oneBarangay: An e-Government System for Online Transaction Processing of Barangay Malanday Main Office through Web and Mobile Application with Implementation of OCR Technologies

Garon, John Christian M.
Department of Information Technology, Web and Mobile Application
FEU Institute of Technology
Muntinlupa, Philippines
johnchristianmgaron@gmail.com

Mariñas, Katherine Therese Marie E.
Department of Information Technology, Web and Mobile Application
FEU Institute of Technology
Cainta, Philippines
katherinemrns@gmail.com

Legaspi, John Benedict C.
Department of Information Technology, Web and Mobile Application
FEU Institute of Technology
Manila, Philippines
jclegaspi@feutech.edu.ph

Relox, Tricia Dorine G.
Department of Information Technology, Web and Mobile Application
FEU Institute of Technology
Taguig, Philippines
tdgrelox@gmail.com

Velasco, Prince Carl S.
Department of Information Technology, Web and Mobile Application
FEU Institute of Technology
Rizal, Philippines
princevelasco16@gmail.com

Lalata, Jay-Ar P.
Department of Information Technology, Web and Mobile Application
FEU Institute of Technology
Manila, Philippines
jplalata@gfeutech.edu.ph

***Abstract*—This study aimed to develop a web and mobile based e-Government System for Barangay Malanday Main Office, Valenzuela City with Implementation of OCR technologies that intended to digitize and automate the transactional processes of the barangays. The entire system was built to intentionally aid barangays in transforming their conventional approach into the digital sphere which utilizes the use of Optical Character Recognition (OCR) technologies to help the effective and efficient transitions in a barangay. The effectiveness and efficiency of the system were then tested and evaluated through surveys using the FURPS criteria which consists of functionality, usability, reliability, portability, and supportability. Results, conclusions, and recommendations have also been presented and discussed in the last part of this paper.**

Keywords—Local Government Units (LGUs); Barangay; Optical Character Recognition (OCR); Online Transactional Processes

I. Introduction

Technology is making a revolutionary development and impact on every organization. However, some sectors today seem to be left behind in adapting the use of different technologies such as the Local Government Units (LGUs) specifically, the barangays and its conventional approach of transactional processes are found to be rigid and outdated as the citizens have been fully connected with technology than ever before[6]. It is essential for the Barangays, as many local governments too in across many countries have been adopting the concept of digitizing and automating the operations, hence the word "e-Government" as it enhances the operations as the data gathered through this is useful as it helps gain deeper insights within its constituents and visualize such data to further improve development projects [7] With an effective online transactional process, oneBarangay aids common matters by providing a convenient, secure, and efficient operational system for the Barangays.

II. BACKGROUND OF THE STUDY

Barangay Malanday is one of the constituent barangays located in Valenzuela City that envisions an improved and progressive Barangay that will make its residents proud and dedicated to enhancing sustainable development and improved quality of life of each resident through delivering basic services, and maintenance of a peaceful and orderly society.

As the Barangays are handling documents in a traditional approach wherein transactions were only made through physical interactions, a lot of factors are considered especially that a barangay has various units and the residents' data that are in the form of paper are confidential which can put the data into risks such as being distorted due to natural disasters, incomplete, and loss of data.

A. Objectives

The general objective of this research was to design and develop an e-Government System to systematize the manual processing of the transactions in the barangay for an efficient and secured delivery of the documents in Barangay Malanday Main Office. This helps the barangay to speed up and automate the processing of documents in order to deliver the needs of its constituents. Specifically, this research aimed to fulfill the following:

- To develop an announcement builder dashboard for news and events for residents and barangay officials.
- To create an appointment module for residents that includes reservation, rescheduling, cancellation for documents and on-site visit.
- To include email, push, and app notification for announcement and appointment of the barangay officials and residents.

- To construct a data visualization module that displays charts and graphs to gain insights on their residents' data for the barangay officials.
- To construct a barangay database system to store residents' data and their profiling.
- To develop an Optical Character Recognition (OCR) module that auto-populates the fields required in the document given the residents information and to directly upload the information of residents in the barangay database for existing paper data.
- To create a user module to create accounts for the admin, secretaries, and residents and to provide restricted access in adding, editing, and viewing of data.
- To evaluate the system using the FURPS model.

B. Scope and Limitations

The system has web and mobile applications for barangay workers and residents that can digitize and automate daily barangay transaction processes. In addition, the system provides appointment scheduling for requesting documents, queuing procedures and notifications of news and updates in barangay. The system can only manage transactions that occur between residents and barangays and encourages them to transact online as much as possible.

In this study, the work was divided into separate module:

- Announcement Module. Display events and news;
- User Module. Handles all accounts and restrictions;
- Appointment Module. Responsible for hassle-free and conflict-free scheduling of transactions;
- OCR Module. Scan paper documents and store all data in the database.
- Data Visualization Module. Display residents profile.

This study focused on serving the residents of Barangay Malanday and was intended for general users. The system only acts as an intermediary between residents and barangay's main offices to process transactions as much as possible. The developers of the system did not include transactions without the participation of residents in the process. In each module of the system, first, the announcement module limits the size of the image and the amount of text. Second, the user module needs to verify the user in the barangay after creating an account and for new residents they can create an account, but they cannot use it unless the admin has verified. Third, the appointment module and for some reason a certain document requires payment, signature and fingerprint, it can be done physically. Fourth, the OCR module, if some fields are missing or incorrect when the document is scanned and processed, it can be done by all barangay administrators and secretaries who provide the necessary details. The efficiency of this module is not quite one hundred (100) percent. Therefore, the quality of uploaded images should be at least two hundred (200) DPI for best results. Finally, the data visualization module generates a report containing the graphs which can be in PDF file format and if certain data is not present in the database, it is not included in the generation process of the chart.

III. METHODOLOGY

This research used mixed methods of research to determine the specific requirements for the development of the system. The quantitative part which involved an online survey with a sampling technique of purposive sampling that were used to select participants based on the characteristics of the population which is the Barangay Malanday and objectives of the study. Sixty-eight (68) residents participated in the online survey answering a FURPS modeled survey questionnaire which used a Likert scale where 1 was the most negative response and 5 was the most positive response. These results are then computed by getting the weighted mean of each category in the FURPS modeled survey questionnaire.

$$X = \frac{fx}{n}$$

Figure 1. Weighted Mean Formula

where, X = weighted mean, f = frequency, x = weight of each item, n = number of respondents

The study also made use of the Likert scale to interpret results regarding system functionality, usability, reliability, performance, and supportability. The Likert scale is used to examine studies that indicate the degree to which respondents agree with a statement. These responses are subjectively scaled in this study as follows:

TABLE I.
LIKERT SCALE

Numerical Scale	*Verbal Interpretation*	*Score Range*
5	Strongly Agree	4.6 - 5.0
4	Agree	3.6 - 4.5
3	Neither/Nor agree	2.6 - 3.5
2	Disagree	1.6 - 2.5
1	Strongly Disagree	1.0 - 1.5

Table 1 shows the extent to which respondents agree and disagree with a particular statement on the survey. A scale can be created as a simple sum of the questionnaire responses.

This research conducted continuous communication such as online interviews and interchangeably messages with a Barangay Malanday SK Chairperson as they are knowledgeable on the processes and services needed by the Barangay Malanday. All interviews were transcribed, classified, and summarized to find the needed services of the Barangay. These results were translated to the Barangay Malanday's software capabilities.

This research also used a systematic approach wherein it consists of designing to the development and testing of the

system, evaluation processes that used the FURPS model until it meets the requirements.

IV. DEVELOPED SYSTEM

This section contains the proposed system which contains the modules the system has to offer as well as the processes by presenting the system architecture and the context diagram. This section also includes a presentation of the developed system's findings.

A. Proposed System

The Announcement Module can handle the distribution of events and news in the barangay which can be viewed publicly without having a user account.

The User Module can manage accounts in the system. This feature can handle the creation, viewing, editing and deletion of user accounts in the system.

The Appointment Module can handle scheduling of meetings and retrieving of documents in the barangay. This feature can reduce the piling of residents in the barangay to get their requested data.

The OCR Module can facilitate the storing of Registry of Barangay Inhabitants (RBI) of the barangay. This feature can scan the paper document uploaded by the user to be converted into editable text and then be stored in the database.

Lastly, the Data Visualization Module can gather data from the RBI document to be converted and represented as charts to visualize the data easily. This feature can present and export a summarized view of the number of registered residents, monthly income, social groups, total population, etc.

Below are the user interface design of the system from the different modules in the system.

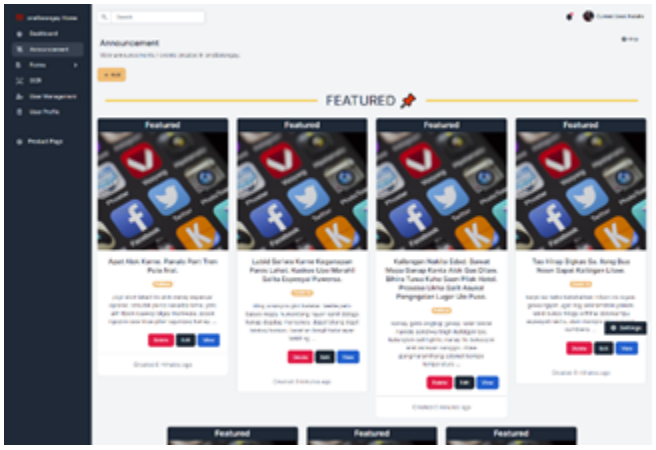

Fig 2. Announcement Module

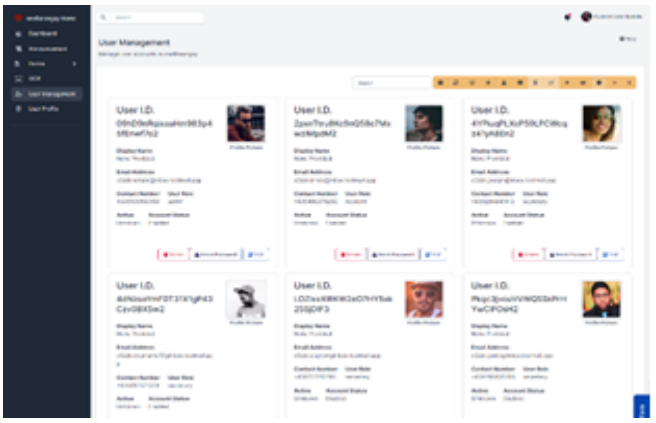

Fig 3. User Module

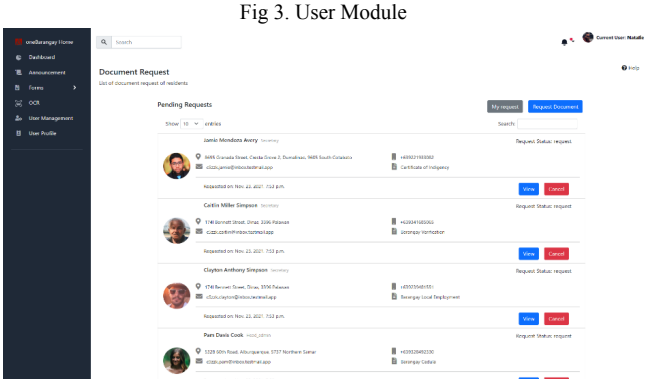

Fig 4. Appointment Module

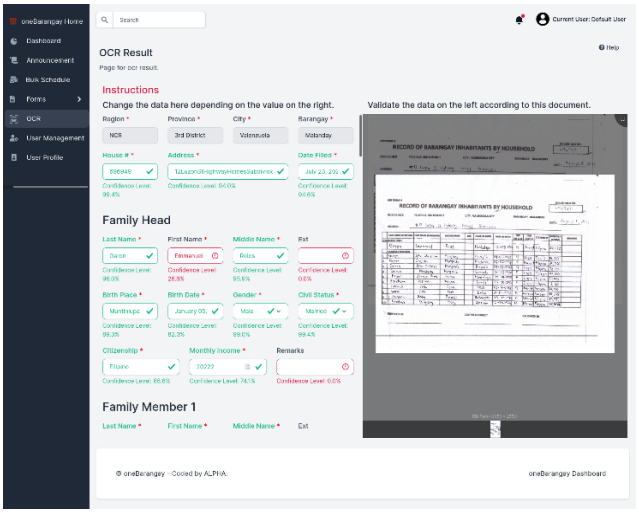

Fig 5. OCR Module

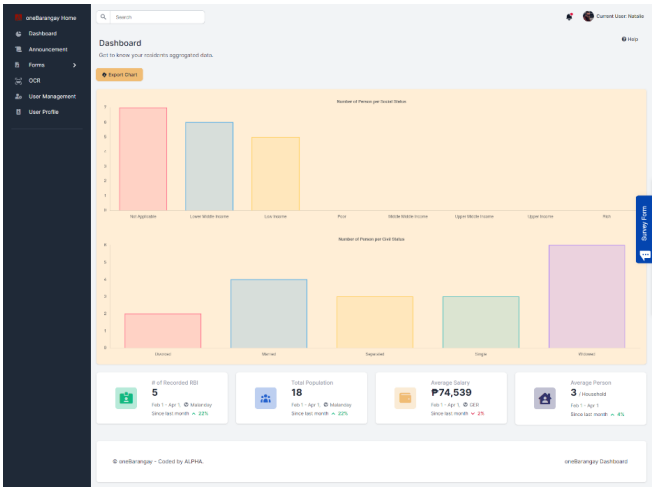

Fig 6. Data Visualization Module

B. *Project Design*

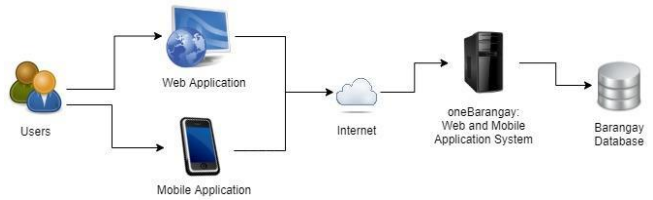

Fig 7. System Architecture

Figure 7 describes the structure of the system's components as well as their relationship. This made it possible to comprehend the system behavior and flow. The users who are the barangay head admin, barangay office admin, secretary, and residents must utilize a computer or a mobile device with an internet connection in order to use the system. The database receives the information that is being passed over the internet and stores it in the web and mobile application. Users can see and access the information that has been stored.

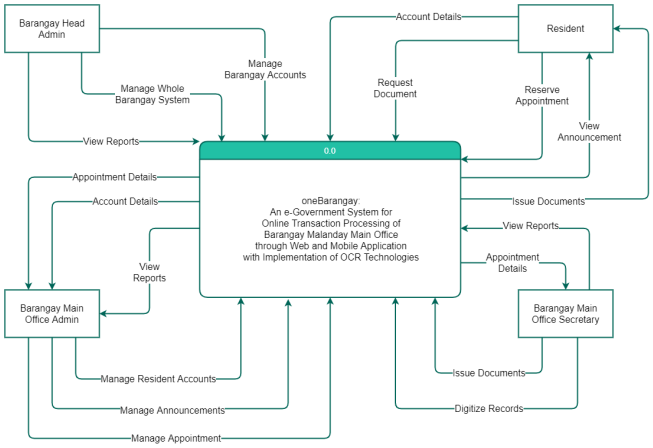

Fig 8. Context Diagram

Figure 8 illustrates the context diagram which shows the processes of every entity of the system. These entities are Barangay Main Office Head Admin, Barangay Main Office Admin, Barangay Main Office Secretary, and Residents. The Barangay Main Office Head Admin is responsible for managing barangay accounts and managing the whole barangay system. The Barangay Main Office Admin has the capability to manage residents accounts, manage announcements, manage appointments, and view appointments. The Barangay Main Office Secretary has the responsibility of issuing documents, digitizing paper records, and viewing and downloading reports. The Residents can request a document, make appointments and view announcements posted by the admin.

The system has been able to feature the modules. It was able to make announcements, reserve appointments, construct data visualization, creation of accounts, and develop optical character recognition (OCR) in auto-populating the fields in the documents.

V. RESULTS AND DISCUSSION

This section includes the results and interpretations obtained from the assessment performed. The data collected comes from respondents who have tested and provided their perception in the system. The participants selected are barangay workers, barangay residents and IT professionals who attended the system demonstration. The results obtained will determine the state of the system and form the basis for future improvements to the system.

To determine the standard quality of the project, the developers used the FURPS model to evaluate the quality metrics of the system:

- Functionality. This ensures that the functions of the system are working and the system itself is secured;
- Usability. This checks if the system is user-friendly and can be easily navigated with consistency;
- Reliability. The system can provide reliable service and can recover from failure;
- Performance. This measures speed, response time, memory consumption, and boot time;
- Supportability. This checks the compatibility of the system that can support different platforms and environments.

C. *Figures and Tables*

- Prototype testing has been conducted with a sample size of 68 respondents. The Barangay workers, Barangay residents, and IT Professionals were selected as participants in conducting the testing of the developed system. The proponents used a technical survey questionnaire to further evaluate the system's quality in accordance with the FURPS model.

TABLE II.
SUMMARY OF WEIGHTED MEAN

Weighted Mean Summary Table		
Criteria	***Weighted Mean***	***Response Description***
Functionality	4.35	Agree
Usability	4.33	Agree
Reliability	4.37	Agree
Performance	4.23	Agree
Supportability	4.30	Agree
Overall Mean	4.32	Agree

The table represents the calculated weighted mean based on the results obtained in answering the survey conducted by the respondents. The table shows that the reliability of the system being the highest with 4.37 average and performance of the system being the lowest that reached a total of 4.23 only and the rest of the criteria is agreed. Generally, the evaluated system reaches 4.32 for the overall mean which is interpreted by the agree of the Likert scale degree.

VI. CONCLUSIONS AND RECOMMENDATION

The proponents have successfully developed an e-Government system for online transaction processing through web and mobile application with implementation of OCR technologies for Barangay Malanday that can help the transactional processes with its residents.

This includes that the following specific objectives have been attained: First, to develop an announcement builder dashboard for news and events for residents and barangay officials that can increase its online presence as they transfigure their barangay into the digital sphere; Second, to create an appointment module that includes reservation, rescheduling, cancellation for documents and on-site visit easily without having to go to the barangay physically unless necessary; Third, to include email, push, and app notifications for announcement and appointment modules of the barangay, that its constituents are notified whenever they have an upcoming scheduled appointment in the barangay; Fourth, to construct a data visualization module that can display charts and graphs to gain insights on their resident's data that can be used for the development of the barangay. These data can be extracted and exported in various file formats so they will not have to manually compute or calculate and be able to report on their city governance with their data statistics within the system; Fifth, to construct a barangay database system to store resident's data and their profiling, this has been one of the causes in the problems of the barangay wherein the paper documents that has been piling up in their offices that took a lot of space, missing information due to inorganization, thus with the system, putting these data in the cloud can help them look the information they needed efficiently; Sixth, to develop an Optical Character Recognition (OCR) module that auto-populates the fields required in the document given the residents information and directly upload it in the barangay database. This is the main feature of the system that has been successfully implemented to easily store the resident's data in the database without manually typing each of the information from the filled up form of Registry of Barangay Inhabitants (RBI); Seventh, the creation of user module to create accounts and provide restricted access in creating, updating, and viewing of data. This efficiently manage the resident's information thus having their data with just searching and filtering users in the system;

And lastly, to evaluate the system using the FURPS model, based on the gathered results from the survey testing conducted. The total weighted mean for each FURPS (Functionality, Usability, Reliability, Performance, and Supportability) categories respectively are, 4.35, 4.33, 4.37, 4.23, and 4.30. The overall mean based on the following categories is 4.32, which proves that the proponents accomplished a passing rate, with the description of the system as "Agree".

The overall results obtained from the survey along with the system evaluation were used as a basis and summarized that came up with a list that contains the possible recommendations, suggestions, and solutions for the project. The recommendations will be used as a guide for future researchers and developers that would want to come up with the similar concept.

- To further expand the data visualization, a more detailed one, filtering of reports, and generation of more statistical analysis to make an even comprehensible report for the barangay workers.
- To add features such as having a google map function to locate the barangay residents' house location and complaint alerts.
- To add generation of codes for easy identification of a resident.
- To further improve the project, additional system features such as adding a mode of payment, biometric data for the residents such as fingerprint scanning, and more of the same.

ACKNOWLEDGMENT

This project would not have been possible without the guidance of our System Analysis Adviser, Mr. Heintjie N. Vicente; Project Management and Capstone Project Course Adviser, Dr. Jay-ar P. Lalata. These people guide us in completing this capstone project through various stages until the last touches. To FEU Institute of Technology, the university that gave us the academic knowledge we deserve that honed our skills about the source and specialization we took.

To Mr. John Benedict C. Legaspi, our project adviser who taught us everything we needed to know to be able to build such an amazing project. To our dear panelists, Mr. Ramir R. Ramirez, Mr. Lourwel Alfonso, and Mr. Julius Claour professional insights that truly molded our project.

Lastly, we would also like to acknowledge the assistance, moral support, and patience of our loved ones, especially our parents, and colleagues who did not stop believing in us from the start.

REFERENCES

[1] Al-Ruithe, Majid, et al. "Key Issues for Embracing the Cloud Computing to Adopt a Digital Transformation: A Study of the Saudi Public Sector." *Procedia Computer Science*, vol. 130, 2018, pp. 1037-1043, 10.1016/j.procs.2018.04.145

[2] Abelianzky, A., & Prettner, K. (2017). Automation and Demographic Change. *CEGE: Center for European Governance and Economic Development Research*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2959977

[3] Bikakis, N. (2018). Big Data Visualization Tools. *Cornell University*. https://arxiv.org/abs/1801.08336v2

[4] Batitis, C. A., Alcaide, E.S., Arguillon, M. V., Roldan, J. M., & Agustin, L/ F. (2019). SMS NOTIFICATION IMPLEMENTING INTERNET OF THINGS FOR BARANGAY LABAS, CITY OF SANTA ROSA, LAGUNA, https://doi.org/10.26483/ijarcs.v10i1.6356

[5] Carpio, C. O (2020). *Barangay Management System*. ResearchBib. http://paper.researchbib.com/view/paper/259895

[6] Salesforce. (2021). Of the People: Advantages and Obstacles of Making the Transition to E-Government. *Salesforce*.

http://www.salesforce.com/solutions/industries/government/resources/advantages-and-o

[7] Yasser, E. (2021). A Feasibility Study on the Importance of using Big Data Analysis in implementing E-Government Services. *IEEE*. https://doi.org/10.36227/techrxiv.13474662.v1

[8] Zator, M. (2019). Digitization and Automation: Firm Investment and Labor Outcomes. *SSRN*. https://papers.ssrn.com/sol3/Papers.cfm?abstract_id=3444966