



Web-based Census-Tracking Application with Integrated Geospatial Information System: A Step towards Promoting Civil Registry Efficiency

Digna S. Evale

College of Information and Communications Technology, Bulacan State University
City of Malolos, Bulacan, Philippines

Abstract - *The main purpose of this research is the development of a web-based system which can help the municipalities of Bulacan in promoting efficiency of transaction processes involved in Local Civil Registry Office (LCRO) which in turn will promote the customer service experience of the citizens. This work aimed to lessen the arduous tasks which are part of the LCRO daily routines and operations. The system was developed using advanced web development tools. The integrated Geospatial Information System is one of the useful facet of this application. Standard file operations (Creation, Retrieval, Update and Delete); security components; and report generations are also among the salient features integrated into the system. Acceptability of the project was evaluated using ISO 9126 Software Quality Assurance Standard; a “Very Satisfactory” rating was gained which was interpreted as “acceptable” for implementation.*

Keywords - *Civil Registry, Local Registration Process, Web-based Registry System, File Management, Computerized Registration, Software Quality Assurance Standard, Agile Software Development Model.*

I. INTRODUCTION

“The right to identity is central to human rights and development” and the completeness and accuracy of recording the identity also coined as “vital statistics” of all the residents in a community is a great contributing factor in the success and failure of national and international government fundamental services [1]. Talking about the statistics of global data, about two-thirds of the world’s annual deaths are still unregistered or unaccounted and it might be a surprised to many that almost half of the world’s children remains unregistered just the same with the birth of millions of children every year which are never registered too [2]. This on some point may be associated with the fact that there are some countries especially developing countries which even until today haven’t instituted yet laws or infrastructures for civil registry-related functions, but aside from that, another great barrier is the unavailability of service to rural areas. According to [3], those registry-related data are very essential in planning and developing a good public health programs, thus, civil registration activities should really be optimized and should be brought closer to people.

Civil registration is a fundamental function of the government which governs the continuous and compulsory act of recording and monitoring of the important events in our lives. This is the rationale why our government can keep records of birth, death, divorce, annulment and other vital status of its citizens [4].

Employing the power of technology in civil registry-related transactions and functions are considered to be among the greatest challenges of various countries decade ago but is now coming into reality in an accelerated phase [5]. As of today, the Philippines is implementing Civil Registry System - Information Technology Project. This system aims to speed up the transactions at the National statistics Office and avoid a growing queue of the volume of costumers who are availing registry services. That indeed is a very good IT-related project of our country however that system might be of its best if that happen to be implanted too in the Local Government units for maximum utilization.

But perhaps due to some constraints, Civil Registry System – ITP is only being used at the national level amidst the fact that there is now the so called decentralization of government from national to local, meaning most of the services due for people are now being served at the local government units. And so, the researcher decided to come up with the development of a mock version of that CRS-IT Project which aims to increase the level of satisfaction of the local citizens.

Based on the result of the Census of Population and Housing released by the National Statistics Office on 2012, Bulacan has a total population of three million one hundred twenty four thousand (3.124 million) people with more than 588,693 households (as of 2007 statistics) which makes it the second most populated province in the Philippines next to Cavite [6]. The Province which is subdivided into twenty-one municiplaities and three cities spread all over the land area of 2,775 square kilometers has a population density of about 1,099 persons per square kilometer [7].

Currently, the Human Population Development Office of various municipalities in Bulacan is encountering problems in their manual system of gathering from millions of households. They are using labor-intensive survey and everything is stored and filed in from of hard copies; they cannot easily generate statistical reports because there is no centralized database, thus the consolidation of data from its 569 barangays is indeed a tedious task. Thus, the province

seems to be really in need of a web-based tracking system where the Local Civil Registry Office can access household data which will promote faster and easier tracking and consolidating of census-related information. Efficiency in tracking or locating of areas could be further enhance through the integration of a Geospatial Information System.

Objectives of the Study

The general objective of this study is to promote the efficiency of recording and tracking civil-registry related data in the municipalities of Bulacan through the development of a Web-Based Census Tracking Application with Geospatial Information System which can be used as standard tool to produce statistical reports.

Specifically, the study aimed to achieve the following objectives:

1. To analyze the technical requirements of the clients necessary for the development of a web-based Census Tracking System.
2. To develop the salient features of the application on the top of Geospatial Information System based on the user requirements that will be identified by the clients so as to optimize the usage of census data.
3. To evaluate the quality of the system using the ISO 9126 software quality evaluation standards.

Significance of the Study

Citizens of Bulacan. The residence of Bulacan are the primary beneficiaries of this project. A web-based civil registry system will give them an improved customer-service experience in terms of the speed and quality of transactions they could avail from the LCRO.

Bulacan Local Government. Because of the availability of consolidated database of the residence of Bulacan, the administration can now give better civil registry-related services to its constituents. Administrative and labor costs can be reduced too since automation is proven to scale down human intervention in accomplishing certain tasks.

Local Civil Registry Office. The LCRO can save time and reduce the amount of paper works involved in their daily operations.

To the ICT workforce. This study will leave a challenge to those who working in the field of Information and Communications Technology in terms of integrating various tools such as web, database and geospatial information system.

II. DEVELOPMENT METHOD

Project Methodology

The Research Paradigm in Figure 1.2 shows the Input, Process and Output phase of this study, their relationship to each other as well as the components and boundaries of each phase. The Input phase involves the identification and understanding of the knowledge requirements, and all the necessary software and hardware technology on the top of other resources vital to the completion of this research work.

The process phase basically includes the activities that must be done by the researcher for the successful realization of this study. the proponent adopted the Systems Development Life Cycle (SDLC) Waterfall Model which is a conceptual model used in project management that describes the stages involved in an information system development project, from an initial feasibility study through maintenance of the completed application (Blanchard: 2006).

The SDLC is a project management technique that divides complex projects into a more easily managed segments or phases. In this study, the proponent started the process of developing the system in initiation phase, followed by planning, design, development, testing, implementation, and maintenance phases.

The last stage on the research paradigm is the Output stage which shows the development of a fully-functional Web-based Census Tracking System with Integrated GIS.

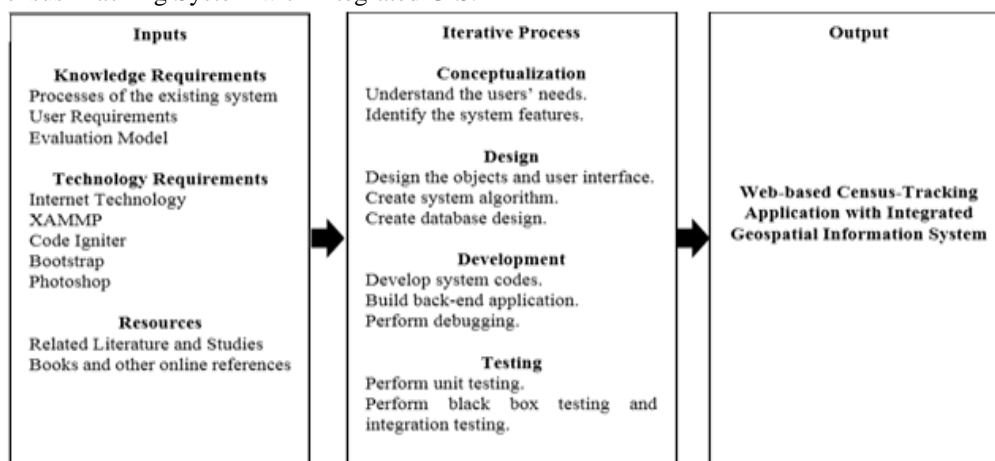


Figure 1. Conceptual Framework of the Study

Architectural Design

In order to develop a framework of the new work processes that will happen upon implementation of the system, the researcher created a Data Flow Diagram as shown in Figure 2 which illustrates the flow or movement of pertinent

information in the different processes involved in the Census Tracking System. A USE Case diagram was also created (refer to Figure 3) and analyzed to gain better understanding of the different interactions and transactions involved among various actors. This will help the researcher in identifying the design requirements of the system which is also closely related in identify the presence of difficulties or problems which affect the efficiency of transaction processing.

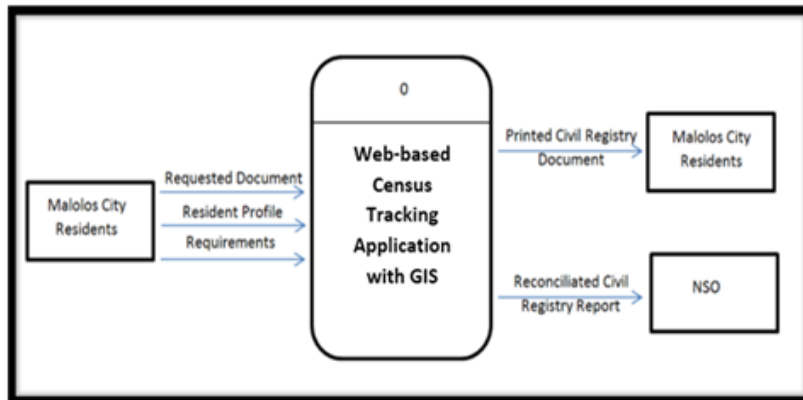


Figure 2. Data Flow Diagram of the Automated Census Tracking System

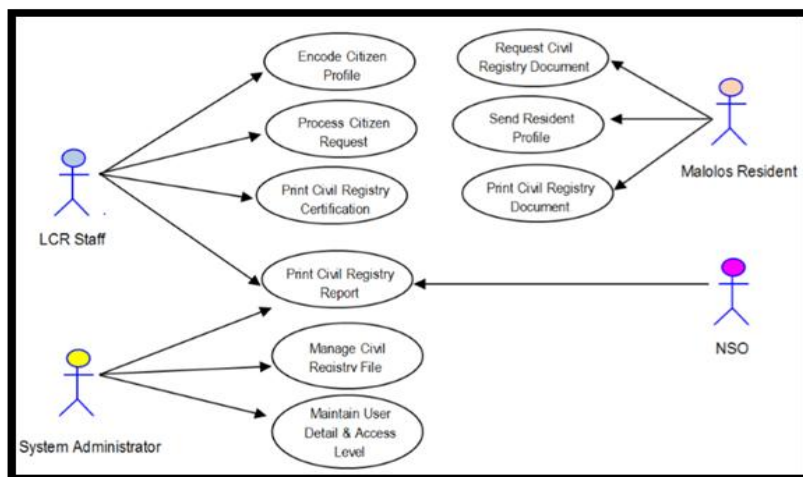


Figure 3. USE Case Diagram of the Web-based Census Tracking System

Software Requirements

The researcher used the following in order to develop the Census Tracking System with its salient features:

- **CodeIgniter** is an application development framework that used in developing websites and web applications and the proponents use this for coding the system. The coding structure is minimal and simplified than other framework used in developing web based applications.
- **Bootstrap** for the interface; bootstrap is a front-end framework; it has a free collection of tools for creating websites and web application. The proponents decided to use bootstrap because the graphical user-interface automatically fits in all screen.
- **XAMPP** is a free and open source cross platform web server solution stack package it has MySQL database and this is what the proponents use for their database. Because XAMPP is an open source it will run in different platforms.
- **Adobe Photoshop** is an image editing software and the proponents use the Adobe Photoshop in editing backgrounds, icons and logos used in the system.

Research Instruments

The researcher will used data gathering methods to identify the problems which were used as the basis for improving the current civil registry system. This includes observation, personal interviews, questionnaires and evaluation forms.

Observation. One of the instruments to be used in data gathering is through direct observation. This will provide firsthand information about the processes. The researcher will observe the actual operation of the manual system; this will enable him to acquire the basis for the development of the proposed system.

Personal Interviews. In conducting this method, the researcher will ask questions to the respondents about the processes in civil registry system, these are; the personnel and staff in Civil Registry Office and some citizens. The researcher will then gather information and identify any problems, which will then be used as the basis in improving the old system.

Questionnaires. One of the instruments that the researcher will use to gather information is a questionnaire or survey form for the respondents to get their personal opinions as to any problems that they may have encountered with the manual system, and to also give them the opportunity to suggest or comment on any improvements or solutions that can be integrated to the new system.

Evaluation Procedures

The system was evaluated based on ISO 9126 Software Quality Assurance Model by a set of respondents indicated on Table 1 using the Scale Range Indicator on Table 2.

Table 1. Respondents of the System

Profiles of Respondents	Number	Percentage
IT Experts	5	8%
End users	12	19%
Residents	45	73%
Total	62	100%

IT experts were asked to evaluate the system to ensure that the Census Tracking System met the required functionality and data integrity in terms of technical aspects. The end-users were also required to evaluate so as to check if all the necessary features were integrated into the system. Residents who are the main beneficiaries of the system evaluated the system to make sure that other detailed requirements from their point of view will be included. Mean value will be used to get the rating gained by each indicator.

Table 2. Scale Range Rating Indicator

Rating	Range	Remarks
4.50 – 5.0	Excellent	4.50 – 5.0
3.50 – 4.49	Very Good	3.50 – 4.49
2.50 - 3.49	Good	2.50 - 3.49
1.50 - 2.49	Fair	1.50 - 2.49
1.00 – 1.49	Poor	1.00 – 1.49

The developed system will be evaluated using the five-point scale range from one to five, with one interpreted as “outstanding” and five interpreted as “poor”.

III. RESULTS AND DISCUSSION

Technical Requirements

The Web-based Census tracking System with Integrated GIS was developed based on various requirements such as the user requirements, system requirements and interface requirements which are all very necessary for the design and development of a system.

User Requirements

As part of the data gathering phase of the system development process, the researcher had an interview on the persons related to the proposed system. A series of questionnaires was also distributed to get an idea of the user’s expectations of what are the functionalities that must be integrated into the system. The following are the data obtain:

The users suggested that the system should have one administrator account that can add, edit delete, and update the databases of both householder and barangay representative. Administrator can monitor the transactions made by the representative for each barangay. Administrator can create a maximum of three (3) accounts for representatives. Representatives are created by the administrator. They can add householders respective to their barangay and search the whole city and it’s each representative should have their corresponding barangay. Administrator can view transactions made by each representatives.

The system also should generate statistical reports such as crime rate, death rate, and health rate for each barangay. The system also should monitor the population of each barangay and municipality. It should be able to track all householders by searching them by Name (First Name, Middle Name, and Last Name) by barangay or by householder ID automatically given. The system should tally reports based on the survey form the barangay given by each householder.

System Requirements

These are the list of requirements which must be integrated as functionalities of the system as described by the stakeholders.

1. Logging In and Out, Activating Account, and Profiles

- 1.1 Administrator, Representatives should have their own login account

- 1.2 Representatives should fill-up the required fields to be able to register. Fields will be related to their personal information.
- 1.3 Administrator and Representatives can only input three (3) incorrect passwords or else the user will be blocked, Trials will be reset once the user has logged in
- 1.4 In case the Representatives will be blocked, the system will allow the power user to unblock depending on the confirmation given by Administrator. The Administrator can contact the power user in case he will be blocked.
- 1.5 There can be only one (1) Administrator account, and three (3) Representatives per barangay.

2. Accessibility, Account Settings, and Householder Information

- 2.1 The system allows the Administrator to manage the householder table of database which means that the Administrator can Add, Update, View and move householder to archives
- 2.2 The system allows the Administrator to access all the Representative accounts, which the Administrator can Add, Update, View and delete their account by searching their username respectively
- 2.3 The system only allow Representatives to add and search householders in the database, to be able to search for the whole information of the Householder, they must have the confirmation of the Administrator.

3. Tracking and Searching of Householders

- 3.1 The system allows the Administrator to have full access of the tracking system. They can search for householders and view all their information; they can also filter results they want by just typing on the text box for searching.
- 3.2 The system allows the Representative to search for name and the ID of the householder, however they need the confirmation of the administrator to view the full profile of the householder they want to search.

4. Statistical Reports/Survey

- 4.1 Representatives and Administrator must fill up every householder survey; one (1) Householder per survey
- 4.2 If the householder wants to update Householder's survey, they must ask for the permission of the representative by sending them confirmation through email.
- 4.3 Administrator can update reports based on their survey
- 4.4 Representatives must update reports by sending them through email
- 4.5 Administrator can view reports based on their category (crime rate, birth rate, death rate)
- 4.6 The users can view statistics like population and householders per barangay
- 4.7 Administrator can change the data of survey and update the fields
- 4.8 Administrator can view yearly population report per barangay or the whole municipality

System Features

To discuss to different features integrated into the system, functionalities are described through the presentation of screen shots from Figure 4 to Figure 7.



Figure 4. Login Page. Standard feature for the verification of username and password.



Figure 5. Dashboard Page. User interface that organizes and presents information in a standard format.



Figure 6. Statistic Page. For the generation of different statistical reports.



Figure 7. Geospatial Information System. For identification and tracking of households.

Evaluation Results

The web-based system was evaluated to determine its level of acceptability, an assessment to know if the system meets the needs of the clients. Evaluation criteria from ISO 9126 Software Quality Assurance to test the functionality, reliability, usability, maintainability and portability of the system was used. The formula to get the mean of the evaluation criteria and the scale used in getting the perceptions of the respondents which were described in methodologies were used in evaluation and interpretation of gathered data.

The portability got the highest rating which is 4.41 equivalent to Very Good. Functionality and Maintainability of the system got 4.32 and 4.31 respectively. Reliability of the system is second to the lowest which got 4.27 rating. Usability of the system got the lowest rating which is 4.25 but is still interpreted as Very Good. The weighted mean is 4.34 which mean that the respondent found that the system with features and functionalities fitted for a Web-based Census Tracking System with GIS is acceptable in terms of various requirements and functionalities stated by the client.

IV. CONCLUSSIONS AND RECOMMENDATIONS

The objectives of the system are met in developing a Web- based Census Tracking System with GIS for the Civil Registry Office of the municipalities in Bulacan. The system provides a systematic way in processing census transactions, and a database that contains information of the persons in certain place. The system enables lessening of administrative works of organizing and maintaining records. It can be used in easily manipulation of data for it does not require bulk of paper work. It also organizes the records and files to avoid mismatching of identities. It requires little time and effort because of adding of records is made easier, faster and more secured. Instead of manual keeping of records it is electronically stored onto system and it may eliminate loss of files. It is also easy way of submitting and transferring files through internet connection using the web. These important features of the system enables the municipality and its barangays communicate with one another.

Despite the fact that the system performs efficiently and reliability there are some recommendations for the enhancements to greatly improve its functionality. Application of more advanced tools in development and integration of GIS is highly recommended to make identification and tracking of houses in the city more accurate and reliable.

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