well designed. The reliability and validity of the system was tested by five (5) ICT professionals using ISO 9126 standard. Based on their responses, the system's evaluation shows that the system conforms to international standards and is therefore valid and reliable to use.

Keywords –Barangay Information System, Decision Support, Mapping

INTRODUCTION

The barangay is in charge of keeping track of records of people, businesses and activities within its jurisdiction. These records are very important to Local Government Units (LGUs) and the National Statistics Office (NSO). The information generated by the system such as barangay map, demography, residents by household, population structure, children's nourishment, literacy distribution, domestic violence, employment distribution, and barangay hazards are information needed by local LGU's and NSO for various barangay planning activities and implementation of barangay projects. Most barangays have their own personal computers which is commonly located in their respective Barangay Halls. Therefore, information storage and retrieval could have been enhanced.

However, most transactions are still done manually. The lack of user training and the availability of computer software hamper the opportunity of the barangay to maximize the power of computing in terms of storage and retrieval of the needed information. Consequently, the barangay secretary manually does the generation of the needed documents ranging from barangay clearances, permits and the record of disputes inside the barangay. Vital information such as the list of residents in the barangay, the list of businesses and others are not readily available.

The study was anchored on the current but varying solutions identified from various sources. According to Celeste [1] the government had done several measures to address the issues in storing and retrieving information from local government since the Local Government Code has been implemented. However, due to the limited budget given by the government to statistics agencies the retrieval of data from local sector includes only the population data. On her study conducted at Iligan City, in Lanaodel Norte Philippines she evaluated the capacity of National Statistics Office (NSO) field office in developing and maintaining a database for barangay level and test the developed information system to determine what information should be generated by the system which are significant to local level planners.

The study was also anchored from Fusilero, Magracia and Palencia [2]. The Barangay Households Information System (BaHIS) was designed and proven to provide inventory of local population and housing units of the barangay.

Aside from data processing, the need to identify various hazards in barangay level can help informed and warned the community about its impending danger.

The study also accommodates mapping of barangay hazardous areas. This idea was anchored from Pineda [3] which emphasized the importance of hazard maps in risk management and early warning process. However, the study only has two hazard maps available to the users, namely, the flood map and the fire map. Whereas in this study, the user was given the opportunity to specify different barangay hazards in the area as well as identify the different affected households.

Hazards are undeniably considered as treats to every community. The necessity to identify the possible hazards within the community can help them plan and impose actions to mitigate the occurrences of these hazards. The barangay official given various hazards information identified in their own local maps can warned residents whose homes are located or near hazards zones. Also, through this the local officials can plan the various locations of barangay structures away from identified hazards zones.

As Coppola [4] has stated impacts of identified hazards can be reduced when effective precautionary measures, timely and efficient organization and delivery of information are done.

This study is conceptualized to help the barangay organize their file into a single database and identify hazards location within the community so that valuable information becomes readily available and accessible to those who need it.

The Barangay Decision Support and Mapping System allows the user to upload barangay ordinances, resolutions and minutes of meetings. The system also allows the user to issue barangay clearances and business permits. A copy of these issued documents will be saved by the system.

Moreover, the users of Barangay Decision Support and Mapping System can create their barangay map by placing miniature markings on the map surface representing houses, churches, schools, recreational centers, halls, business, and other topographic features within the barangay and hazard prone areas.

The Barangay Decision Support and Mapping System also records information about the residents. The reports generated by the system include residents per household, families per household, family size and the age-sex population structure as grouped by age and gender. It also includes records about local businesses and barangay hazards. The location of the barangay households, businesses and hazards is readily available within the map.

OBJECTIVES OF THE STUDY

This study aimed to develop an automated barangay decision support and mapping system to support the core functionality of storage and retrieval of information that are vital to the operation of the barangay.

Specifically, the system is designed to allow the storage and retrieval of the record of all the residents in the barangay; allow the user to create and edit the barangay map using the generally-accepted symbols or icons which represents the natural and man-made features within the barangay; automate the processing of barangay clearances, permits and similar documents issued by the barangay; allow the storage and retrieval of barangay-approved ordinances, resolutions and other necessary reports; record environmental problems in the barangay and the solutions provided; record and retrieve cases of domestic violence, child abuse and barangay hazards and the actions taken by the concerned officials; and provide the necessary reports including existing businesses, demography, residents by household, population structure, children's nourishment, literacy distribution, domestic violence, household composition, households by dwelling, employment distribution, barangay hazards, barangay residents, minutes of meetings, barangay ordinances, barangay resolutions, and barangay topography.

To ensure the reliability and validity of the study, the system's functionality and ease of use should be evaluated by the intended users and to test the system's conformance to IS0 9126 standards selected Information and Communication Technology professionals (ICT) should be invited to evaluate the system.

MATERIALS AND METHODS

This study used the Software Development Research as well as Descriptive Research method.

This study includes the development of the Barangay Decision Support and Mapping System. The researcher used the Prototyping Process Model in defining the task that the researcher must undergo to complete the software. Prototyping process model ensures user's involvement during the evaluation of the system as to determine the system's compliance with the user requirements. According to Pressman [5] a prototyping technique is used when the requirements of the users are unclear. A prototype is evaluated by users as to provide feedbacks to further enhance the developed system. With this, project iteration occurs to refine, satisfy and better understand the system's requirements.

The researcher used the descriptive research to gather, organize, tabulate and present the collected data from various respondents as to determine the extent of the compliance of the study to the specified requirements.

The mapping system used in the development of the system map is based onCreating a Design Surface Using Windows Forms and GDI+ in Microsoft .NET. According to MacKenzie, [6] the Design Surface Using Windows Forms and GDI+ provides user with various tools to allow user to design surfaces and draw, move and rotate various graphical elements such as text, pictures, shapes. The package also allows finished compositions to be savedand restored back into the design surface and displays the printer page boundaries.

The system also considers the concepts of Decision Support System hence it provides valuable information to its intended users to support their decision making activities. Decision Support System according to Turban, Rainer, and Potter, [7] is a computer based information system that combines models and recorded data to solve semi structured and some unstructured problem with extensive user involvement.

The study falls under the Data Driven Decision Support System category. According to Power [8] Data Driven DSS emphasizes on the use and manipulation of historical data as to compare data trends and changes. The basic functionality of Data Driven Decision Support System includes accessing and retrieving stored data. The retrieval of data is done primarily using relational database, where data are displayed to show changes from past and present data.

The various report queried and generated by the system can be used by the respondents to act on certain issues like identification of barangay hazards, domestic violence, literacy, demography and economic distribution. This can also help them compare statistics of past and present data to plan well barangay programs.

The Barangay Decision Support and Mapping System was represented using a Unified Modeling Language (UML) Component Diagram which depicts the high-level structure of the proposed system.

According to Dennis, Wixom, Tegarden [9] UML Component Diagram illustrates the physical relationships among the software components and allows the designer to model these relationships among the various program modules.

The necessary parts or components of the system provide its services to other components thru its provided port or interface using the lollipop symbol. Likewise, the component retrieves its needed information thru its required interface denoted by a half-circle or socket icon. An interface is the definition of a collection of one or more methods, and zero or more attributes, ideally one that defines a cohesive set of behaviors.

As illustrated in Figure 1, the Barangay Information System component acts as the central processor of the system. It delegates the information it gathered from the User Interface component to the relevant component for processing and the result is returned to the User Interface component and/or persisted to the BrgyDB component.

The User Interface component represents the visual component of the system. It is responsible for system's interaction with the user from data collecting data to the display the result. The required interface Task represents the action the user wants the system to undertake. Based on the selected Task, the User Interface component has the Response interface to provide feedback to the user.

The system has the Access Admin interface which provides the validation process for validating and authenticating the user. The system delegates the validation process to the Barangay Details component with the user's provided access information usually consisting of user name and password.

To draw the barangay map, the Map Admin component provides the necessary methods to allow the user to draw or edit the barangay map.
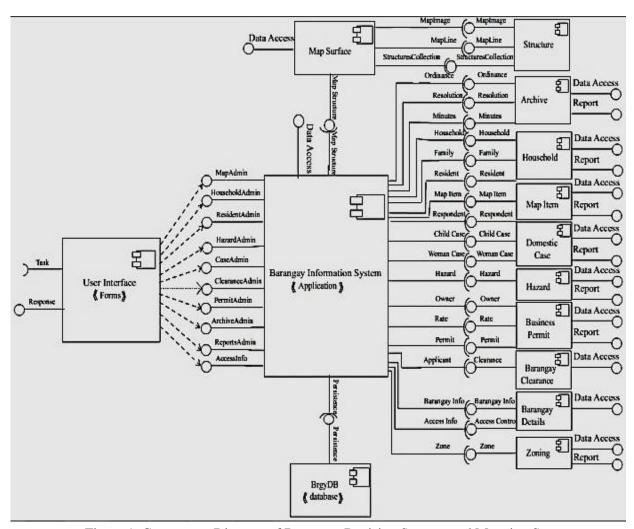
Figure 1. Component Diagram of Barangay Decision Support and Mapping System

In the drawing process, the system delegates the process of drawing the map structures to the Map Surface component. This component is dependent on the Structure component which contains the actual structures to be drawn.

There are three interfaces between the Map Surface and Structure component, with the following purpose:

a).The Map Image interface contains the properties and methods of map structures that are rectangular in shape such as a house or a bus terminal.

b) The Map Line interface represents map structures that are linear when drawn such roads and waterways.

c) The Structures Collection provides interface that returns all the map structures composed of Map Image and Map Line to be displayed by the Map Surface component.

The Household Admin component realizes the interface to allow the user to enter the household information, the families within the household and the family members. The actual process of entering the information is delegated to the Household component thru a set of interfaces: the Household, Family and Resident.

To update the resident information or to move the resident from one household to the other, the Resident Admin interface provides such functionality and uses the Resident interface to realize its function.

The Hazard Admin interface provides the methods to select the existing hazard and add the affected households. It is the Hazard component that contains the interface to persist the information obtained by the Hazard Admin component.

Cases of domestic violence are handled by CasesAdmin component with interface to select whether it is a child or woman case. It provides methods to allow selection from among residents who were the complainant and the respondent to the case. The process of saving and updating the information is delegated to the Domestic Case component having Respondent, Child, or Woman interfaces.

The ClearanceAdmin contains the interface for selecting the name of the applicant from the list of residents and for printing the barangay clearance.

The PermitAdmin contains the interface to process the applicant of the permit consisting of the business owner, the permit rate and for the printing the business permits.

Barangay records of ordinances and resolutions passed as well as minutes of barangay meetings are handled by the ArchiveAdmin. It provides selection whether the item to archive is an ordinance, resolution or minutes of meeting. The information gathered by the component is sent to the Archive component.

The ReportsAdmin provides the interface to allow the user to the select from among the available reports that each component provides. Note that in the figure, most of the components provide the Report interface. Since this is a top-level component diagram, the reports provided by each component is initially hidden to avoid ambiguity or clutter.

Evaluation and Respondents of the Study

To determine the respondents for the study, a purposive sampling technique was used by the researcher. Purposive sampling includes the selection of respondents according to the researcher's judgment based on the availability and credibility of the respondents.

In evaluating the systems functionality the researcher used a black box and white box testing.

According to Pressman[10] the black box testing is conducted as long as the respondents know the overall functionality of the system. The test is conducted to demonstrate the required functionalities of the systems as well as to look for errors and fix them. The respondents in black box testing do not need to be experts in programming or database design. The respondents can give valid evaluation as long as they know the overall functionalities of the system.

The Barangay Officials of San Miguel, Guimaras were invited to test the system for black box testing. Nine (9) Barangay Officials of San Miguel were invited to evaluate the system. The respondents include Barangay Captain, Secretary and Barangay Kagawads.

White-box tests focuses on testing the program's control structure and written codes as well as database design. In this type of software testing the respondents should be knowledgeable with the overall logical and control flow of the system. For this type of test, the researcher invited several Information and Communication Technology (ICT) professionals to conduct the evaluation.The system was evaluated by five (5) ICT professionals using ISO 9126 which includes six (6) software standardization criteria.

The instrumentusedfor the study was adopted from Abran,Al-Qutais,Desharnais,Habra[11] and Tacuban [12]with modification related to the study. The instrument from these studies already undergoes content validation and the modification integrated in the instrument was reviewed by an ICT professional.

Data Processing and Statistical Treatment

Microsoft Excel 2007 was utilized to record and analyze the data collected for this study.
To determine the validity and reliability of the system, the weighted Mean and Standard Deviation (SD) was used to ensure that the system conforms to its stated requirements.

The scoring method used by the ICT respondents to evaluate the system based on ISO 9126 was as follows:3.26- 4.00: Very Effective; 2.51-3.25: Effective; 1.76- 2.50: Fairly Effective; and 1.00 – 1.75: Ineffective.

The scoring method used by the Barangay Officials to evaluate the functionality and ease of use of the system are as follows: 4.21-5.0: Strongly Agree; 3.41-4.20: Agree; 2.61-3.10: Either Agree or Disagree; 1.81-2.60: Disagree and 1.0-1.80: Strongly Disagree.

RESULTS AND DISCUSSION

In determining the functionality, and user-acceptability of the system, the researcher used the weighted mean and standard deviation. Based on the data gathered from the barangay officials of San Miguel, Guimaras, the overall Mean value is 4.85 with SD of 0.19. As shown in Table 1, the respondents "Strongly Agree" with all system's functionalities and indicates the users' acceptability of the system. It is also noted that in each of the enumerated system's

functionality, the respondents "Strongly Agree" or have a high regard with the system's features.

For objective 1 stated as the system allow the storage and retrieval of the record of all the residents in the barangay has a Mean value of 4.88 and SD of 0.21 which is described as "Strongly Agree". This means that the system records all the Household Information in the Barangay including necessary data such as Mode of House Occupancy, Lot ownership, Income compared with Minimum Wage and Existing Utilities, the system was able to accurately store and retrieved Households Family Information, the system was able to accurately link family within a Household, the system was able to list all the residents of the barangay, the system was able to accurately generate reports about Household composition, the system was able to accurately generate reports about Household by dwelling, the system was able to accurately generate reports about Employment Distribution and the system was able to accurately generate reports about possible blood donors, address and contact Information.

For objective 2 , the system allow the user to create and edit the barangay map using generally accepted symbols and icons which represents the natural and manmade features of the barangay was rated the Mean value of 4.87 and SD=0.20 which is described as "Strongly Agree". This means that the mapping system is easy to use and the necessary map item properties are identified and stored by the system, most of the necessary icons that represent natural and manmade features are accessible in the mapping system, the system was able to accurately report all the barangay structures / topography within thebarangay,the system was able to accurately report all the barangay structures / topography within the barangay, the symbol used in mapping is familiar and easy to understand.

For objective 3, the system automated the processing of barangay clearances, permits and similar documents issued by the barangay have an overall mean value of 4. 81 and SD=0.05. This means that the system allows the user to automate the storage and retrieval of Barangay clearance and Business permits, the printed Barangay clearance contains all the necessary data required for a barangay clearance, and the printed Business Permit contains all the necessary data required of business permits.

Table 1. Evaluation of the System's Functionality as Perceived by Barangay Officials

Statement	Mean	Description	SD
Objective 1: Allow the storage and retrieval of the record of all the residents in the barangay.	4.88	Strongly Agree	0.21
Objective 2:Allow the user to create and edit the barangay map using generally accepted symbols and icons which represents the natural and manmade features of the barangay	4.87	Strongly Agree	0.20
Objective 3: Automate the processing of barangay clearances, permits and similar documents issued by the barangay	4.81	Strongly Agree	0.05
Objective 4: Allow the storage and retrieval of barangay ordinances, resolution and other necessary reports	4.72	Strongly Agree	0.20
Objective 5: Record environmental problems in barangay and the solutions provided	4.89	Strongly Agree	0.18
Objective 6: Record and retrieved cases of domestic violence against women and children and the actions taken by the concerned officials	4.86	Strongly Agree	0.05
Objective 7: Provide the necessary reports	4.89	Strongly Agree	0.22
As a whole	**4.85**	**Strongly Agree**	**0.19**

For objective 4, the system allow the storage and retrieval of barangay ordinances, resolution and other necessary reports has an overall mean value of 4.72 and SD=0.20 which is denoted as "Strongly Agree". This means that the respondents strongly agreed that the system allows the user to automate the storage and retrieval of barangay ordinances, and resolution, the printed Barangay ordinance contains all the necessary data required for a barangay ordinance and resolution.

For objective 5, the system records environmental problems in barangay and the solutions provided has an overall mean value of 4.89 and SD=0.18 which means that the respondents "Strongly Agree" that the system can identifies prevailing hazards in the barangay through the mapping system and report generation, the system was able to determine the

affected households and the system records and store action taken for each problem.

For objective 6, the system recorded and retrieved cases of domestic violence against women and children and the actions taken by the concerned officials has an overall mean value of 4.86 and SD=0.05 which signifies that the respondents "Strongly Agree" that the system automates the storage and retrieval of Barangay reports about domestic violence against women and children, the system records the type of abuse reported, the system was able to generate the percentage of the type of abuse from the total number of women and the system was able to generate the age bracket of women/children who suffered from abused.

For objective 7, the system provides necessary reports needed by the barangay has an overall mean value of 4. 89 and SD=0.22 which means that the respondents "Strongly Agree" that the system was able to report Existing Businesses, Barangay demography such as Residents by Households, Population Structure, Nourishment of Children and the system accurately generate reports on Barangay literacy distribution, Domestic Violence, Household Composition, Household by Dwelling, Employment Distribution, Barangay Hazards, Barangay Residents, Barangay Ordinances, Barangay Resolutions, Barangay Topography, and Blood Donors showing monthly and yearly data.

Based on the results as presented in Table 2, with Mean = 4.92 and SD = 0.14, it shows that the respondents "Strongly Agree" to the ease of use of the system. It signifies that the system is easy to use and the features of the system are easily understood by the users.

Table 2. Summary of Responses on the Evaluation of the System's Ease of Use

Statement	Mean	Description	SD
1. The user could easily comprehend how to use the system.	4.89	Strongly Agree	0.31
2. The user could easily learn to use the system.	5.00	Strongly Agree	0.00
3. The user could use the system without much effort.	4.89	Strongly Agree	0.31
4.The interface looked good	4.89	Strongly Agree	0.31
As a whole	**4.92**	**Strongly Agree**	**0.14**

Table 3 shows that using ISO 9126 standards, the respondents affirmed the validity and reliability of the system with the overall Mean = 3.87, SD = 0.22. For the six software qualities, the system's Efficiency got the highest rating from the respondents with Mean = 4.00, SD = 0.00 and is considered "Very Effective".

Meanwhile, the system's Reliability and Maintainability got the lowest ratings from the respondents with Mean = 3.76, SD = 0.23. However, the ratings are still within the range of the scale "Very Effective" and are considered statistically tied with the highest ratings given by the respondents for the system's efficiency.

Table 3.Summary of Responses on the Evaluation of the System Based on ISO 9126

Statement	Mean	Description	SD
1. Functionality	3.88	Very Effective	0.22
2. Reliability	3.76	Very Effective	0.23
3.Usability	3.96	Very Effective	0.16
4. Efficiency.	4.00	Very Effective	0.00
5. Maintainability	3.76	Very Effective	0.18
6. Portability	3.88	Very Effective	0.20
As a whole.	3.87	Very Effective	0.22

The respondents rated the Functionality of the system with the Mean value of 3.88 which denoted that the Functionality of the system is "Very Effective". This means that the system functions accurately based on its stated purpose and set of functionalities, the various system components interoperates cohesively and smoothly such that the map could refer to the location of the household and the record of residents provides data for clearance application and domestic cases, the look and feel or design of the system is appropriate , there is a suitability in the design of the system features, the functions and content of the system is design for its intended user, and there is a presence of security mechanism requiring the user to log-in to the system with the proper security credentials.

The respondents rated the Reliability of the system with the Mean value 3.76 which means that it is "Very Effective". This means that the system is consistent and accurately store and retrieve the application's related data such that the design of the map remains precise across system shutdown, the functionality of the components of the system is based on its design purpose, there is an absence of system failure and the system does not manifests certain

degradation in performance, the system is able to easily recover, there is an absence of errors on the system's output such as of reports and clearances, and the system has the ability to smoothly and cohesively interact with other systems like MS Word in document processing.

The respondents rated the Usability of the system with the Mean value 3.96 which means that it is "Very Effective". This means that the system help or instruct user how for use the application, there is an appropriateness in the organization of Windows forms and the presentation to the user, the necessary navigational interfaces are adequately provided to allow the user to move across system components, there is simplicity of the elements of the system requiring less time and effort on the part of the user to learn how to use the system and there is consistency in the placement and location of the user interface elements such that menu items, toolbars, navigation bars, help and search bars remains the same across windows.

The respondents rated the Efficiency of the system with the Mean value 4.00 which means that it is "Very Effective". This means that the system's response time in terms of processing the reports needed by the user is acceptable; there is a presence of the proper tools for mapping and easily recognizable map symbols allowing the user to draw the map more efficiently, there is a presence of a Search box to easily search the record of interest when there is an enormous set of records to view, the response time of the system to locate the structures in the map being sought for is acceptable and there is a presence of paging to move from one record group to the other to improve navigation and searching.

The respondents rated the Maintainability of the system with the Mean value 3.76 which means that it is "Very Effective". This means that the system provides a mechanism for analysis to determine the cause of an application error through the use of informational messages, there is grouping of database queries into their respective classes for code reuse, ease of error detection and modification, there is a separation of the presentation components from the data access component of the system where the data access component's task is to provide data to the presentation layer and the latter's task is to display the data, applied the process of normalization to the application's database to promote consistency and reliability of data and there is a well-designed hierarchy of classes which is easier to follow, understand and maintain.

The respondents rated the Portability of the system with the Mean value 3.88 which means that it is "Very Effective". This means the system provides an automated deployment system which eases the installation of the application, the system was develop without regard of the size of the barangay and the total number of the residents therein making it applicable for all barangay regardless of land area and number of residents, the system has the capability to install its needed components or prerequisites in case the target server lacks such component and the application deployment uses standard setup files (setup.exe, .msi) making application deployment easy and familiar to Windows-based users.

CONCLUSION AND RECOMMENDATION

This study addresses the current issues encountered by the barangay in managing barangay information. Also, this study aids the decision making activities of barangay officials by retrieving information relevant to various barangay programs.

Based on the perception of the respondents, they "Strongly Agree" on the functionality of the system and therefore indicates that the system strongly conforms to its design objectives and the needs of its users. The respondents "Strongly Agree" on the ease of using the system and is an indication that the system is easy to use and the system's features and functions is easily comprehensible by its intended users.Based on the perception of the respondents, the system conforms to ISO 9126 standards and with the overall mean rating corresponding to "Very Effective", it implies that the system highly conforms to international standards.

Based on the results shown the following recommendations are hereby presented: Any barangay who is lacking this type of system must obtain a copy of the software as the system addresses the numerous areas of concern of the barangay. The system promotes efficiency and provides accurate and timely information for the concerned barangay.

The system is designed for the barangay but the components making up the system may be extended. It is therefore recommended that future researchers develop a system like a Municipal/City Information System or the Regional Information System. The barangay map may also be made as a starting point to create a map for diverse purpose.

The map is drawn using the predefined map sizes as it was what the researcher intended to support. It is recommended that future researchers enable the user to draw the map size arbitrarily. Likewise, it would be much better that the map is printable, allowing the user to zoom out the map surface until it fits the printable area of the user's printer device.

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