2021-03-04

DESIGNING AN AUTOMATED LETTERING PLATFORM TO ENHANCE PRIMORDIAL MAILING SERVICE

BELAY, ALAMNEH

BAHIR DAR UNIVERSITY

BAHIR DAR INSTITUTE OF TECHNOLOGY

SCHOOL OF RESEARCH AND POSTGRADUATE STUDIES

FACULTY OF COMPUTING

DESIGNING AN AUTOMATED LETTERING PLATFORM TO ENHANCE PRIMORDIAL MAILING SERVICE

BY

BELAY ALAMNEH WUBIE

BAHIR DAR, ETHIOPIA

March 4, 2021

AN EFFICIENT LETTERING PLATFORM FOR ORGANIZATIONS OF ETHIOPIA: A DESIGN SCIENCE APPROACH

By

Belay Alamneh Wubie

A Thesis Submitted to the School of Research and Graduate Studies of Bahir Dar Institute of Technology, BDU in Partial Fulfillment for the Degree of Master of Science in Software Engineering in the Faculty of Computing

Advisor: GEBEYEHU BELAY (PhD)

Bahir Dar, Ethiopia

March 4, 2021

DECLARATION

I, the undersigned, declare that the thesis comprises my own work. In compliance with internationally accepted practices, I have acknowledged and refereed all materials used in this work. I understand that non-adherence to the principles of academic honesty and integrity, misrepresentation/ fabrication of any idea/data/fact/source will constitute sufficient ground for disciplinary action by the University and can also evoke penal action from the sources which have not been properly cited or acknowledged.

Name of the student: Belay Alamneh Wubie Signature 

Date of submission: 3/4/2021

Place: Bahir Dar

This thesis has been submitted for examination with my approval as a university advisor.

Advisor Name: Dr. Gebeyehu Belay

Advisor's Signature: _____

BAHIR DAR UNIVERSITY

BAHIR DAR INSTITUTE OF TECHNOLOGY (BIT)

SCHOOL OF RESEARCH AND POST GRADUATE STUDIES

FACULTY OF COMPUTING

THESIS APPROVAL SHEET

Student:

Belay Alamneh		03-03-2021
Name	Signature	Date

The following graduate faculty members certify that this student has successfully presented the necessary written final thesis and oral presentation for partial fulfillment of the thesis requirements for the Degree of Master of Science in Software Engineering.

Approved By:

Advisor:	**Dr. Gebeyehu Belay**		03-03-2021
	Name	Signature	Date
External Examiner:	Fekade Getahun		March 2, 2021
	Name	Signature	Date
Internal Examiner:	**Seffi Gebeyehu**		03-03-2021
	Name	Signature	Date
Chair Person:	**Belete Biazen**		03-03-2021
	Name	Signature	Date
Chair Holder:	**Dr. Gebeyehu Belay**		03-03-2021
	Name	Signature	Date
Faculty Dean:	**Belete Biazen**		03-03-2021
	Name	Signature	Date

iv

ACKNOWLEDGEMENTS

Before all, I would like to thank the Enormous God, for He is the Source of Wisdom and my life, and the Beginning of Knowledge. I praise and thank Him for His great help throughout this research work. I would also thank the Ever-Virgin, St. Marry, Mother of our Lord and my mom has been gifted.

Next, I would like to express my deepest gratitude to my advisor, Prf. Dr. Gebeyehu Belay, he was my Wisdom and humble father next to God and for his continuous support and guidance throughout the various stages of this thesis research. Without his contribution and interference at critical and basic stages, it would have been very challenging to complete the thesis research. He provided basic, critical, and useful feedback and suggestions on how to address the research problems systematically and tactfully. He showed me how research questions can produce, how to contact and achieve the solution of the problems, and follow-up with me well. His inspiration has always moved me and help me to see in all direction, to overcome good result and the completion of the research work in time, thank you so much. Thanks also to all my teachers in BIT.

My heartfelt thanks also go to the staff of human resource management, finance office, and record office in BIT, those have provided us a brief description of paper-based manual work of formal letters and for their brief questioner's information.

Then after, I would also thank my brothers, Tibebu Alamneh (Mergieta), Getnet Alamneh (lecturer) Tirunh Alamneh (Er.), Teume-lisanTarekegn (Mergieta), and both my sisters Banchalem Alamneh andAsmarech Alamneh (teacher) those have spent many hours for discussion to make things go right and within time.

Finally, I would like to thank my father, Mr. Alamneh Wubie, and my mother, Mrs. Ehit-enatBirhanu, **Wolkite University** that sponsors me and all the rest of my family and friends, who in one or another brought me up to succeed in my academic effort.

ABSTRACT

Every organization, including universities, and other industries is performing its duties using paper-based information exchange systems. However, the existing information transaction or flow system is primitive, and also insecure, costly, labor-intensive, and time-demanding. Therefore, in this thesis, we proposed designing an automated lettering platform (ALP) to enhance the primordial mailing service. The purpose of this study is a digital and technology-based lettering service that provides modern, safe, fast, and effective information access and connectivity using a networked and distributed infrastructure. The design science research approach is used for designing the platform and evaluating it using the Post Study System Usability Questionnaire (PSSUQ) framework. The PSSUQ had been used to evaluate the platform's information quality, system usefulness, and interface quality. The functionality and performance of the platform were evaluated by Katalon studio and J-meter respectively. The proposed automate platform is modernized and technology-based against the existing paper-based lettering system. The lettering service is enhanced by 95% in system usefulness score and optimize resources usage with trustful and efficient operation as users' demand. The expected research outcome is a solution to optimize resource usage and information handling with trustful and efficient operation. It is a modern and advanced information flow platform that can enhance lettering services through digital technology.

Keywords: formal letter, resource optimizations, design science approach, paper-based, ALP, PSSUQ, system usefulness score, distributed infrastructure, platform

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Ajax	Asynchronous JavaScript and XML
ALP	Automating Lettering Platform
API	Application Program Interface
BIT	Bahir Dar Institute of Technology
CSS	Cascading Style Sheets
DMM	Domestic Mail Manual
DSP	Design Science Presses
DSR	Design Science Research
Email	The classic internet-based information exchange system
E-mailing	Electronics or digital mailing (lettering system)
FM	Frequency Modulation
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IBM	International Business Management
JCSP	Junior Certificate School Program
MHz	Megahertz
N	Number of respondents
NA	Not Accepted
PSSUQ	Post-Study System Usability Questionnaire
RDBMS	Relational Database Management System
SPA	Single Page Application
TV	Television
UI	User Interface
USPS	United States Postal Service.
XML	Extensible Markup Language

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

1.1. Overview

Nowadays, the use and adoption of technology are increased in various institutions for communication and exchange of information. Speedy ongoing digital developments are currently changing how we live. For example the businesses, the public services, and welfare services of delivering style (Digital Denmark, 2016). A formal Letter is one way of worker's communication in the higher sectors like the university, where people use a paper-based lettering system to disseminate information among themselves. However, this way of communication has a high consumption of resources. According to (Palme, 2019)the letter handles 11% of the time for communication media, The research, we proposed an automated platform that can improve the service of e-mailing, writing, transcription, forwarding, reordering, and receiving efficiency of the formal letter. The platform clearly shows how letters can be managed and organized between the sectors and the other staff of the sectors to facilitate lettering communication services by using the internet. This can contribute to the wise use of official resources by enhancing the service performance, privacy or security issue, and resource expense. The proposed solution provides internet-based service to a better acceptance of new technology and ideas for making and supporting lettering information through distributed architecture.

The study has basic advantages toward higher sectors like universities and other institutions that have exchanged several paper-based letters in the context of organizational work. Almost, it can be indispensable for those higher institutions and their employees to manage and facilitate their lettering activity. The first aim of this research work is to design the ALP system platform that enhances and gradually replaces paper-based information flow in a digital and suitable condition with a transaction of how the letter can be written, mailed, and received. The second contribution of this research can be more indispensable for managing, exchanging, and organizing formal letters through the life of business work. And the research supports the design by distributed web-based platform structure that shows clearly how the letter can be e-mailed and

managed in the sectors through the online world using network connection infrastructure to increase the usability of lettering technology and decrease the time wasted through transportation expenses among users. In this thesis, the designed platform also displays relevant information necessary for writing for instance letter templet, transcription, forwarding, and sending of formal letter options to the target users.

"All research in all disciplines are problem-solving" (Wieringa, 2016). In a paper-based lettering system, there is a basic and lack of efficient design problems. Due to this condition and for this design problem we use design science research methodology to design something useful based on the design science research cycle processes.

1.2. Background of formal letter

Currently, many services can be supported by technology in higher institutions for communication and exchange of information. A formal letter is one approach of communication among employees and co-working sectors. According to (Sommer, 2019), a formal letter is a standard genre in professional and academic settings. While the function and purpose of the body of the letter may change based on the conditions in which we are writing, many of the formatting and organizational conventions may be consistent. In some cases, the purpose can be to inform or persuade, to apply for a job/position, or to introduce another document (Hacke, 2006). Typically, formal letters follow a constant set of category prospects. Common formal letter conventions include the date, inside address, salutation, body, closing, seal, signature, and enclosures. A page layout may vary between writing contexts, however, we want the one and margins on all sides with line-spaces between each component of the letter (Formal Letters, 2019).

A formal letter is not like Personal letters. We do not write in a chatty manner or use slang. For example, we would write a different letter to our Principal inviting him to your class JCSP graduation as we would to our friend. Formal letters are usually written for some of the following: To apply for a job, make a complaint, order goods and for the editor of a newspaper, ask for something, a form, an appointment, ask for information and make a booking for a holiday, etc…. when you write a formal letter, The sender's address is on the top right-hand corner and The address of the company/person to whom

the letter is being sent is written on the left-hand side. If you know the name of the person or organization you are sending the letter to e.g. Dear Ms. Johon, you end the letter with 'yours sincerely' and your full name (Road, 2006).

1.3.Statement of the problem

As it is known that the traditional paper-based letter mailing system has many limitations including resource allocation and utilization, business modernity, security, and unable to go in line with the technology. Therefore, the fundamental motive of this research work is to enhance the lettering service by designing the ALP based on the challenges of paper-based formal letter writing, sending, and receiving service. The current way of writing, receiving, and mailing the formal letter in sectors is very time Consuming, not secure (vulnerable to unwanted conditions), and requires much input resource. So we list basic problems to understand and analyze and support it by technology through designing an Automated and Efficient Lettering System. The following paragraphs focus on cost, labor, time, and security issues.

Costly: Many companies are introducing mandates to reduce, reuse, and recycle materials in every facet of their operation. Including paper-based direct mail programs, Communicate with your partners. Most of the time mailing of formal letters in the sector is done through traditional processes that need a high amount of resources such as paper, envelope (letter stream, 2019), printer, postman, machine input resources, etc... Those resources later became waste and may pollute our environment. So the current and traditional way of printing, enveloping, and sending formal letters uses a high amount of paper and machine input resources. In the globalization era, living is becoming smart and most works that require labor force and resource have been translated into technology or supported by technology but the current way of writing, mailing, and receiving the formal letter in higher sectors like universities use labor force for mailing it to different parts of sectors and workers at most.

Mailing and paper-based communication time: The current running way of writing, mailing, and receiving formal letters in sectors is so much time-consuming. When we see from the starting point writing and editing requires a high amount of time due to the lack

of a sated up template. The second is mailing and receiving of the formal letter also requires time for preparing it mailing and to carry it in postal service many late too (United States Postal Service (USPS), 2019) or by a labor force that can't be supported by digital technology. This can't improve our ability to work more effectively even when time is close-fitting and pressures are high. Lack of Good time usage lets our work not smarter and harder so, we get less done in more time

Security/ Privacy Concerns: As the working condition indicates, the current way of mailing and receiving formal letters in sectors is doing by using the labor force and postal service from source to destination. During this condition, the content of the letter may be surlily exposed to vulnerability conditions and for unwanted viewers like copying the file, and so on. This Conditions indicated the current service is not secure, not digitized, not internet-based that supports distributed system service and the letter could also be lost.

Lastly, this thesis answer the following research questions to achieve specific objectives. Hence, the research questions are formulated as follows.

- ✓ What are elements need to design the basic structure of automated mailing service, and its functionality to optimize resources, and other factors during communication flow?
- ✓ How to design and develop a high fidelity mailing service for the formal business letter that automates paper-based lettering service?
- ✓ How to identify components to evaluate the effectiveness of the system that performs better service and proper resources considering users' requirements?
- ✓ How to measure and check a formal and trustworthy automated and efficient lettering service?

1.4.Objectives of the study

1.4.1. General objective

The general objective of this research is to enhance the paper-based formal lettering service by designing a digital lettering platform that automates formal letters transaction and provides efficient services between users.

Specific objectives that support the aimed to be successes are

- ✓ Define, identify, and extract fundamental digital lettering components and structures to automate the traditional paper-based lettering systems.
- ✓ Design and develop an automated and efficient lettering platform for information flow in qualified and effective communication services between users,
- ✓ Evaluate the proposed approach using usability contents of system usefulness, information, and interface quality by applying the PSSUQ framework and performance measuring tools.
- ✓ Measure system usability according to user requirements and determine the artifacts as a solution of the primitive mailing service.

1.5.Scope and limitation of the study

A formal letter is one written in a formal and ceremonious language and follows a certain stipulated format. Such letters are written for official purposes to authorities, dignitaries, colleagues, seniors, etc., and not to personal contacts, friends, or family(Formal Letters: Introduction, Format with Solved Example and Videos n.d.). In this research, we only address the way how the current and paper-based way of writing, receiving, and mailing the formal letter can be automated and supported by the internet through designing automated formal lettering service platform that enhances formal lettering service with its key functionalities like writing, e-mailing and receiving of a formal letter that was written by normal persons (not disable) with secure and digitized way. The limit of this thesis work is to get a benchmark service platform for the comparison of the performance and functionality of the proposed to automate mailing service.

1.6.Significance of the Study

Technology is introducing innovations today to make life good. This research helps the user by reducing the time required to do tasks in pepper-based formal letter work. Depending on this thesis, it can be used to minimize the time required to deliver sent letters to the needy in cases of different tasks. The designing platform can be used by the people interested in writing the letter by fulfilling the required attributes and basic supports. This provides internet-based means of communication and synchronization between the workers in the sector for writing, e-mailing, and receiving formal letters. Generally, the thesis has the following basic categories of significance.

- ✓ The first one is to ensure the security issue of the written formal letter.
- ✓ The second is to decrease the labor force that requires writing, mailing, and receiving the sent letter.
- ✓ The third is to minimize the costs like input material for writing, mailing, and receiving the formal letter.
- ✓ The last is to save time for writing, mailing, and receiving of the letter and can be mailed as required time to the required destination whatever and whenever and avoid letter lost

1.7.Organization of the Thesis

The whole thesis is organized into 5 chapters. The first chapter describes the introductory part. The second chapter is for the literature review, in which approach design the platform related works are discussed in this part. Chapter three is concerned more with the methodology of the automated and efficient lettering system platform that defines the architecture of ALP and related works, designing tools, languages, and features. Chapter four deals with the experiment's results and desiccations of platform demonstration, evaluation, and communication. The last chapter is on the conclusion, contribution, and recommendation of the study.

CHAPTER TWO

REVIEW OF LITERATURE AND RELATED WORK

2.1. Overview

According to (Pechota,et al, 2017) the letter was given attention to the price of letter mail. However, the paper does not consider the content, resource, and time of delivery. In this paper, the researchers calculate the correlation between the price of the letter mail and the amount of sent letter mails. The researchers do not calculate the annual inbox and outbox letter in their work. The article (Pechota,et al, 2017) focuses on the importance of the postal services on the mailing service of formal letters.

The automated lettering platform is a web-based application platform designed to give e-electronic letter service in online business to higher institutions, for example, health institutions and universities. As (guru99, 2020) and (Web application, 2020), 'web application is something more than just a web site. It is a client/server application (Buzan, 2019) that uses a web browser as its client program and makes an interactive service by connecting with servers over the internet. Mostly a web site supplies content from static files. A web application presents dynamically custom-made content based on request parameters, tracked user actions, and security considerations.

2.2. Digital platform

A platform is a group of technology(What is a Platform? - Definition from Techopedia n.d.) that is used as a base upon which other processes or operations are done based on digital service infrastructure for users. According to(Mullick et al. 2020), digital platforms have been developed with the major aim to connect local service providers and remote service users by sharing information based on their needs and supplies. As noted in (Feld 2020) digital platforms form a distinct part of the economy that requires its own rules custom-made to the unique features of the digital platform space, and its regulator to constabularies new service system to the sector.

As touted in(Gawer 2020), The platform phenomenon has stimulated a rapidly growing body of innovation and academic research on platform competition. Based on the (Gawer

2020), Digital platform firms such as Google, Amazon, Facebook, and Alibaba adopt platform business models that use information and communication technologies to facilitate interactions that including commercial transactions to facilitate interaction between users, collection and use of data about these interactions, and network effects which make the use of the platforms with most users most valuable to other users in the era of digital technology. Article (Klein et al. 2020) and (Gawer 2020) states in information systems research, the digital interface that was designed for the specific task situated between the platform and its complementary products or services is construed as a result.

2.3. Benefits of a digital platform

According to (The rise of digital platforms and why they are important • Solveo n.d.), the best benefit of the digital platform is being able to put people in the focus of the business. Next, provide tools for many purposes, but each tool is a separate part of the process that has its role. This also allows the team who works on the digital platform to exchange information and ideas with each other. This is also necessary since they all function like separate users with their tasks remotely based on the infrastructure of the platform. A digital platform significantly reduces costs. It shortens the business processes and transactions and it doesn't take a lot of time to be implemented. In the article (Mäntymäki, Baiyere, and Islam 2019), a digital platform defines as the digital infrastructure, rules, and processes that enable resource exchange between external producers and consumers in this study the consumers are the employee of the organization that uses the paper-based lettering services.

As (Rangaswamy et al. 2020), A platform designed to enable business interactions (in this study automated lettering service platform) typically provides a relatively digital,internet-based, and participative infrastructure for the interactions of users that take place and sets the governance (managing) conditions to arrange those interactions between users and sectors. Its primary purpose is to identify, create, and control interaction-creating services among its users and facilitate the exchange of goods, services, or social currency that create value and benefit all participants by executing the

exchanges (in the case of this study the official letters). The (Duch-Brown and Rossetti 2020) states Digital platforms gradually propose business models that improve the economic organization by better coordinating supply and demand under imperfect information- and attain higher efficiency levels.

Digital platforms are composed of applications (Panori et al. 2020), datasets, and roadmaps, which altogether create a digital environment for empowering the design of smart specialization strategies for local and regional systems of innovation. The results indicate that digital transformation(Schwanholz and Leipold 2020) allows the operationalization of multiple methodologies that havet been used earlier by society, due to lack of capabilities. It can also increase the scalability of services facilitating decision making at different scales in the sector and, therefore, better respond to the complexity of innovation systems providing dynamic and scale-diverse information for users and between the sectors for enabled new forms of work (Mäntymäki, Baiyere, and Islam 2019).

2.4.Web Application platforms

A web application is a select kind of program built on the client-server architecture (Corporation, 2008). Its individuality lies in the fact that the web application itself is located and executed on the server, while the client receives only the results of its operation. The effort of such an application is based on receiving requests from the user, their processing, and delivery of the consequences. The transfer of requests and the consequences of their processing are carried out via the internet. One advantage of this method is the fact that clients do not depend on a particular user’s operating system, thus, making web applications cross-platform services to get the response of the request.

A specific application means the browser (Google Chrome, Safari, Opera, etc.) It is commonly involved in displaying the results of clients' requests, as well as receiving data from him/them and sending it to the server. One of the primary purposes of the browser is to show and display data collected from the internet in the form of a page described in HTML. Therefore, the result communicated by the server to the client should be presented in this language (HTML). The web application of the server-side performs,

with the help of special software (web-server) which receives users' requests, processes them, generates a response in the form of a page described in HTML, and sends it to the client.

2.5.Web Application Architecture

Nowadays, the Internet has become a critical part of every person's life in most progressive countries. Over the past ten years, the audience using the benefits of the internet daily has exceeded 50 million users and continues to grow (listlink, 2019). Recent software applications have reached such a level of development that the term "architecture" applied to them no longer looks out of place. Creating an effectively and reliably functioning information system from scratch is no easier than constructing and build a modern multifunctional building. Hence the term web application architecture is about decisions that impact characteristics of the rising system e.g. maintainability or scalability (Stochmiałek, 2015).

Whilst plenty of modern developers struggle to learn how to design a web application that can be more attractive and profitable than others. (MARK DOUGLAS JACYNTHO, 2012) States that web applications syndicate challenging technological issues such as allowing access from mobile devices, or balancing support for current HTML/XML releases, with more conceptual ones such as implementing new distributed business platforms such platforms are quite complex.

Web applications are more inexpensive and easier to install and administrate (Galbriath, 2009). By using such applications, enterprises can lower the cost of maintaining internet technology units that are responsible for the installation of software and its maintenance. Web app updates are less complicated and less expensive (Web Application Architecture: Best Practices and Guides, 2020). The price of software maintenance is always an important article of outflow for any company. A web application must be updated on the server only, that everyone can be able to work with the new version immediately.

Web applications are more useful and practical for the end-user. The only requirement is to install the web app on a server supporting any modern operating system (Mac operating system, Windows, Linux, etc.), and it can be possible to use it over the Internet on any computer or smart mobile device. Web applications enhance the organization of data storage. If there is a need to operate with the same data from different locations, it is much simpler to organize its storage in one particular place and distributed servers. It removes the need for synchronization and increases the security of valuable information.

Application architecture represents a particular interaction platform between the vital "participants" of the web application, both internal and external. Web Application Architecture Diagram is the scheme of the user-server process that can explain the heart of the web application architecture in figure 1.

- ✓ The client types in a particular URL.
- ✓ The browser receives the request, defines the location of the needed website (provided by a computer with Internet access) and requests access to that webpage.
- ✓ The server transmits the information to the browser.
- ✓ The browser "translates" the sent data, so that the user can be able to display his/her request's result on their computer.

Complex Web applications usually involve customized navigation topologies and support for triggering transactions in their underlying corporate application, which in turn may contain sophisticated business rules that may affect the application's behavior and look-and-feel (Mark et al., 2002). System architecture helps to understand that the web application architecture determines 95% of the success of its operation, including the ability to manage with high loads. The MVC architecture is a software architectural pattern in which the application logic is divided into three components based on functionality. These components are called:

- Models - represent how data is stored in the database
- Views - the components that are visible to the user, such as an output or a GUI
- Controllers - the components that act as an interface between models and views

The MVC architecture is used not mostly for desktop applications (How to Design a Web Application: Software Architecture 101 n.d.)but also for mobile and web applications. due to this, we selected the three tire architecture. Figure 1. Adopted from (listlink, 2019): (Web Application Architecture: Best Practices and Guides, 2020).

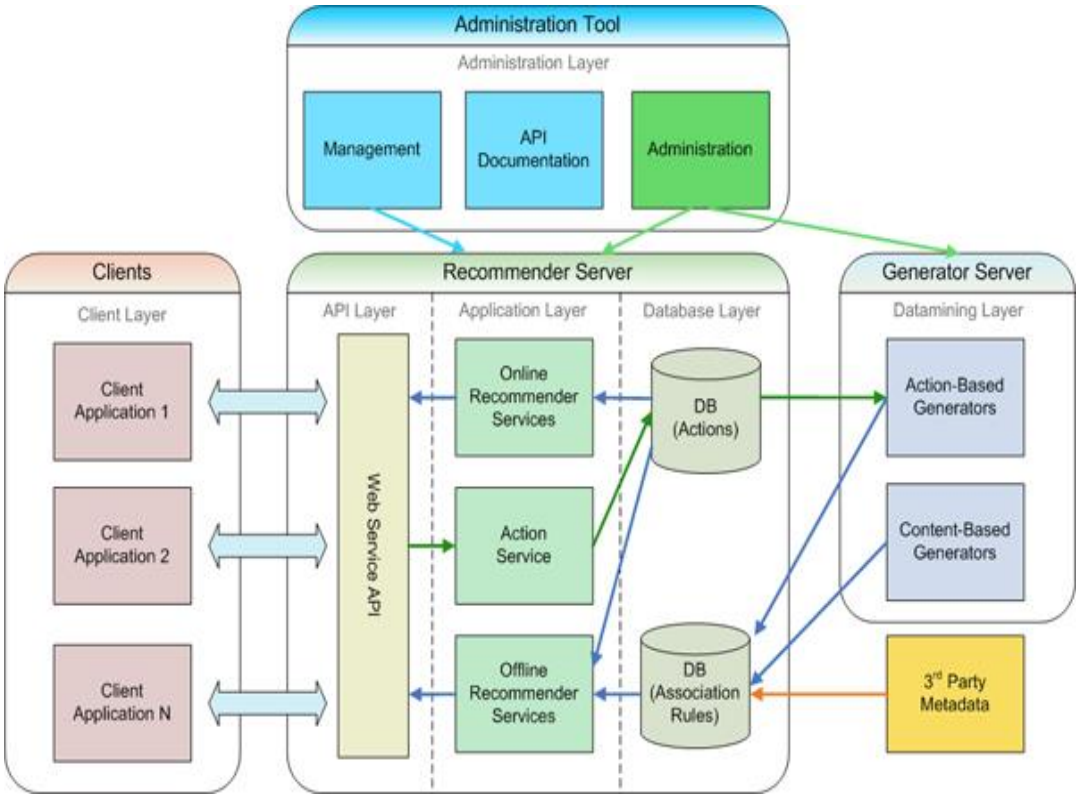


Figure 1 Web application architecture adopted from *(Web Application Architecture: Best Practices and Guides, 2020).*

2.5.1. Web Application Architecture in digital technology

Web applications work on the principle of client-server communication, entailing two programs functioning simultaneously. One of the processes the requests of the user through the web-browser, showing them the search results. Another, based on the server, handles the HTTP request that was sent out (Gibb, 2020).

Since both browser (client) and respondent (server) operate with specific codes, the choice of the programming language must be based on the interaction of these codes. Specialists working in this field tend to use the following languages on the server-side: JavaScript, PHP, Python, and Ruby on Rails (Gibb, 2020). As for the user side code, the

most common computer languages are (listlink, 2019): HTML, JavaScript, and CSS. The browser code may be opened and changed by the client, unlike the server scripts. The browser works only with the HTTP request, responding to the data entered by the user.

2.5.2. The Need for web Application Architectures

Web architecture plan is a significant part of the manufacture of even the smallest web projects. Without this, it is almost unbelievable to build a covered representative of a stable, working software platform with a satisfactory performance (Mark et al., 2002).

As (Lech MADEYSKI, 2005) defines, reliable web apps can be created only through a high-quality layout. If the application can be used on various devices, if both server and user scripts can successfully cooperate, such an application can always be in high demand. Because programs constructed with the use of good recent web architecture can strongly work with the client's information, offering additional options such as user's authorization, update, and removal of data, every reliable innovativeness should pay special attention to this matter of development because it saves developer resources.

2.5.3. Components of Web Application Architecture

The feature of web application building includes a few aspects that ensure its digital performance. Such components can be separated into two groups: internal (client interface) and building elements.

- ✓ The design of the user interfaces emphasizes mainly the visual and practical needs of the client. A comfortable experience cannot be obtained without a suitable authentication option and other useful settings. More significant web application components are represented by:
- ✓ The server of databases. The database server keeps all the necessary information that can be further processed by the application server.
- ✓ The browser is used by the client. This program controls the communication between the client and the web app.
- ✓ Web application, on which the server is grounded. This implements rules and restrictions on automated operations and provides data persistence.

2.5.4. Web application architecture components

According to (altexsoft, 2020), three-tier system architectures have three components: presentation layer, business layer, and persistence layer.

Presentation layer: this layer is accessible to users by the browser as defined in (techopedia, 2020)and contains user interface components and interface process components that provide interaction between user and system. This was developed using three core tools: HTML, CSS, and JavaScript. While HTML is the code that determines what your web application will contain, CSS controls how it will look. JavaScript and its frameworks make your UI more interactive, responsive to a user's actions, and device-independent. Developers use JavaScript frameworks such as angular and react to make the content on the page dynamic and responsive (techopedia, 2020).

Business layer: This layer, also named business logic or domain logic or application layer, receives user requests from the browser, processes them, and determines the routes through which the data will be accessed. The workflows in which the question and requests travel through the back end are encoded in a business layer. For example, if our application is a digital and efficient lettering system, business logic will be responsible for the sequence of letter events a letter will go through when the task is performed. Although business rules can be a demonstration of business logic (ben-morris.com, 2020) which are not the same. Sometimes business rules are extracted and managed separately, using a business rules management system (ben-morris.com, 2020).

Persistence layer: Also called the storage or data access layer, the persistence layer is a centralized location that receives all data calls and provides access to the persistent storage of an application. The persistence layer is connected to the business layer, so the logic knows which database to talk to and the data retrieving process is more optimized. The data storage component contains a server and a database management system software to communicate with the database itself, and user interfaces to obtain data and

describe it. Typically we can store our data either in owned hardware servers or in the cloud servers, that we purchase data center management and maintenance services while accessing our storage virtually. Using the facilities of cloud technology providers such as Amazon.

2.6.Web application evaluation techniques

Acquiring to (Vogels, 2020), more and more web applications are being developed these days. And with each line of code being written, the possibility for bugs arises. The costs of fixing bugs increase exponentially the later you find them to fix them. The Systems Sciences Institute at IBM states that "the cost to fix an error found after product release was 4 to 5 times more than one uncovered during design, and up to 100 times more than in the maintenance phase". These numbers highlight the significance of discovering bugs as early as possible and thoroughly test an application before it is released. Web application testing frequently involves multiple steps that safeguard that an application is fully functional and runs smoothly and securely. It is an essential part of web development and ensures that an application is running properly before its release. There are many steps to test web applications. However, we put together a 6-step guide, which should give us an overview of what kind of tests and how to test run to test our ALP.

Step 1: Functional testing: the first step of web testing ensures that the roles of a system are tested. Functional testing is a process of increasing the quality of a system product which is a type of black-box testing based on system test cases on the specifications of the software component under the test suite. Functions are tested by feeding them input and investigative the output, and internal program structure is rarely considered (unlike white-box testing). Functional testing can be done in the source code, where the system is tested against functional requirements and specifications. Typically, functional testing includes the identification of functions that software is invented to do, data input and entry, the execution of the test case, and an analysis of the actual results. During functional testing, actual system usage is simulated.

Step2: Usability Testing: Usability testing refers to evaluating a product or service by testing it with demonstrative users (Usability Testing, 2020). Usability testing is not the

same as User Acceptance Testing. Usability goes outside functionality testing and chain testing for functionality as well as overall user experience. However, both are vital to the accomplishment of a web application. They each have a very different effort and are performed at different phases of the software development life cycle. This can be done internally or by getting external testers that fit potential users immoral. Usability testing involves the following steps (Vogels, 2020) in figure 2 Usability Testing diagram to develop a testing strategy that ensures all functions of our application platform can be examined that include navigation and content, Employee test participants (tester), either internally or externally Run the test under the observation of experts and Analyze the results and improve the application accordingly. Image source (Vogels, 2020).

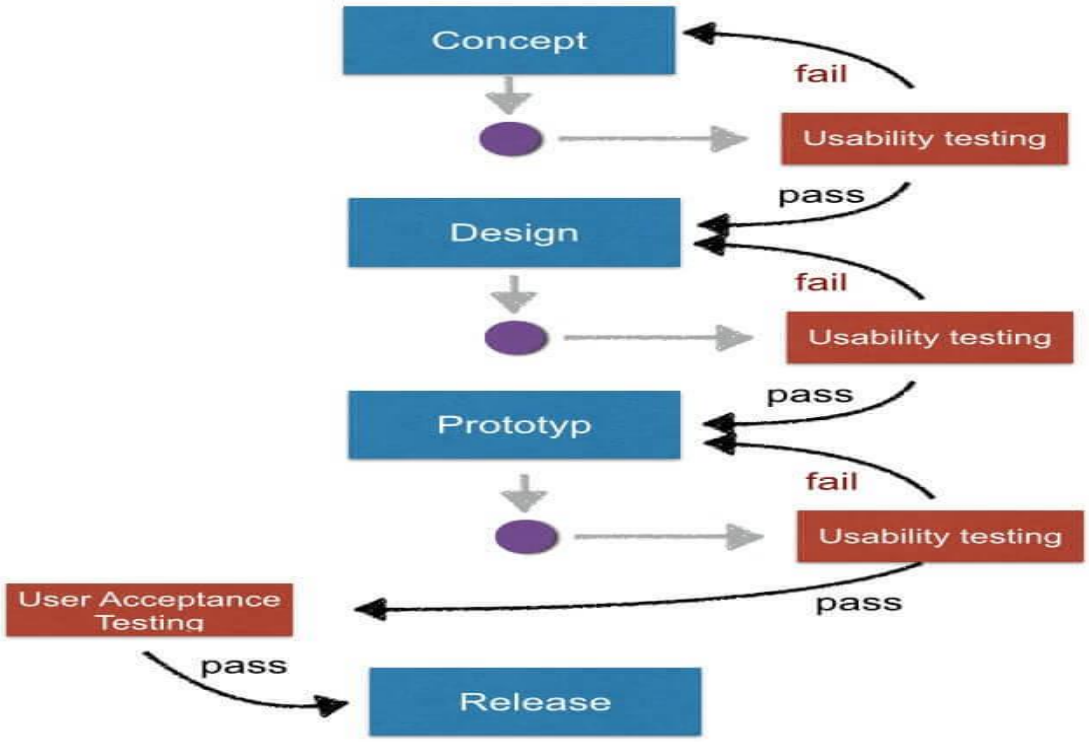


Figure 2 Usability Testing diagram adopted from *(Vogels, 2020)*.

Step3: Interface Testing: interface testing is defined as a software testing type that verifies whether the communication between two different software systems is done correctly (Interface Testing, 2020). This contains checking the communication processes as well as making sure that error messages are displayed correctly.

Step4: Compatibility Testing: this test is a type of software testing to check your software is running on different hardware, operating systems, applications, network environments, and mobile devices as defined in (Compatibility Testing, 2020). Browser compatibility makes sure that our application is functioning correctly across different browsers. This includes checking the browser notifications, and authentication requests are working as designed. Besides checking that our application runs in all the browsers. Mobile compatibility indicates ensuring that our application runs on mobile that is an essential part of web testing.

Step 5: Performance Testing: it is time to take a look at how it performs under heavy load. This also called load testing defines testing the application through different internet speeds and how it behaves under normal and peak loads. To determine the breaking point of your application, it is put under increasing amounts of stress until it ends to function (stress testing). Performance testing authorizes the speed, response time, reliability, resource usage, scalability of a software program under their expected workload (guru99.com, 2020).

Step 6: Security Testing: as defined in (Corporation, 2008), security testing is the final step of web application testing that helps to makes sure that our application is protected against unauthorized access tests whether secure pages can be accessed without authorization. Overall, a security testing checklist that helps us to structure and organize our testing efforts. Such a checklist should include tasks like Secure Transmission (using post() method rather than get () method), authentication, session management, authorization, and data validation of forms.

2.7. Related work

In this technology world communication, E-mails, texts, etc. are most of our preferred modes of communication (Formal Letters, 2019). However, letters still have a major use and importance in our society for information exchanges. Especially formal letters written to authorities or organization contacts, because they stay on record for a long time. Due to this, there are previous studies in the area of the mailing service of letters. From those efforts, we look at the U.S.A. postal based Service, email-based service, and paper-based formal letter exchange service in the following paragraphs, and lastly, we

define the research gap that we focus for this study according to the real-world technology and the lettering service providing now.

According to (United States Postal Service (USPS), 2019)declaration, there is a service that can mail letters. The Postal Service has different mail processing categories for mail pieces: the first one is a letter. Letters and cards claimed at any machinable, automation, or United States Postal Service (USPS) Marketing Mail carrier route price, must meet the standards in the Domestic Mail Manual (DMM). Except prepared as a folded self-mailer, booklet, or postcard, each machinable. This mailing service simply mails the letter by using sorting machines, but its content is not digital and does not use the internet for emailing the letter rather for tracking purposes.

As noted in (Frehner, 2013) description, email has become a common mode of communication that is used by young and old. To have an email address or even several is something that is taken for granted; email has become as natural a communication channel as the telephone. Most readers are familiar with sending emails and with their structural elements of the email, which include the header, the body, an optional signature, and files well. But the email has not a special temple to email formal letters between sectors in the digitalization mechanism without scanning or in the form of document format.

In higher sectors for example Bahir Dar University (BIT), there are rules and guidelines that we follow and obey while writing formal letters. The continent of the letter example header, footer, body, and others should be included, and email the formal letter to the required sector or user as noted in (formalletter.net, 2013). However, this current formal lettering writing and mailing system is not digitalized and not an internet-based service still. The lettering system is currently run in paper-based manual work and has several problems like security issue (when the letter was mailed using labor force by enveloping or not), time of the delivery problem (the latter may not be delivered at the required time since it is worked in postal and manual by the person and lack of internet-based), high resource expense problem (like paper, envelope printer input (color print) money of

mailing in Posta and labor force) and not efficient due to non-existence of internet-based and distributed structured service.

Mainly, workers in all sectors use traditional or paper-based lettering system to disseminate information among themselves. However. This way of communication has limitations/concerns, such as security issues, longer delivery, and receive the time, costly (consumes a lot of resources). We collected basic data and analyses it in the chart to understand more how much is its concerns as follows.

The case study encompasses Bahir Dar University/ Bahir Dar Institute of Technology (BIT). Figure 3 shows the number of the inbox and outbox letters in the BIT human resource management office. In three consecutive years from 2009-2010, 2010-2011 and 2011-2012 E.C. This chart shows the number of inbox letter is 406 and outbox letters is 10804 in 2009-2010, the number of inbox letter is 706 and outbox letters are 11800 in 2010-2011 and the number of inbox letter is 500 and outbox letters is 12100 in 2011-2012 E.C. Generally, the total number of outbox letters in three years is 34704 and the inbox letter is 1612.

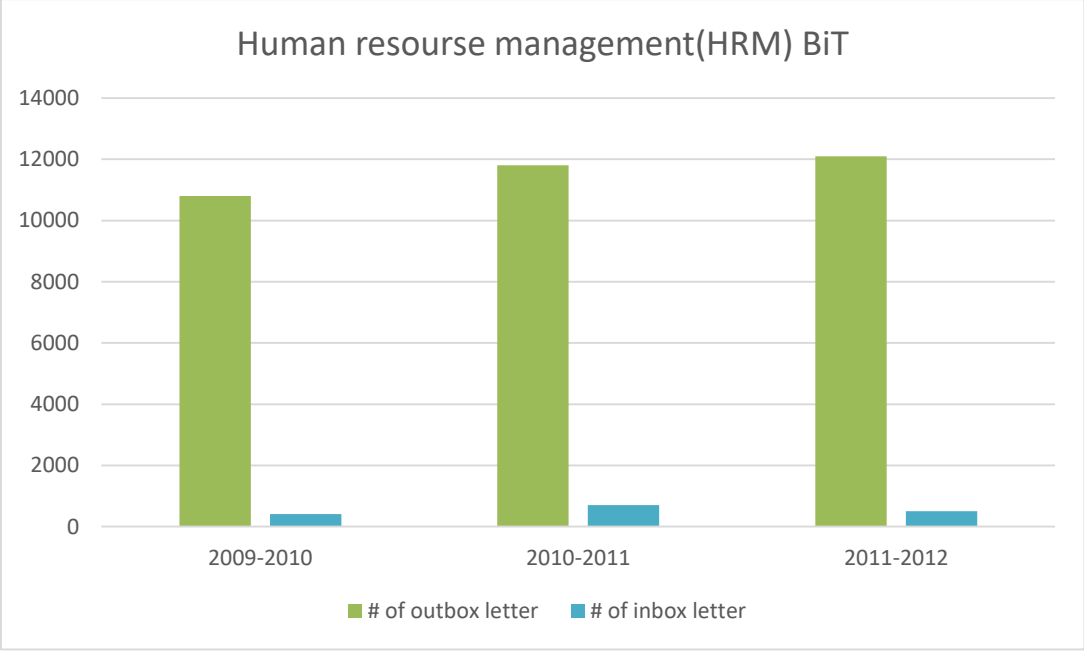


Figure 3 Number of inbox and outbox letter in BIT human resource management

Figure 4 shows the number of the inbox and outbox letters record management office from 2010-2011 and 2011-2012. However, the number of inbox letter can clearly show in Figure 5 for the two years. Figure 5 states the inbox letters in BIT record management office in two consecutive years from 2010 -2011 and 2011-2012 E.C. The number of inbox letters is 49 and outbox letters are 15050 in 2010-2011 and the number of inbox letters is 54 and outbox letters is 16056 in 2011-2012 E.C. as the recorded document defines.

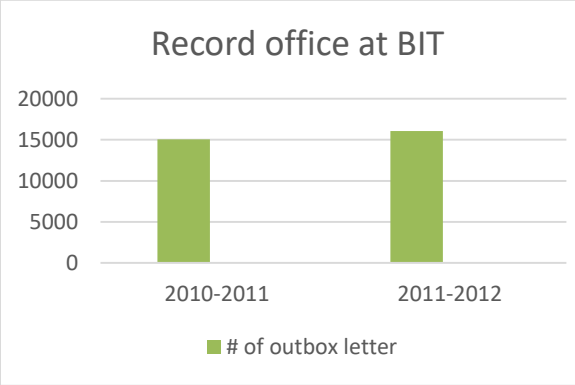


Figure 4 Number of outbox inbox letters in BIT at the record office

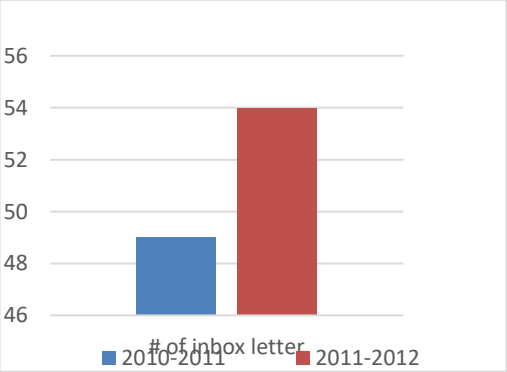


Figure 5 Number of inbox letter in BIT at the record office

As touted in the article (Pechota, Matúšková, and Madleňáková 2017), the researchers had encompassed the trend of cost or price of letter mail of letters in Slovakia provided by national postal. The researchers suggest finding out another way how to make the postal services more inviting and effective in the service that was provided. And finally, they suggest new additional work on how the universal postal service is unique on the market and postal operations should innovate and the way how to use it as an opportunity.

As table 1 previous studies indicate, the Postal Service simply mails/carries the letter by using sorting machines, and identification code from the source to destination in herd copy. But the letter content is not digital and does not use the internet for emailing the letter rather for tracking the letter. From the second paragraph, we have seen that email

has become a common mode of communication between users like telecommunication. However, this communication is informal communication and the communication system has no special template for formal letters so this is the other gap. And finally, we know that from day to day activities in higher sectors like a university for example our university BIT, the current formal lettering system service is not digitalized and not an internet-based service still. Consume high resources the total number of outbox letters in two years is 248848 and the inbox letter is 824 this shows the traditional or paper passed lettering system consumes a high amount of paper and other input resources to exchange information among users. The short comes that we list here are the fundamental research gaps that we want to solve through this research.

Table 1 Previous studies summary

Attributes	USAPS	Email	Paper-based lettering	The Trend of Cost of Universal Services Provided by National Postal Operator and Correlation between Price of Letter Mail and Amount of Sent Letter Mails in Slovakia
Purpose	Mails the letter and other materials like postcard by using sorting machines and transport	Mails the letter and other materials like documents by using printing, scanning machines, and the internet	Mails the letter and other materials like supporting documents by using labor force and the postman	To analyze the trend of the price of letter mail and amount of sent letter mails and importance of the postal services in Slovakia
Methodology	Not mentioned	Not mentioned	Not mentioned	statistics methods

Framework Evaluation	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Time	More than two days	~0.08 seconds for sending	~594.7 (minute)for sending and receiving	Not mentioned
Letter format	Has no letter format	Has no letter format	Has no letter format	Not mentioned
Resource	Highly consume	Highly consume	Highly consume	Highly consume
Internet	Used for tracking	Used for sending the file	Not used	For tracking letter destination
Outer	allan c. fisher, jr	Not mentioned	Not mentioned	Matej Pechotaa, Mária Matúškováa*, Lucia Madleňákováa
Finding	Letter and card, etc.. transportation platform from source to destination	A file-sharing platform for customers in the online world	The legal and formal working environment of institutional workers	calculate a correlation between the price of the letter mail and the amount of sent letter mails.
Limitation	Not support lettering service in the automated and internet-based platform	Has no special platform for formal lettering digital services	Consume a high amount of resources and not efficient service	Not consider supporting lettering service in the automated and internet-based platform

CHAPTER THREE

METHODOLOGY

3.1.Overview

Design Science Research Methodology (DSR) is defined as another side of IS research cycle that creates and evaluates information technology artifacts intended to solve problems identified in an organization(Peffers et al. 2007) Design science has six paths Following are the description of each phase: problem identification and motivation, objectives for a solution, design, and development, Demonstration, evaluation, and communication (Vijay Vaishnavi, June 30, 2019). Identifying a relevant problem to practice involves recognizing a deficiency in a current system and then justifying the value of finding a solution to this problem (Peffers et al. 2007) (Thuan, Drechsler, and Antunes 2019). In this study, the research problem is defined and the value of a solution is justified.

Problem definition is used to develop an artifact (something observed in a scientific investigation that is not naturally present but occurs as a result of the investigative procedure) that provides a solution. Justifying the value of a solution helps to motivate the researchers and to understand the reasoning associated with the researchers' understanding of the problem. By clearly defining the research problem, a focus for the research is created. Depending upon this, we focus on the paper-based manual work of formal letters. However, it is too broad a concept, so, it is necessary with DSR, a relevant problem was identified, which helps focus the research on an area that practitioners can benefit from (Cathal et al., 2016). Various kinds of literature are reviewed to acquire knowledge about the state of the problem and the importance of the solution. Research works that have been done to detect various types of digital systems can be analyzed and evaluated to get an understanding of the various methods to design the platform that can digitalize the paper-based traditional work. The gaps in related research works are analyzed and how we fill in the gaps are presented.

Building a platform is a complicated process made up of many different parts. Among them is developing software architecture. Software architecture refers to the process of translating software characteristics into a structured solution that matches business and technical requirements. As we described in chapter two, software architecture focuses more on the interaction between the externally visible components of the system which is more about what we want the system to do. Software architecture indicates how the different units of the system interconnect with each other and other systems. What language is to be used? What kind of data storage is present? What recovery systems are in place? Like design patterns, there are architectural patterns. Such MVC, 3-tier layered design, etc. we use 3-tier software architecture for the demonstrations of digital and efficient lettering platforms. As noted (Wei and Broniatowski 2019) (Science 2004), web application architectures lay in three-layered architecture. This architecture is consists of presentation, business, and data layers. Figure 8 illustrates a common web application architecture for the ALP with common components grouped by different areas of concern.

3.2. Design science research

In this study, we followed and applied the design science research (DSR) standards and processes in design science and information system scientific research methodology procedures. This is a research paradigm and the creation of a new artifact and evaluation of the artifact is a key contribution of users/customers (Peffers et al. 2007)

The DSR is well-thought-out relevant in information systems research because it can able to solve two main issues: those are the role of information technology artifacts and information systems research. In general, information systems research that uses DSR is better suitable for problem-solving (Ave Adriana Pinem, et al, 2020).

According to (Ave Adriana Pinem, et al, 2020)declaration, DSR varies from Professional design concerning the problems tackled and the solutions offered. The professional design resolves problems that already exist and can be solved using artifacts of best follows. By contrast, DSR resolves a significant new problem that must be solved in a unique, effective, and efficient way.

Design science has six phases Following are the lists of each phase: problem identification and motivation, objectives for a solution, design, and development, demonstration, evaluation, and communication (Vijay Vaishnavi, June 30, 2019) Considering this, DSR has a significant impact on research in the area of information systems regarding problem-solving. Design science has six paths Following are the description of each phase: problem identification and motivation, objectives for a solution, design, and development, Demonstration, evaluation, and communication (Vijay Vaishnavi, June 30, 2019).

3.3.Problem identification and objective definition

As we have seen in chapter two research gap paragraphs, the postal service simply mails/carries the letter from source to destination by using a sorting machine and identification code in hard copy inside an envelope. But the letter content is not digital and does not use the internet for emailing the letter rather for tracking the letter. As it is known that the traditional paper-based letter mailing system has many limitations including resource allocation and utilization, business modernity, security, and unable to go in line with the technology. Therefore, the fundamental motive of this research work is to enhance the lettering service by designing the platform based on the challenges of paper-based formal letter writing, sending, and receiving service. The current way of writing, receiving, and mailing a formal letter in sectors is very time-consuming, not secure (vulnerable to unwanted conditions), and requires much input resource.

The lettering transaction activities consume time for the exchange of information in higher sectors like a university, for example, Bahir Dar University BIT, the current formal lettering system service is not digitized and not internet-based service still and consumes high resources. For example, the total number of outbox letters in two years in figures 4 and 5 is more than 248848 and the inbox letter is 103. This shows the traditional or paper passed lettering system consumes a high amount of paper and other input resources to exchange information among users. The design and development of the ALP for the higher institutions are important for the manager and staff due to their distributive infrastructures or mobility for completing tasks. Therefore, this study is aimed to enhance

the traditional lettering system service by designing a digital and efficient lettering system platform that is can write, send and receive formal letters to provide efficient and digital lettering services between users based on user requirements.

The main problem to be addressed is to enhance the formal lettering service .based on the limitations of scan and email approach for the specific type of letters such as employment, notification, and any other formal letter those which are not personal. the proposed ALP has been done in this work to address privacy issues like resource optimization(printer and scanner device).

3.4.Research Procedures

There were six stages carried out in this study: problem identification and motivation, objective definition, design and development, demonstration, evaluation, and communication. Figure 6 can show the way how we apply the DSR approach for this study. In problem identification and motivation, we identified a relevant problem for recognizing a deficiency in a current system and then justify the value of finding a solution to this problem. Next, the design and development, demonstration, and evaluation, and communication processes were conducted in the way of iterations. In the first iteration, the design was made in the form of a static page, where users could try the flow process and evaluate the design interface. In the second iteration, the design was made in the form of a dynamic platform for use by participants with smartphones that had the android operating system and human-computer. The design success rate was measured using the PSSUQ framework. The PSSUQ was used to see evaluate three dimensions: system usefulness, information quality, and interface quality.

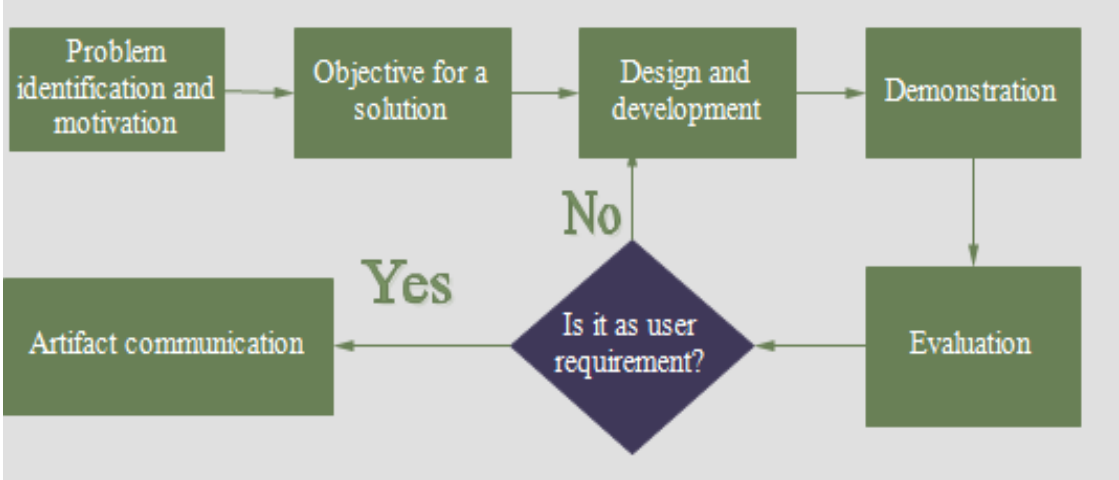


Figure 6 Research procedure

3.5. Research instrument

For the evaluation and communication processes of this research, PSSUQ framework measures were chosen. This framework measure was chosen because this is a well-known usability testing framework that is widely used for testing and evaluation of the web application platform (Ave Adriana Pinem, et al, 2020) As previously mentioned, the PSSUQ framework was used to evaluate the ease of repair, assistance, and feedback regarding system quality that was created for the demonstration.

The instrument used in this research was the questionnaire that included a statement that was related to the research, PSSUQ usability testing frameworks, and criticisms and suggestions regarding the platform. The research statement was answered via a 7-point Likert scale for the PSSUQ.PSSUQ version 3 consists of 16 questions with 7 options plus not an applicable option appendix 1states questionnaire what we used for this study. The overall result is calculated by averaging the scores from the 7 points of the scale (the average scores of questions 1 to 16). PSSUQ, has also three subscales, namely system usefulness (the average scores of questions 1 to 6), information quality (the average scores of questions 7 to 12), and interface quality (the average scores of questions 13 to 15). The sub-scales provide a more detailed breakdown of different factors affecting the system product (T, PSSUQ (Post-Study System Usability Questionnaire), 2020).

Readability of the data tests was conducted with three respondents on Jun 17, 2020, to ensure that all questions and statements could be understood. Feedback from this testing guided the revision of the questionnaire. Generally, improvements were made regarding keywords for each statement.

3.6. Population and data collection

Data collection in this study was conducted by distributing customized PSSUQ framework questionnaires offline to a sample of a random population. The data collection was performed by us from Bahir Dar University (BIT) and Amhara state health facilities. To get the questionnaire report back we install the platform on the worker's computer and present the demonstration for respondents to fill out the questionnaires and conduct the report back. All participants were asked to read the agreement at the beginning of the questionnaires. If the participants agreed, then the questionnaires were carried out well.

The platform was designed for all governmental and non-governmental sectors whose tasks are related to formal letter facilities. Purposive sampling, which is a method that was done randomly on managers and secretaries with characteristics that are suitable for this research was used. Data was collected by going to the working office and installing the platform and presenting the demonstration in meetings of the staff and managers at Bahir Dar University (BIT) wisdom tower and Amhara state health facility office with direct interaction between the researchers and respondents.

3.6.1. Design and development tools

To design a demonstration of the platform for this research, we have used different tools like E-draw max for design system platform, MySQL for database design, Microsoft word for editing the document, PHP back end programing language for the server-side program, and Html-5 and javascript for the front end design programing language of the system, different editors like edit+ to edit the code for demonstration and implementation of the system. We have used Katalon studio for functional testing, J-meter for performance testing, and PSSUQ framework for research data analysis, and Smartpls for checking the reliability and consistency of the research data.

3.7. System design and testing data

Data type: the types of research data are grouped into four main types based on methods of collection (LIBRARY, 2020): observational, experimental, simulation, and derived. The type of research data we collect to ensure this research was collected through questionnaires, experiments, and observations. We have two types of data the first is design data (requirements) this data helps to design the digital lettering platform and the second data is testing data which helps to validate the proposed platform.

Data Sources: when the data retrieved immediately is known as primary data, however, the data retrieved from previous sources is recognized as secondary data. We have used the primary data for the validation and testing of the platform. The primary data sources include information collected and processed directly by as, such as observations when the secretaries and workers write the letter, interviews, and focus platform implementation experiments in addition to questionnaires. We have collected 161 platforms designing data (requirements), 13 alpha testing data (requirements), 13 paper-based formal lettering time data, 19 platform functional test case data (requirements), and 35 PSSUQ questionnaire data with 16 lists of questions(that means 35*16) for the validation of the platform.

Data processing: we have performed a series of actions and steps on the data to confirm, organize, integrate, and extract data in an appropriate production form for all users with the other three co-workers. When the analysis of this data, we involve actions and methods performed on data that help and describe facts related to usability, identify design, develop, and validate the platform, and test the specific platform functionalities. Then after we validate the data to ensure the delivery of a clean and clear platform, functionalities, and services. This checks for the integrity and validity of data that is being inputted to platform design, database design, functional testing of the developed platform, system usefulness, information quality, and interface quality.

3.8. The proposed system ALP

This research focuses on designing a new platform as an artifact on the fundamental problems of mailing services of a formal letter that automates existing paper-based working services in the higher sectors. Depending upon those problems, we tried to study the writing, receiving, and emailing of formal letter service that was still done in paper and traditional way. We design a fully automated and internet-based distributed platform with its key components and key functionalities. The basic components of the proposed e-mailing service platform are the root sector component, leaf sector component, manager of leaf sector component, and customers (workers for that sector) component. Those each component has writing, mailing, receiving, sent letter retrieving, inbox letter viewing, and setting system functionalities.

The proposed solution approach concerns the user expected functionalities as that can be addressed through designing, implementing, and testing its functionality, performance, and user acceptance of the system. This research can contribute artifacts by enhancing the effectiveness of secure e-mailed letter issues, time of delivery to destination, and resource expense when we write, email, and receive the letter through digital service. We have design attributes: those are used to design the lettering system like the type of letter, date of writing, the seal of the sector, the signature of the manager, source of the letter where it was written, the destination of the letter, the body of the letter, header, footer and closing, and record number. The general mind map service platform structure can be designed as figure 7 which represents the conceptual digital lettering platform min map structural architecture.

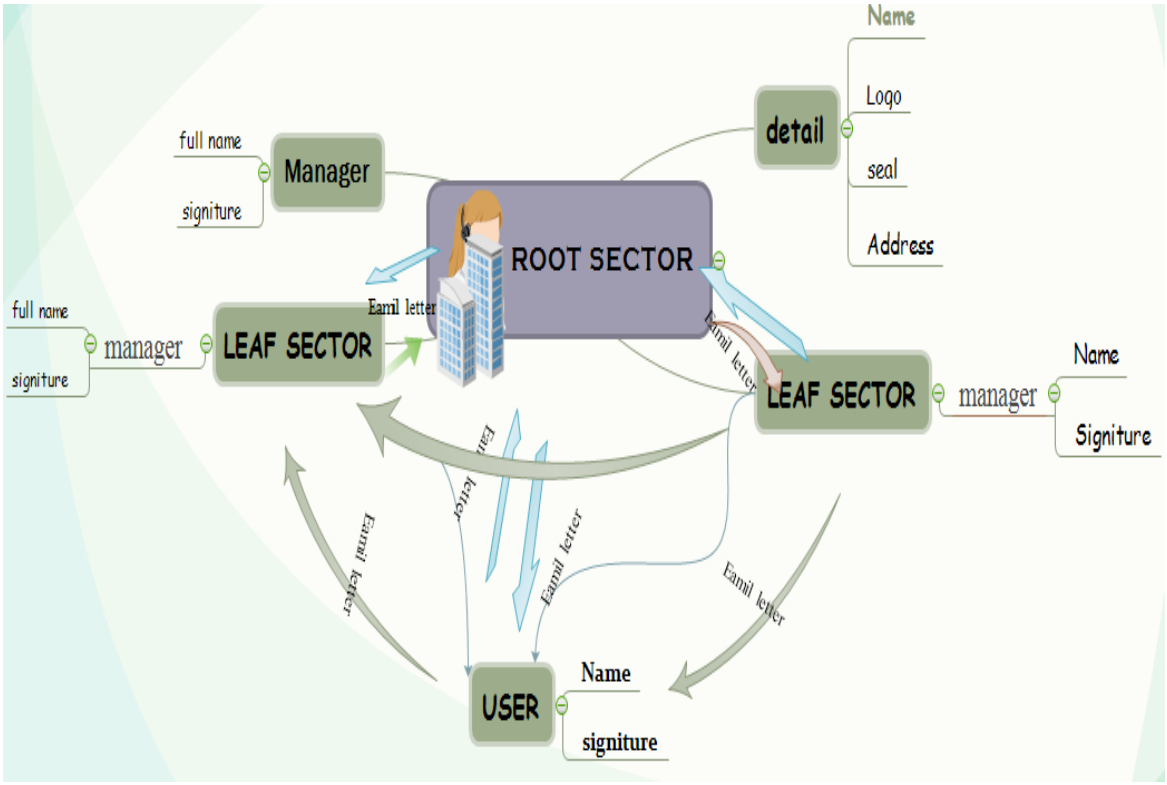


Figure 7 Conceptual digital lettering mailing service mind map architecture

3.9. System Architecture

System architectures represent these as networks of resource or information flows that are related to flexibility and controllability in systematic ways (Wei and Broniatowski 2019). The proposed ALP platform has four components: client components, a server component, database components, and administration tool components. In the ALP, we organized the letter component to a standard size and temple. The Clients are inclusive in the leaf sector and composed of three fundamental classes: the leaf sector, leaf sector manager, and staff of the leaf sector. The server component describes the application program interface that helps the client can able to communicate with the server through questions and answers in synchronized conditions. The database component is used to store the data of users. And the last component is the administrative component this component contains the system management documents and settings.

The digital and efficient lettering system architecture is the fundamental organization of the wiring, sending, receiving, transcription, and forwarding process of the letter with its

body that is embodied in its components, and its design. We have used edraw-max architecture software to draw the architecture of the platform. This ALP architecture serves as a blueprint or platform for a system. It offers an abstraction to manage the system difficulty and create a communication and coordination mechanism among components. To design the ALP architecture we use 3-tier software architecture because due to its three components layers these are client layers contain presentation layer includes presentation logic, the server layer contains data and the business layer that includes busses logic and data access logic. The database layer contains a database which is a basic component of the platform. A clear logical separation also offers more choices for scaling this platform adopted from (Alex, 2018).

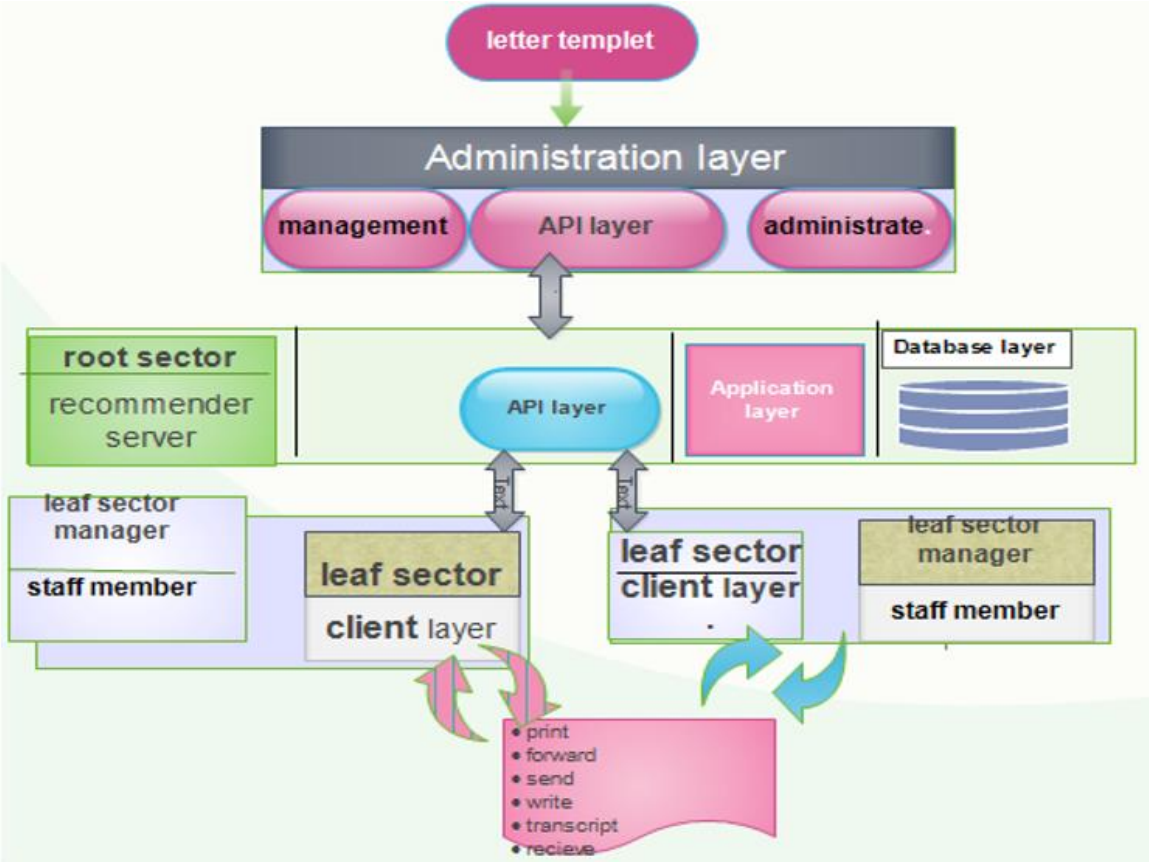


Figure 8 Three-tier ALP architecture in web-based

Figure 8 is the 3-tier platform architecture of ALP that defines a structured solution to meet all the technical and operational requirements while optimizing the common quality attributes like performance and security.

3.9.1. Client layer

The client layer of this platform architecture contains the Presentation layer which Provides a user interface that handles the interaction with the user Sometimes called the GUI or client view or front-end. This should not contain business logic or data access code. The presentation layer is the front end layer in the 3-tier system and consists of the user interface. This user interface is often accessible by the web browser and displays content and information useful to an end-user. This layer is often built using web technologies like HTML5, JavaScript, CSS, and other popular web development frameworks and languages, and communicates with other layers through API calls. It can be called a view or presentation layer UI. In this layer, the application shows to the user what is needed to be seen and gives the system for interaction. The interaction depends on the application. However, such a case does not need advanced architecture. In most cases, the user will generate some input, send it for processing, and then receive feedback, which can be the final result or a step for further operations.

Following the example by ALP, the user that wants to see the inbox letter in user login, the presentation shows where the letter exists and sees the actual content. The content of the letters display is shown, and the user can interact with the provided controls of the letter. For example, the user able to see the sanded time, sender name, and other basic information.

The technologies regularly involved in this layer on the web improvement context are mainly the markup that is processed by the browser (HTML/ XHTML), the style of the page (CSS), and client-side scripts (JavaScript). All of these tools together can produce a rich environment for user interaction and content display (Layered Architecture for Web Applications, 2020) . It can be said that server-side scripts can be used to yield content, but at the final level these scripts produce the HTML that will be shown by the browser, so this role of the development can be subdivided: the content generation is created by

the business logic layer and then it is passed to the view layer, maintaining the logical division of the application.

The browser displays the content originally written or formed by the server-side scripts, and the client-side scripts can adjust that content. A javaScript code, for example, can be used to validate form data... HTML5, the present (2020) movement for web development is admired for its flexibility, especially where it touches the concept of responsiveness that is the ability to change the content-disposition according to the screen size. This stuffs because, in current days, the accessibility of a page in different screen sizes and devices is very important. Having many options like desktops, tablets, smartphones, wearable devices, and even augmented reality or voice user interface, the range of technologies and targets for the view layer is very wide, and it shows both the importance of it to the user and reinforces the need of a logical division of the application for supporting such variety.

This layer communicates with the business logic layer and the information passes from the user and controls it. This passing of information is usually done through forms, like a user log-in into a system by giving a username and password, but there are other ways. AJAX is an asynchronous way to pass information to the server and get responses. The synchronicity comes from the fact that in a form the content needs to be passed and then the response will come after a page refresh, but with AJAX the requested information, that is the result of the user's task will come in the actual page soon. It saves time and gives the user the impression that the application is interacting with him.

3.9.2. Business Logic Layer

The data layer is the physical storage layer for data persistence that manages access to a database or file system sometimes called back-end. Data Layer should not contain a presentation or business logic code. The recommender server layer of the platform handles the logic of the program called the business logic layer or application layer. The logic layer is the set of rules for processing information that can accommodate many users sometimes called middleware/back-end. It receives data from the presentation layer level and transforms it, using it in the inner application logics. It also retrieves data from

the deepest data level and uses it to the logic. And, by integrating these two processes, it can do modifications in both levels as well. The business logic layer holds the basic part of the application logic. It includes:

- ✓ Performing all required calculations, validations, and response
- ✓ Handling workflow such as state management means keeping track of application execution, session management which helps to distinguish among application instances, user identification, and service access that consistently provide application services.
- ✓ That means all data access for the presentation layer.

The business logic layer is generally implemented inside an application server for example Microsoft transaction server, Oracle application server, or IBM web sphere). The application server generally automates several services like transactions of the letter, security, persistence, connection pooling, messaging, and provide facilities.

The tools used in this level are usually server-side scripts like PHP, ASP.NET, Ruby, or others. However, we have used PHP for this ALPfor server-side implementation. PHP is related to Perl, being as well as the scripting language, and having similar philosophies. It is one of the most popular languages (Layered Architecture for Web Applications, 2020), which is the implementation language of important content management systems.

3.9.3. Database layer

The database runs on a server separated from the client and easy to switch to a different database. As described in (Layered Architecture for Web Applications, 2020), this is the deepest level in layered architecture. The data layer deals with data retrieval from its sources. Once again, it shows a huge role in the reusability and exchange of technologies. A well-layered design can help by providing the same data to the upper level with identical interfaces and changing only its inner logic.

The technologies used in this layer are database management systems like MySQL that we used in our platform demonstration. An API will be used for making queries and retrieving data, and for the plain text ones a script will do the needed operations. Inside it,

there can be any level of complexity desired by the application designer, so there can be integrity checks, stored procedures, and virtually anything needed to maintain the data in the wanted state.

3.9.4. The 3-Tier Architecture for Web Application platform

The Presentation layer is static or dynamically generated content extracted by the browser (front-end). The logic layer is a dynamic content processing and generation level application server, e.g., we design the ALP using PHP. The data layer is a database, comprising both data sets and the database management system or RDBMS software that manages and provides access to the data (back-end).

3.9.5. 3-Tier Architecture Advantages

The independence of layers is easier to maintain. Components are reusable and faster development (a division of work). A web designer does a presentation, a software engineer does logic, and a database admin does a data platform. As (Staff, 2020), there are many benefits to using a 3-layer architecture including speed of development, scalability, performance, and availability. As mentioned, modularizing different tiers of an application gives development teams the ability to develop and enhance a product with greater speed than developing a singular codebase. It also improves development efficiency by allowing teams to focus on their core work. Development teams have distinct developers who specialize in the front end, server backend, and data back end development, by modularizing these parts of an application you have no longer time to waste on full-stack developers and can better utilize the areas of each team.

Scalability is another great advantage of a 3-tier architecture. By separating the different layers you can scale each independently depending on the need at any given time. For example, if you are receiving many web requests that may not affect your application layer, you can scale your web servers without touching your application servers. Similarly, if you are receiving many large application requests from only one or two web users, you can scale out your application and data layers to meet those requests without touching your web servers. This tolerates you to load balance each layer independently,

improving overall performance with minimal resources. The independence created from the modularized task in different tiers gives you many development options. For example, your web servers are hosted in a public or private cloud while your application and data layers may be hosted onsite. That may influence the performance of your application.

If you have disparate layers, you can increase the reliability and availability of your system by hosting different parts of your system application on different servers in a different place and managing stored results. With a full load system, you have to worry about a server going down and greatly affecting performance throughout your entire system. But with a 3-layer application, physically separated parts of an application minimizes performance issues when a server goes down. This is the reason why we select the platform architecture of the ALP.

3.10. Automated Lettering System Flow Diagram

System prototyping is the process of developing abstract platforms of a system (Sommerville, 2020). With each module, we present a different view or perspective of the digital and efficient lettering system workflow as in figure 9. It is a way of representing a system platform using some types of graphical notation, which is based on notations in the Unified Modeling Language (UML). However, we have used the edraw max system modeling tool. The Platforms flowchat diagram helps us to understand the functionality of the platform and how to communicate with customers. The platforms flowchart diagram can explain the platform from different perspectives: for example an external perspective, where you model the context or environment of the system, an interaction perspective, where you model the interactions between a platform and its user of the platform, or between the components of the platform. And a behavioral perspective, where you model the dynamic behavior of the platform and how it responds to events, that we have used the behavioral perspective to platform the dynamic behavior of the platform and how it responds to events. Figure 9 represents the graphical user interaction flow of the platform.

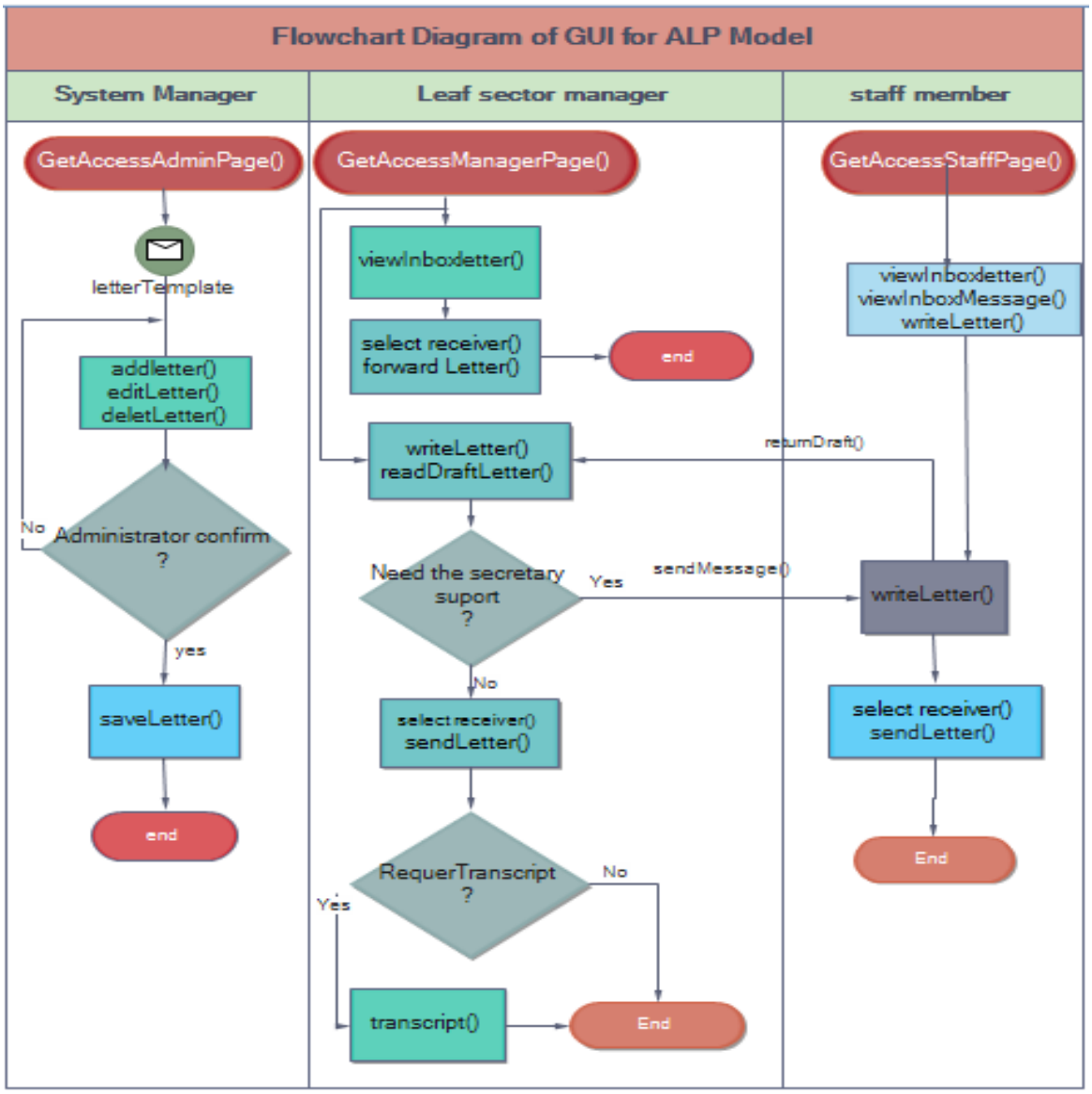


Figure 9 Flowchart of the GUI of the ALP service

As distinguished in (Sommerville, 2020), there are five types of UML diagrams that are useful for system modeling: the first one is activity diagrams, which show the actions elaborate in a processor in data processing of the system. The second is use-case diagrams, which show the interactions between a system and its environment. The third is sequence diagrams, which show interactions between actors and the system and between system components. The fourth one is class diagrams, which show the object classes in the system and the associations between these classes. And the last one that we have used

to platform this digital and efficient lettering system as shown in figure 4 is flowchart diagrams, which show how the system reacts to internal components and external users.

The platform contains three fundamental components: the admin component, here the admin can able to manage the other system states such as adding the indispensable component of the system and recording leaf sectors with their managers. The second component is leaf sector managers, thus can able to do many tasks such as forward the inbox letter, transcript thus sent the letter, command the secretary to write the new letter and send back as a message to her/ his manager, send the written letter to the concerned body after reviewing it and print the letter what the manager want. The third component is the staff component, thus they can able to do tasks such as view transcript letter to his or her, sent the newly written letter to her/ his manager, and print the letter what the staff wants.

3.11. Logical Frameworks of ALP

The logical framework offers a linear, "logical" explanation of the relationship between inputs, activities, outputs, outcomes, and impacts concerning the objectives and goals of the research. It shows the causal relationship between inputs, activities, outputs, outcomes, and impact regarding the goals and objectives. The logical framework of ALP summaries the specific inputs needed to carry out the activities/processes to produce specific outputs that will result in specific outcomes and impacts. The logical framework of ALP does form the basis for monitoring and evaluation activities for the basic stages of the research. Figure 10 logical framework of ALP presents a straightforward view of a platform designed to improve the formal lettering system workflow against the paper-based work. The ALP logical framework does not try to account for all of the activities that may influence a platform's operation and results. Instead, the logic framework focuses on the platform's inputs, activities, and results. This fine focus assists users, managers, and monitoring and evaluation planners as they clarify the direct relationships among elements of particular interest within a specific module.

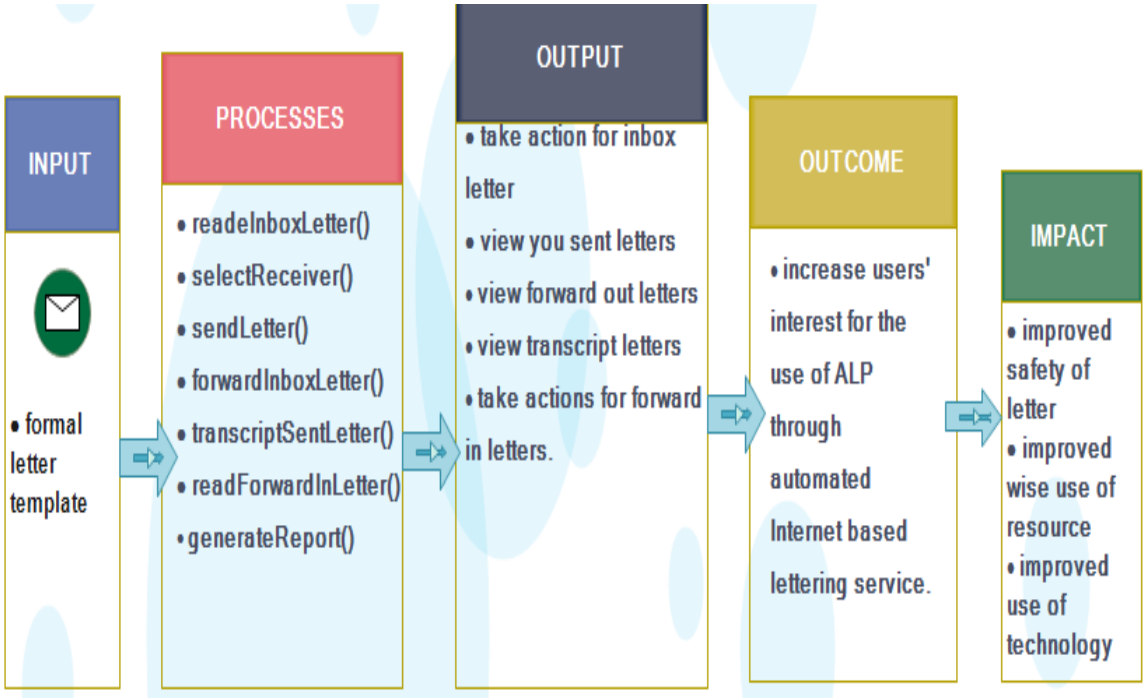


Figure 10 Logical framework of ALP

CHAPTER FOUR

EXPERIMENTS AND RESULTS DISCUSSION

4.1. Overview

Web applications are vibrant websites joined with server-side programming which offer functionalities such as networking with customers, joining back-end databases, and producing results to browsers. There are different web-based applications such as online banking, Facebook, online reservations, e-commerce/shopping cart applications, interactive games, online training, online polls, blogs, and so on. As noted (Prof. Dr.Wieringa, 2016) “If the problem is to learn about the performance of a design. Implementation of a solution is the construction of a platform and test environment is the part of this research”.

4.2. Design and Development of ALP service

There are two main categories of code scripting in programming for creating web applications:

I. **Client-side scripting:** client side scripting is the type of scripting code that is interpreted by browsers. Client-side scripting is generally viewable by any user of the application (from the view menu click on "View Source" to view the source code). HTML (HyperText Markup Language). CSS (Cascading Style Sheets), JavaScript) Ajax (Asynchronous JavaScript and XML), and jQuery (JavaScript Framework Library - commonly used in Ajax development) are some common client-side scripting technologies that we used for designing ALP.

II. **Server-side scripting:** server-side scripting is the type of code that is executed or interpreted by the webserver. Server-side scripting is not viewable or accessible by any visitor (user) or the general public. PHP (very common Server Side scripting language - Linux / UNIX based Open Source - free redistribution, usually combined with MySQL database) is the common server-side scripting technologies that we used as a server-side

programming language of ALP. An example of the inbox letter read interface that was designed for managers can be seen in Figure 11.

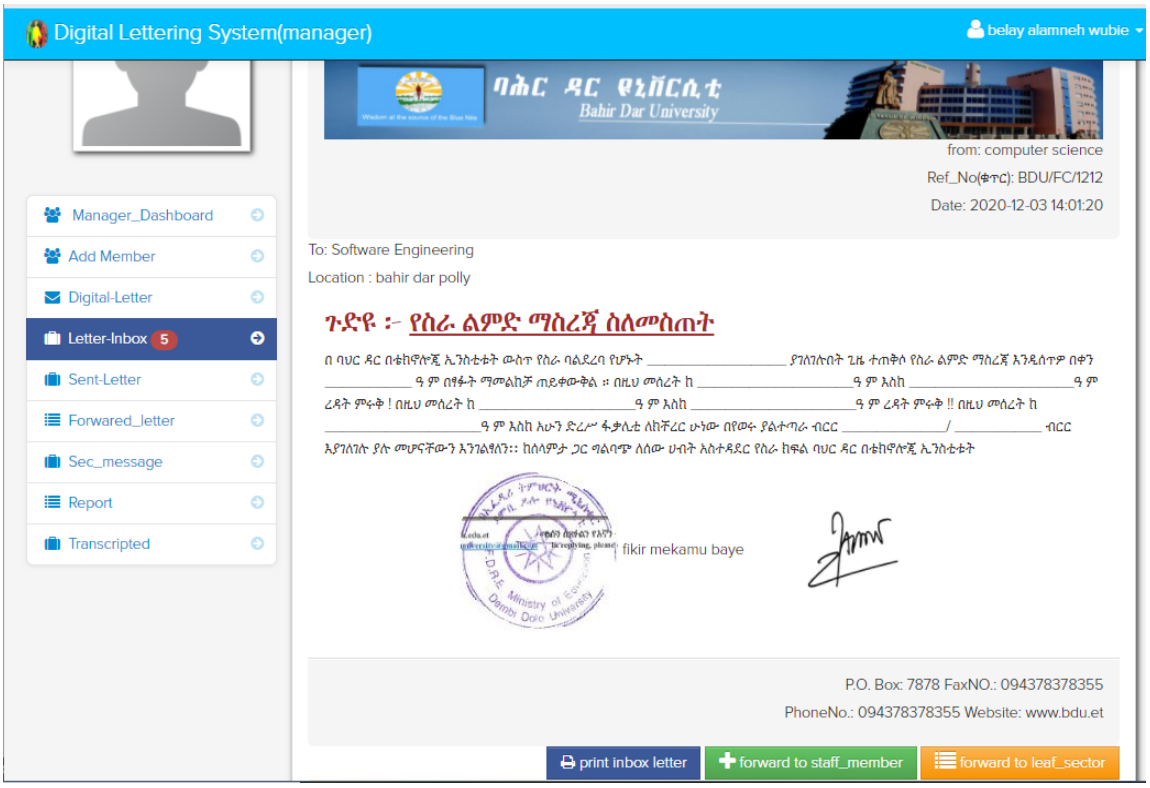


Figure 11 Manager read inbox letter platform interface

After the design and development of the platform, we have performed the functionality and compatibility evaluation, nonfunctional tasks, and context discussion, and performance testing of the platform and graphic representations on the designed and developed platform.

4.3. Functionality and Compatibility Evaluation

In design rule, the functionally of a system can be designed deeply and carefully. Due to this we design and develop the user interface deeply and that should be easy to use for example figure 12 reads the inbox letter interface in mobile phone. The interface that shows the user interface design of all modules for the admin, leaf sector manager, and staff member is compatible with every browser. This user interface designed for admin, managers, and staff members modules can able to preserve the page constancy and

reduce page redundancy and increase the reusability of the design page. For example figure 12 shows a mobile device compatibility test result.

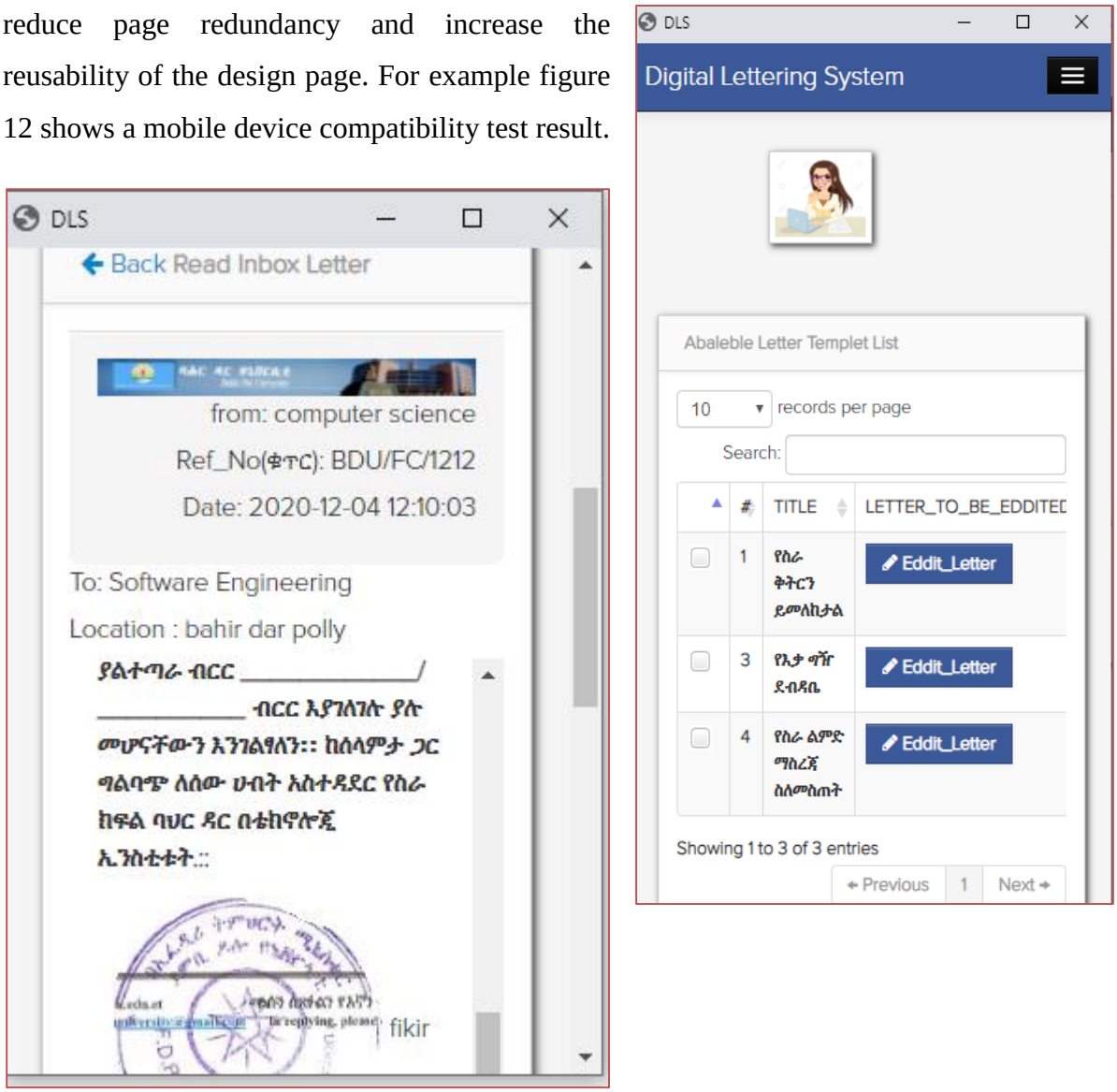


Figure 12 Mobile device compatibility platform result

The basic functionality and the user interface design can be tested in different browsers and mobile devices. Figure 12 mobile device compatibility result shows the design is compatible with smartphones tablets' iPhone and other smart devices. To support this functionality in our design, we used a bootstrap framework for device compatibility.

4.3.1. System Operability and Performance Discussion and Evaluation

We all have to agree that in today's ever-changing and competitive world, the internet has become an integral part of our lives. Most of us make judgments by searching for

information on the internet these days. So using the web application is not optional but mandatory for all kinds of business operations. This makes the internet the first choice for becoming and keep on relevant in the market. Just having the application is not enough. An organization is needed to develop a web-based application that is informative, accessible, and user-friendly. To maintain all these qualities, the web application should be well tested. Web testing is a software testing practice to test software or web applications for potential bugs. It's very indispensable to perform complete testing of web-based applications before making live for end users. A web application needs to be checked completely from end-to-end before it goes live in business for end users. So the platform was tested according to our testing ability.

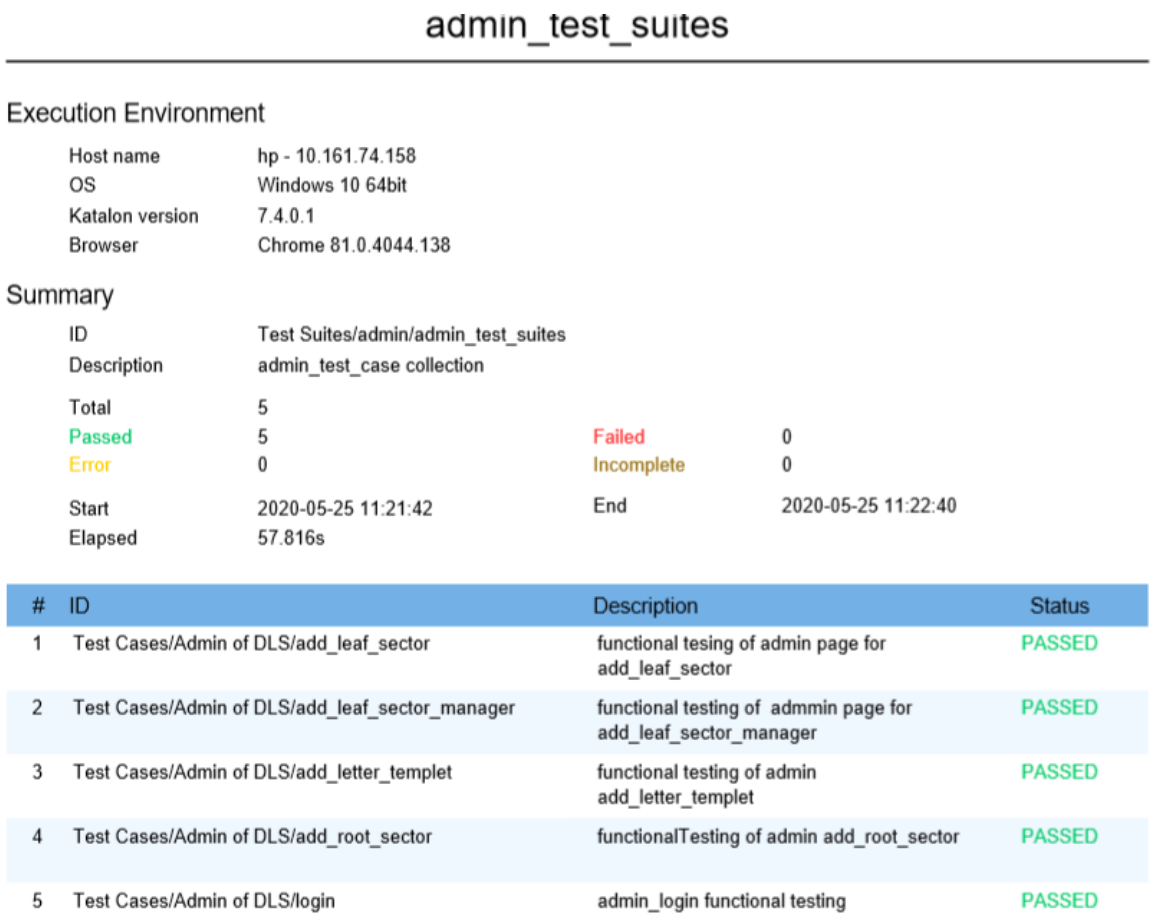
4.3.2. The functionality of the ALP service

Functionality testing is a software testing process used when software development was performed. This type of testing is carried out based on the platform modules' functional specification data (test case data). Functional testing is performed on a complete and integrated system to evaluate the system's completeness with its specified requirements to achieve. The functional testing includes any user commands, data manipulation, searches, business processes, user screens, and integrations. This testing is done using the functional specifications provided by the user or by using the design specifications like test cases provided by the design team. So, this type of testing is strictly specific. For functional testing of ALP, we use automation tools called Katalon studio which is a more powerful tool and has many features for testing web applications.

4.3.3. Functionality measuring facts

To test the functionality of the ALP we have used Katalon studio web application testing tool as we have discussed. This tool has many features to test web applications and is completely free to download and used it. We test all module functionality of the platform well. We have to get good results at all. However, the challenge is too hard. We list the basic functionality of the platform for desiccation and analysis with steps depending upon the test case data that we prepare. To test the functionality of the platform, we modularize the system into three modules. These are the admin module, manager module, and the

staff module. Figure 13 results show the summary of the automation test result from Katalon studio for the admin module.



admin_test_suites

Execution Environment

Host name	hp - 10.161.74.158
OS	Windows 10 64bit
Katalon version	7.4.0.1
Browser	Chrome 81.0.4044.138

Summary

ID	Test Suites/admin/admin_test_suites		
Description	admin_test_case collection		
Total	5		
Passed	5	Failed	0
Error	0	Incomplete	0
Start	2020-05-25 11:21:42	End	2020-05-25 11:22:40
Elapsed	57.816s		

#	ID	Description	Status
1	Test Cases/Admin of DLS/add_leaf_sector	functional tesing of admin page for add_leaf_sector	PASSED
2	Test Cases/Admin of DLS/add_leaf_sector_manager	functional testing of admmin page for add_leaf_sector_manager	PASSED
3	Test Cases/Admin of DLS/add_letter_templet	functional testing of admin add_letter_templet	PASSED
4	Test Cases/Admin of DLS/add_root_sector	functionalTesting of admin add_root_sector	PASSED
5	Test Cases/Admin of DLS/login	admin_login functional testing	PASSED

Figure 13 Admin page module test suites

In this admin page module, there are more than ten test cases. As figure 13 shows we have done the five basic test cases for the functionality of the module. In this test suite, we added the admin login test case, add the leaf sector, record the leaf sector manager test case, setting the letter template test case, and register the root sector content test case. As the functionally testing shows, all test cases have passed the test and we have no results here its status was failed. The functionality testing of the platform can be done depending upon the test case data that we prepare for the platform test. When we perform the test case in Katalon studio, the Katalon studio doesn't give figure 15 results directly, we have got some failed statuses and we updated the code through design and development.

Then, when we do the test again we get baste results as expected. As the result shows all five test cases can pass the testing conditions well and the platform is good and well designed and implemented.

manager_test_suites

Execution Environment

Host name	hp - LAPTOP-QAELO51O
OS	Windows 10 64bit
Katalon version	7.4.0.1
Browser	Chrome 81.0.4044.138

Summary

ID	Test Suites/manager_page/manager_test_suites		
Description	collection of manager_test_cases		
Total	9		
Passed	7	Failed	2
Error	0	Incomplete	0
Start	2020-05-25 22:23:47	End	2020-05-25 22:27:34
Elapsed	3m - 46.881s		

#	ID	Description	Status
1	Test Cases/leaf_sec_manager/add_staff_member	functional testing of manager page for add staff_member	PASSED
2	Test Cases/leaf_sec_manager/forward_inbox_letter	functional testing of manager page for forward_inbox_letter	FAILED
3	Test Cases/leaf_sec_manager/manager_inbox_view	functional test for manager page for manager_inbox_view	PASSED
4	Test Cases/leaf_sec_manager/manager_login	functional testing of manager page for login	PASSED
5	Test Cases/leaf_sec_manager/print	functional testing of manager page for print letter	PASSED
6	Test Cases/leaf_sec_manager/send_letter _to leaf_sector	functional tesing for manager page for send_letter _to leaf_sector	PASSED
7	Test Cases/leaf_sec_manager/send_letter_to staff	functional testing of manager page for send_letter_to staff	PASSED
8	Test Cases/leaf_sec_manager/send_messagea_to secretary	functional_testing of manager page for send_messagea_to secretary	FAILED
9	Test Cases/leaf_sec_manager/transcripte_sent _letter	functional_testing of manager page for transcriptea_sent _letter	PASSED

Figure 14 Leaf sector manager page module test suite

In this leaf sector manager page platform module, there are more than fifteen test cases. As figure 14 shows, we have done the nine basic test cases for the functionality of this sector manager page module. In this test suite, we added a manager login test case that authorizes the manager to log in to the system, add staff members test case, forward inbox letters test case that able to that manager forward the letter to concern body, inbox

view test case that the manager can view the in boxed letter and print, send a letter to the staff and leaf sector that able the manager send the letter after cauterized and transcript the sent letters to concern boy and send messages to secretary test cases.

As the functionally testing shows in figure 14, seven test cases have passed the test and we have two outcomes where their status was failed. The functionality testing of the platform in the manager page can be done depending upon the test case data that we prepare for functionality testing of this module. When we perform the test case in Katalon studio, the Katalon studio gives us the figure 14 results well and we get the two test cases' status was failed and we carried out the test again after we made some modification of code through implementation. Then, when we perform the test again in the studio, we get good results with challenges as we have seen in figure 15. As the outcome shows all nine test cases can pass the testing conditions well and the platform is good and well designed and implemented. However, two test cases cannot pass the test.

forward_inbox_and message_to_secretary

Execution Environment

Host name	hp - 10.161.74.177
OS	Windows 10 64bit
Katalon version	7.4.0.1
Browser	Chrome 81.0.4044.138

Summary

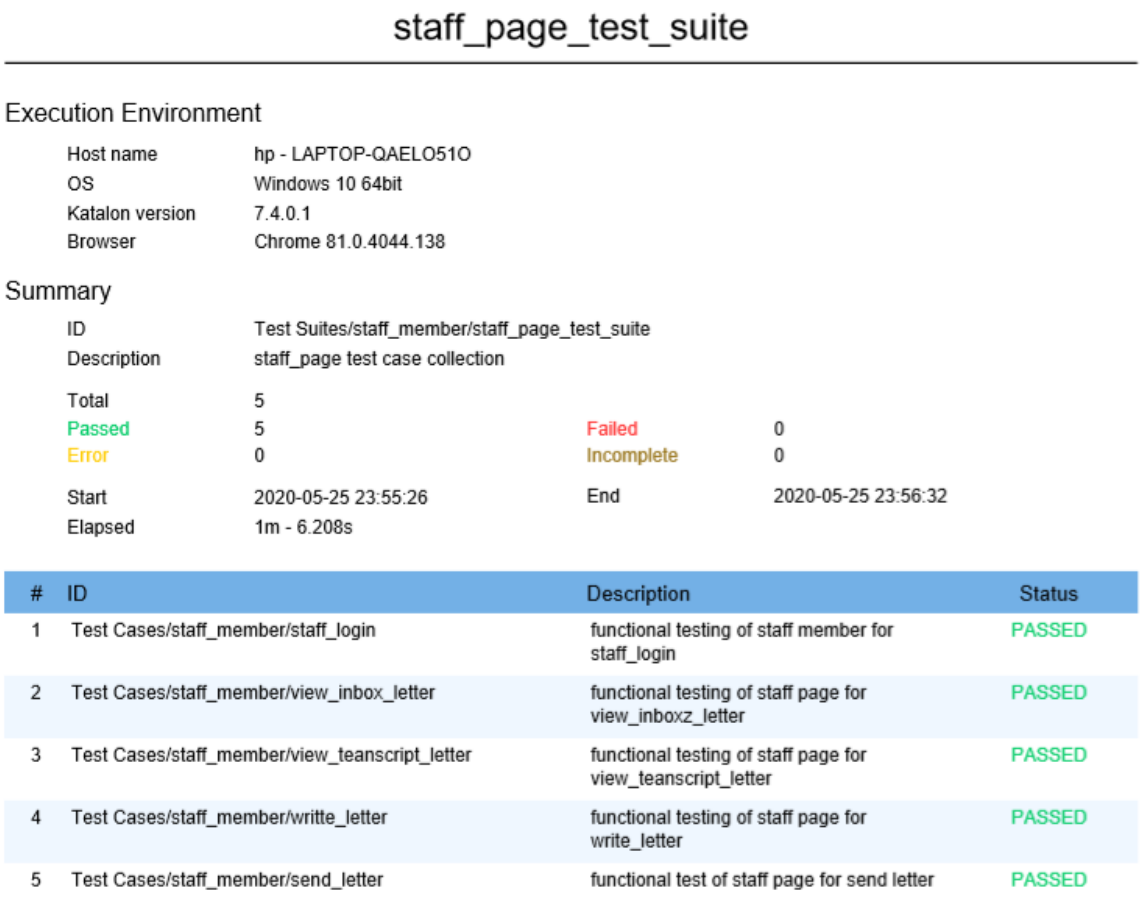
ID	Test Suites/manager page_error/forward_inbox_and message_to_secretary		
Description	functonal testing of forward_inbox_and message_to_secretary for manager page		
Total	2		
Passed	2	Failed	0
Error	0	Incomplete	0
Start	2020-05-26 10:57:18	End	2020-05-26 10:57:50
Elapsed	31.804s		

#	ID	Description	Status
1	Test Cases/leaf_sec_manager/forward_inbox_letter	functional testing of manager page for forward_inbox_letter	PASSED
2	Test Cases/leaf_sec_manager/send_messagea_to secretary	functional_testing of manager page for send_messagea_to secretary	PASSED

Figure 15 Forward_inbox_and_message_to_secretary

In this leaf sector manager page module, we have test nine test cases. However, the two test cases' status was failed as shown in figure 14. We get the challenge to improve the

test result. When we perform the test case in Katalon studio again and again with some modification of the design and implementation (development), the Katalon studio gives the figure 15 results well and we get the status passed. Then, when we perform the test again in Katalon studio, we get the best results as expected. As the outcome shows in figure 15 both test cases such as forward inbox letters and sending messages to the secretary can pass the testing conditions well and the platform is good and well designed and implemented.



staff_page_test_suite

Execution Environment

Host name	hp - LAPTOP-QAELO51O
OS	Windows 10 64bit
Katalon version	7.4.0.1
Browser	Chrome 81.0.4044.138

Summary

ID	Test Suites/staff_member/staff_page_test_suite		
Description	staff_page test case collection		
Total	5		
Passed	5	Failed	0
Error	0	Incomplete	0
Start	2020-05-25 23:55:26	End	2020-05-25 23:56:32
Elapsed	1m - 6.208s		

#	ID	Description	Status
1	Test Cases/staff_member/staff_login	functional testing of staff member for staff_login	PASSED
2	Test Cases/staff_member/view_inbox_letter	functional testing of staff page for view_inboxz_letter	PASSED
3	Test Cases/staff_member/view_teanscript_letter	functional testing of staff page for view_teanscript_letter	PASSED
4	Test Cases/staff_member/writte_letter	functional testing of staff page for write_letter	PASSED
5	Test Cases/staff_member/send_letter	functional test of staff page for send letter	PASSED

Figure 16 Staff page test suite

The staff page module, there are more than five test cases. As figure 16 shows we have done the five basic test cases for the functionality of the platform. In this test suite, we added staff login test cases, view inbox letters, view transcript letters test case, write a formal letter and send to the sender manager test case, and write and send a letter to concerned body test case. As the functionality testing shows, all test cases have passed

the test and we have no outcomes here its status was failed. The functionality testing of the platform on the staff page can be done depending upon the test case data that we prepare for the test. When we perform the test case in Katalon studio, the Katalon studio gives the above results well and we get some failed status and we update the code through implementation. Then, when we perform the test again in the studio, we get baste results as expected. As the outcome shows all five test cases can pass the testing conditions well and the platform is good and well designed and implemented.

4.3.4. Functional Testing Result Discussion

The functionality testing of the web ALP can be done depending upon the test case data that we prepare. We prepare more than twenty-five test cases and data. From those test cases, we incorporate nineteen test cases. When we perform the test case in Katalon studio, the Katalon studio gives the above results well and we get some failed status and we update the code and design through implementation (development). Then after. When we have done the test again we get the good results as expected. Figure 13, 14, 15, and 16 shows the test suite (continuer of many test cases) that defines the result of all testing cases in Katalon studio. As the result shows all nineteen test cases can pass the testing conditions well and the platform is good and well designed. When we perform the test, we follow some steps called test steps and scenarios (Verifies on entering valid username password and any other valid inputs to the system that a manager or a staff can log in to the system and perform the wanted tasks). We test basic functions and get baste results from Katalon studio web application testing tool for our ALP service.

4.4. Nonfunctional tasks and context discussion

4.4.1. Security Testing

The following are some of the test cases for the security testing that we perform on the ALP service using security techniques like authentication and authorization. Test by pasting the internal URL directly into the browser address bar without login. Internal pages should not open.

If you want to log in by using a username and password and then browsing inside pages next try moving URL options directly. I.e. If you are checking some publisher site statistics with publisher site user_id= 123111222. Try directly changing the URL site identification parameter to a different site identification that is not related to the logged-in user. Access should be denied for this user to view other's stats. Try some invalid inputs in input fields like login username, password, input text boxes, etc. Check the system's reaction to all invalid inputs. Web directories or files should not be accessed directly. We have done the login testing case manually for the platform to enhance the security issue of the digital and efficient lettering platform with valid and invalid data. Look at table 2 for the login test case functionality result.

Table *2* Login security authentication and authorization test result

Module	**Test steps**	**Test data**	**Expected result**	**Actual result**	**status**
Admin module	1,http://localhost:8081/dls_v_2 2, enter username and password 3, navigate the login platform	User name=”fries” Password=”frie 1212”	Admin platform	As expected	pass
	1,2,3	Wring input data	Long in error	As expected	pass
Manager module	1,http://localhost:8081/dls_v_2 2, enter username and password 3, navigate the login platform	User name= ”**fries**” Password= ”**frie1212**”	Manager platform	As expected	pass
	1,2,3	Wring input data	Long in error	As expected	pass
Staff module	1,http://localhost:8081/dls_v_2 2, enter username and password 3, navigate the login	User name= ”**fries**” Password= ”**frie1212**”	Staff platform	As expected	pass
	1,2,3	Wring input data	Long in error	As expected	pass

4.4.2. Alpha testing

An alpha testing is a type of user acceptance testing executed to find the possible issues/bugs before releasing the system product to everyday use or the public business. The attention of this testing is to simulate real users by using the black box and white box techniques. The purpose is to carry out the tasks that a typical user might perform. Alpha testing for ALP has carried out the manual and the testers were the three-member employees of BIT and the other ten respondents are from software engineering experts including us. When this tasting was performed, we identified basic possible issues for example sent letter delivery issues and seen notification when the staff writes and sends a letter to his/her manager. At this test, we have recorded writing, sending, and receiving letter time information when the respondents perform a testing transaction on this proposed platform. Table 3 and figure 17 show the time recorded information at this alpha testing of the ALP.

Table 3 Alpha testing result data

manual alpha testing data of ALP result in min			
No. of respondent	writing time(min)	sending time(min)	receiving time (min)
1	3.03	0.18	0.51
2	2.38	0.09	1.1
3	4.02	0.08	0.12
4	4	0.08	0.15
5	5	0.06	0.12
6	3.3	0.08	0.11
7	4.13	0.08	0.08
8	3.4	0.05	0.08
9	3.59	0.08	0.15
10	3.46	0.06	0.22
12	4.7	0.08	0.08
13	2.16	0.08	0.9
sum	43.17	1	3.62
average	3.32	0.08	0.28

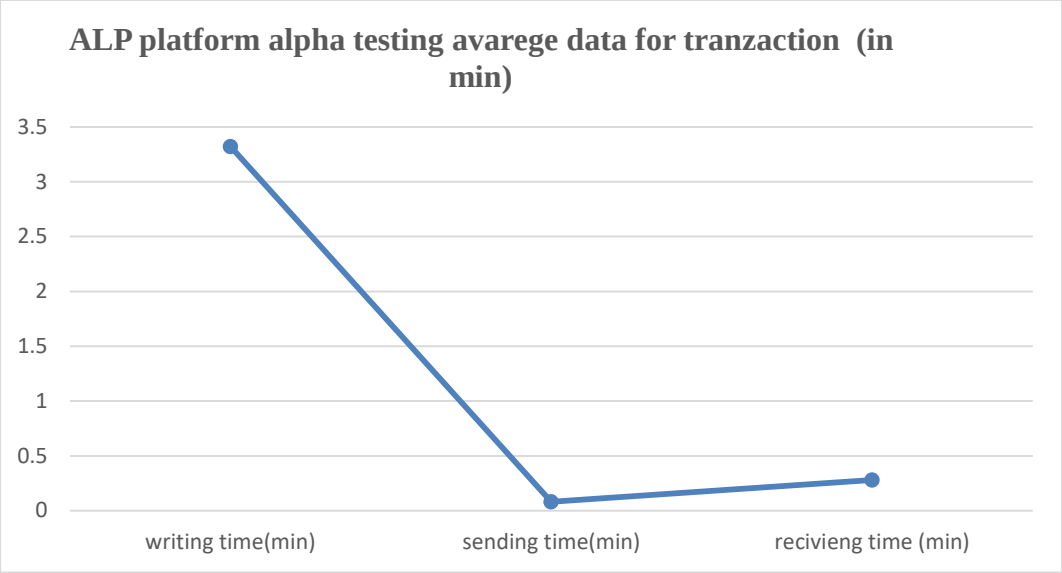


Figure 17 ALP platform alpha testing average result

From table 2 and figure 18, we can see that the average writing time of a single letter is 3.32 minutes this means to write a single letter 3.32 minutes is required. And the sending time and receiving time are 0.08 and 0.28 minutes respectively. This means to send a written letter 0.08 minutes is required and to receive or view the in-boxed letter starting from accessing the system 0.28 minutes is required. This result shows how the platform was efficient in terms of resource consumption especially time.

4.4.3. Performance testing of the platform and graphic representations

Performance testing is one of from non-functional testing techniques that are done to regulate the system parameters in terms of responsiveness and stability under numerous workloads. Performance testing measures the quality attributes of the system, such as scalability, reliability, and resource usage that can able to determine the speed, responsiveness, and stability of a software program or a system under a workload. We use JMeter to measure the performance of the design platform. JMeter is a software application program and open source software that is a completely pure Java application considered to load test functional behavior and measure the performance of the developed application. It was originally designed for testing web applications due to this function we have used this JMeter software to test the performance of the designed platform.

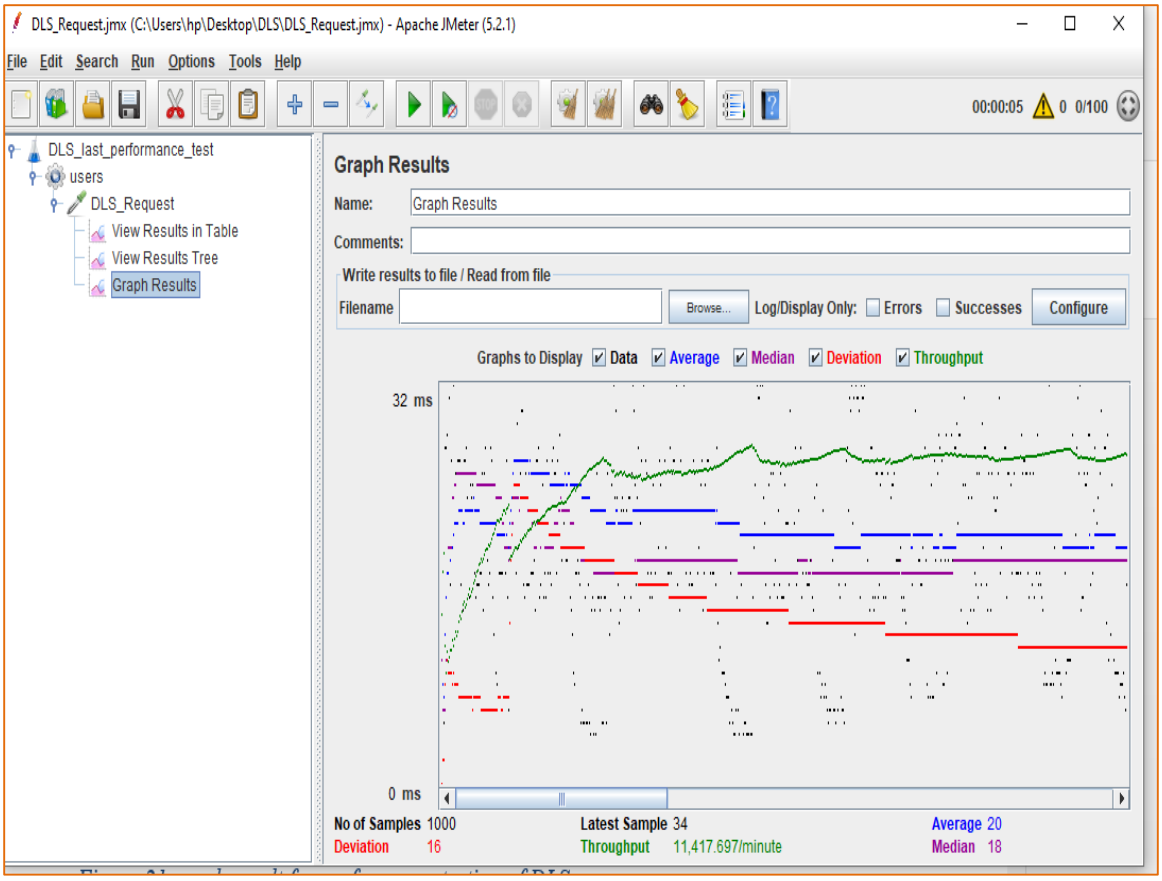


Figure 18 Graph result for performance testing of ALP

4.4.4. Performance testing result discussion

At the bottom of figure 19, there are statistics, represented in colors: the black color represents the total number of current samples sent, the blue color represents the current average of all samples sent, and the red color the current standard deviation.

Figure 18 graph shows the green throughput rate that denotes the number of requests per minute the server handled. To analyze the performance of the platform server, we use the number of threads: 100 (number of users connects to the target http://localhost:8081/dls_v_2 /letter/: 100), Loop Count: 10 (number of time to execute testing), and Ramp-Up Period: 5 (the joining time of users). Under this test, we should focus on 2 parameters thus are throughput and deviation. Throughput is the most important parameter. It denotes the ability of the server to handle a heavy load. If the throughput is higher, then the server performance is better. In this test, the throughput of

the platform server is 11417.697/minute. It means the platform server can handle 11417.697 requests per minute. This value is quite high. So, we can conclude that the platform server has good performance. The deviation is 16, shown in red - it indicates the deviation from the average. The smaller one is better. This value of deviation is 16 is quite small because of this, we can say that the platform server has good performance.

4.5. Demonstration

The demonstration of the ALP evaluation was done offline by installing the application on users' computers in Bahir Dar University BIT staff and information technology experts and by presenting the demonstration of the platform in a meeting of wisdom tower Bahir Dar University and at Amhara state health facility institute. The total number of respondents was 35 (n = 35) (Table 4 shows the profile of respondents). After installing and presentation of the demonstration, the users or respondents were asked to perform one process which was written in the Flowchart of the GUI of the platform Figure 9. And the audience was asked to evaluate and give feedback on what they saw in the presentation.

Table 4 Respondents' profile for the staffs and managers

Variables		**Total**
Gender	Female	22(62.9%)
	Male	13(37.1%)
Age	24–30 years old	20 (57.1%)
	31–40 years old	7 (20.4%)
	>40 years old	8 (22.9%)
Occupation	Managers	8 (22.9%)
	staffs	22(62.9%)
	Information technology experts	5(14%)

Based on the measurement of the PSSUQ framework, the system platform development was in the "good " range, meaning that the results of the design were good (more than 4

which is the middle value of the Likert scale), however, many changes could be made to make it more user friendly to use and easier to manage the letter. To determine what improvements should be made, we utilized an open question questionnaire and we also present on Amhara TV and Amhara FM 96.9 MHz on "Yeteknology sew program", which was designed to get feedback, criticism, and suggestions. The feedback was grouped to distinguish their priority for improvements on the functionality of the system, which are shown in table 5. Besides, the grouping determined the priority of the design and development for improvements.

Table 5 Suggestions and improvements for the ALP module

No.	Functionality	Number of Occurrences	Module	Action
1	Develop with Security technique	5	ALP	Security techniques were used
2	Support forward transaction	4	Forward inbox letter	a forward message supporting form was added
3	Support smartphone device	3	ALP	Bootstrap framework is used
4	Include letter supporting document form	2	ALP makeLetter()	letter supporting form was added
5	Make it an intelligence system	1	ALP	Design as a web-based application

4.6. Evaluation

In the demonstration, we have distributed questionnaires that contain sixteen questions offline for users and audiences to fill in what they saw and understand. The results of the questionnaires after the demonstration and presentation were used to evaluate the platform of ALP. The data obtained by the questionnaire were then processed for interpretation. The process of interpretation was done with three experts for more clear

safety of datasets through calculation. The calculation was made using the PSSUQ usability testing framework online (T, PSSUQ Calculator, 2020).

The internal consistency and reliability of the data were checked in Cronbach's alpha (CA) and **C**omposite Reliability (CR) seen in table 6. Cronbach's alpha is not a statistical test. It is a coefficient of reliability or consistency and a measure of internal consistency, that is, how closely related a set of items are as a unidimensional. Composite reliability **(**CR**)** (sometimes called construct reliability*)* is a measure of internal consistency in scale items, much like Cronbach's alpha (Glen, 2020) Composite reliability **(**CR**)** and Cronbach's alpha (CA) for each variable are shown in Table 6 and figure 19. A1 and a2 The range of CA and CR is between 0.00 and 1.00. A value of less than 0.50 is unacceptable,>=0.5 &<0.6 poor,>=0.6&<0.7questionable,>=0.7&<0.8 acceptable , >=0.8 &<0.9 good, and >=0.9 excellent(Cronbach's Alpha: Simple Definition, Use and Interpretation - Statistics How To n.d.) meaning the result of our measurement is between 0.7 and 0.9 internal consistency and reliability of the data are so good and closely related.

Table 6 Cronbach's alpha and composite reliability**.**

Variables	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Information Quality	0.833	0.900	0.753
Interface Quality	0.888	0.927	0.765
Overall PSSUQ	0.958	0.980	0.960
System Usefulness	0.888	0.926	0.764

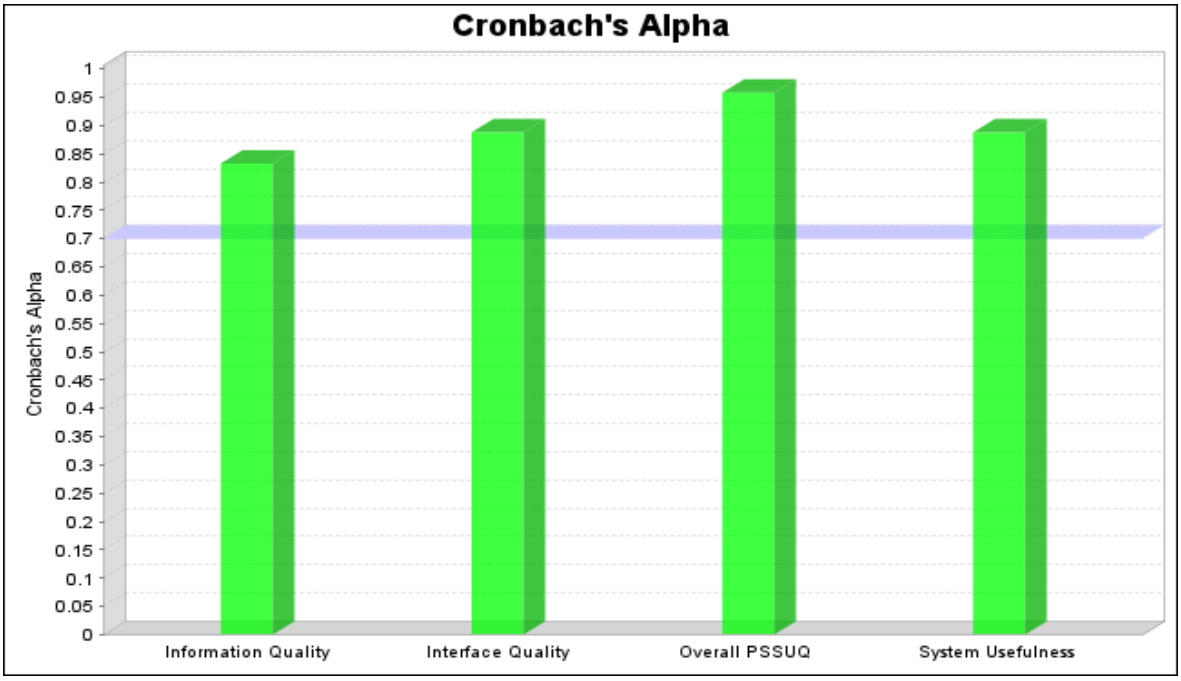


Figure a1

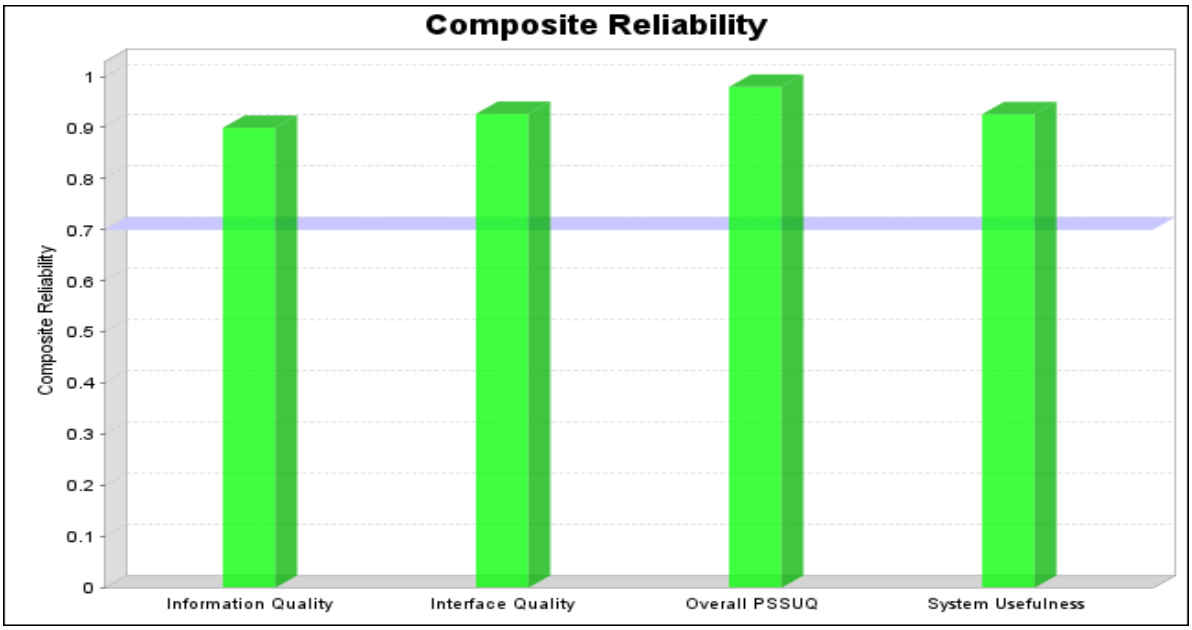


Figure a2

Figure 19 Cronbach's Alpha figure 1a and Composite Reliability a2 Validity charts

4.6.1. PSSUQ evaluation values

The values of system usefulness, information quality, and interface quality can be seen in table 7. In a study like (Ave Adriana Pinem, et al, 2020), the measurement was done with words called “Adjective Ratings” instead of numbers. As noted in (Ave Adriana Pinem, et al, 2020), the adjective words are easy for understanding. However, we can do with numerical value analysis. We chose numerical measurement so that the value that was produced by the PSSUQ would be easier to understand and recognize.

Based on the measurement, the application of the platform module designs was in the range of more than 4 (median value) which is neutral, meaning that the results of the platform design and development with its service was good, however, many changes could be made to make it more user-friendly to use and easier to understand and learn. To determine what improvements should be made, we utilized an open-question questionnaire, which was designed to elicit criticism and suggestions for the content, interface, and service of the platform. The suggestions were grouped based on their reputation to distinguish between improvements to usability and functionality, which are shown in table 4. Besides, the grouping determined the priority of the design improvements, which were the usability groups items and components that should be added to the system platform. The Evaluation was done using the PSSUQ usability testing framework, which was chosen because of this is well-known usability testing frameworks that are widely used for testing and evaluation web applicaton (Pinem et al. 2020). Here is the result of PSSUQ in table 7.

Table 7 PSSUQ values

Design Module	System Usefulness Score	Information Quality Score	Interface Quality Score	Overall PSSUQ Score	Description
ALP platform	6.65	6.5	6.85	6.68	Above the median (4) is considered good
	95%	92.8%	97.8%	95.4%	

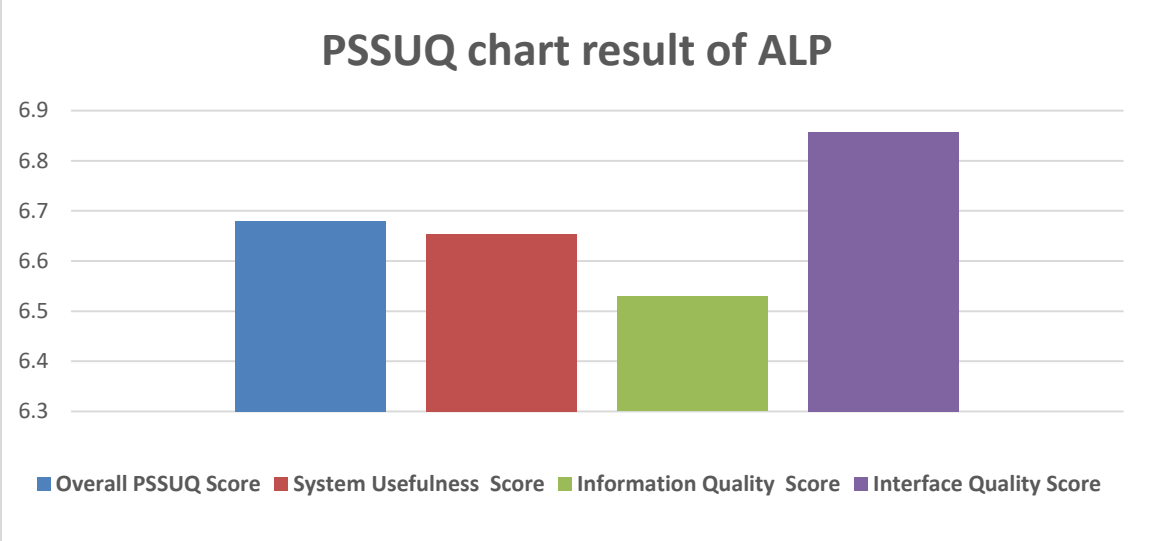


Figure 20 PSSUQ framework evaluation result of the platform (ALP)

The measurement was done according to the median (4) value. We chose this measurement because of this is well-known usability testing frameworks that are widely used for testing and evaluation web applicaton (PSSUQ (Post-Study System Usability Questionnaire) - UIUX Trend n.d.) (Pinem et al. 2020)so that the value that was produced by the PSSUQ would be easier to understand and interpreted in the PSSUQ calculator. Based on the measurement, the application module designs were more than in the median (4) range, meaning that the results of the design were good, but many changes could be made to make it more user friendly to use and easier to adopt.PSSUQ score starts with 1 means "strongly disagree" and ends with 7 means "strongly agree". The higher the score (~7), the better the system performance and users' satisfaction. The overall average score of questions from PSSUQ 1 to 16 is 6.68 out of seven means the average score was 95.4% out of handerd which indicates the overall work was good.

When we see the ALP system usefulness in the average score of questions from PSSUQ 1 to 6 is 6.65 out of seven which means 95% that indicates the system usefulness of the ALP was good from the respondents' perspective. The ALP information quality in the average score of questions from PSSUQ 7 to 12 is 6.5 out of seven which means 92.8% and the ALP interface quality in the average score of questions from PSSUQ 13 to 15 is

6.85 out of seven which means 97.8% that indicates interface and information Quality of the ALP study was good according to the respondents' perspective.

To determine what improvements should be made, we have utilized an open-question questionnaire, which was designed to elicit criticism and suggestions. The suggestions were grouped to distinguish between improvements to usability and functionality, which are shown in table 4.Besides, the grouping determined the priority of the design improvements in the ALP proposed platform.

4.6.2. Platform evaluation based on the framework

The platform was evaluated with a designed logical framework. According to (Dunn, 2020), logical frameworks provide a linear or logical understanding of the relationship between inputs, activities, outputs, outcomes, and impacts concerning the objectives and goals of the research. The ALP logical frameworks that we have designed help to evaluate the developed and implemented platform for processing the input of formal letter data. Table 8 shows the evaluation result and from this, we can see the result as a platform that can perform the logical process as designed logically before implementation.

Table 8 ALP Platform evaluating based on the logical framework

	Admin module	**Manager module**	**Staff module**
input	Formal letter template		
Goal	Set / create formal letter template	Able to read the inbox letter Able to select the receiver of the written letter Able to send() a written letter Able to forwardInboxLetter(); Able to transcriptsentletter(); Able to readforwardintheletter(); Able to generateReport();	✓

output	Update formal letter template	Possible to takeAction() for inbox letter Able to viewYouSenLletters(); Able to viewForwardOutLetters(); Possible to viewTranscriptLetters(); Possible to take action for forwardingInLetters();	✓
outcome	✓ increased users' interest in the use of ALP through automating paper-based lettering system.		
impact	✓ improved safety of letter ✓ encourage wise use of the resource ✓ improved use of technology		

4.7. Communication

In this study, we work to enhance the efficiency of formal lettering services in terms of resources in higher sectors like the university. Due to this, we observe that, when the workers write, send and receive the formal letters we interview this works in questionnaires and they give the response to questionnaires. The case study encompasses Bahir Dar University/ Bahir Dar Institute of Technology (BIT). In the BIT human resource management office for three consecutive years from 2009-2010, 2010-2011, and 2011-2012 E.C. the number of inbox letter is 406 and outbox letters is 10804 in 2009-2010, the number of inbox letter is 706 and outbox letters are 11800 in 2010-2011 and the number of inbox letter is 500 and outbox letters is 12100 in 2011-2012 E.C. Generally the total number of outbox letters in three years is 34704 and the inbox letter is 1612. This indicates the paper-based lettering system uses a high amount of resources as input. So, if those organizations use this system platform, they would be more profitable in terms of resources and get enhanced service due to the system being internet-based and distributed.

Table 9 Paper-based formal letter working time and resource consumptions

No.	Writing time (min)	Sending time (min)	Receiving time (min)	Resource consumption (In birr/letter)
1	20	30	30	28
2	15	60	60	28
3	18	30	30	28
4	20	40	40	28
5	25	50	50	28
6	25	60	60	28
7	20	120	120	28
8	22	2880	2880	28
9	24	4320	4320	28
10	22	30	30	28
11	20	40	40	28
12	15	45	45	28
13	16	26	26	28
total	262	7731	7731	364
average	19.38	594.7	594.7	28

Table 7 shows paper-based formal letter writing sending and receiving time in a minute and resource consumption in birr. The data was collected from workers in BIT through questionnaires and very small and the same. However, that gives enough information for us to see how the paper passed the lettering system consumes much time and money. A single paper requires 19.38 writing time, 594.7 sending and receiving time in a minute, and 28 birrs without including the cost of a postman and a person who carries a letter from sender to receiver and receiver and sender.

Due to this, we observe that, when the workers write, send, and receive a single formal letter, they use 28 birr. It so much costly for example outbox letters in the record management office are 16056 in 2011-2012 E.C which means 16056* 28 birr /office. So,

if the sector has more offices and uses a traditional or paper-based lettering system it requires a high amount of time and resources.

4.7.1. Result Discussion

As in table 3, the ALP platform alpha testing average result shows the average writing time of a single letter is 3.32 minutes this means to write a single letter 3.32 minutes is required, and the sending time and receiving time is 0.08 and 0.28 minutes respectively. This means sending a single letter 0.08 minutes and receiving a single letter 0.28 minutes is required. On average 0.08 minutes was recorded to send a written letter from sources to destination and to receive or view the in boxed letter starting from accessing the system platform, 0.28 minutes is required as the testing record shows.

From this, we conclude that the proposed platform called automated lettering platform is more efficient in time and resource usage. So we can say that the proposed platform entitled a digital and efficient lettering system highly efficient and uses fewer resources if it can be applied in higher sectors like universities.

This study aimed to enhance paper-based service in higher sectors by designing an ALP that could meet user expectations for usability. The proposed platform was designed to cover the scope of the paper-based system and for use by all staff of the sector. The research process was carried through two categories one with the development side and the other is in the respondent side with different measurements. Respondents in the two categories are different which means on the developer side and respondent side. The demonstration was carried out on BIT staff and Amhara health facility staff members who were actively working in the different manager and secretary positions. The occupation of respondents is quite different which means manager, information technology expert, and secretary. The percentage of managers, information technology experts, and secretaries including staff members is 22.9%, 62.9%, and 14% respectively. The overall average score of questions in PSSUQ from respondents is 6.68 out of seven means the average Score is 95.4% which indicates the overall study was good. The system usefulness of the ALP in the average score of questions from PSSUQ is 6.65 out of seven which means 95% that indicates the system use of the ALP study was good

according to the respondents' perspective. The ALP information quality in the average score of questions from PSSUQ 7 to 12 is 6.5 out of seven which means 92.8% and the ALP interface quality in the average score of questions from PSSUQ 13 to 15 is 6.85 out of seven which means 97.8% that indicates information and interface quality of the ALP study was good according to the respondents' perspective.

The first evaluation used the PSSUQ to measure system usefulness, information quality, and interface quality. The second evaluation was a functional and non-functional testing evaluation that was done on the developer side. The purpose of this evaluation was to ensure that the initial design and development was with the objectives of usability and functionality of the platform, which help users to complete lettering tasks effectively and effectively and satisfy their resource utilization level. This evaluation was focused on the overall system functionality and non-functionality testing, which was expected to help users carry out the intended functionalities of formal letters between users.

The implementation of the user interface was accomplished by using the bootstrap framework for more compatibility of the device during the accessing process. For example, when the user accesses the system on a smartphone and computer the content should be consistent and visible when the letter was exchanged. For the dialogs to send, receive, forward, transcript, and view the letter user interface should be consistent in the basic device. The display will tell the user whether the letter has been successfully transacted. For example, if a manager has completed the forward process, then the system will convey that as the letter has been forward to the expected destination and saved. The offer error prevention and simple error handling rule were also implemented in this platform because the user may enter invalid data.

The result forms the PSSUQ shows that the overall value for usability was good with some change suggestions to be made. There are five improvements regarding the usability of the system. The improvement can be categorized as information quality aspect (implementation of the local language, displaying destination information, and success message) and interface quality aspect (the sequence of information) that would be evaluated in reimplementation using research procedures. The application was designed

to prompt an error message and to indicate which field will require correction. For easy reversal of actions, the design includes a return button for each view. To implement the support of internal locus of control, a reference history was made available to the user. In the second iteration, the search field was updated to increase user awareness regarding their power to navigate the platform.

Based on the results of the PSSUQ evaluation, information quality is defined as when information that is provided by a system can be easily understood and can effectively assist in the completion of lettering tasks. The information quality dimension undertook many improvements based on the user's comment with the PSSUQ evaluation.

The interface quality dimension is defined as whether a platform is capable of satisfying its users or not. For example, the color display was changed to include certain information, such as conveniences to the eye in rooms, and out, and when the users write a letter and want to send the letter, the receiver can be more easily seen by users. The three dimensions of the PSSUQ were important for achieving usability that met user expectations and requirements. Based on the results of PSSUQonline calculations, the application's designs obtained good values that mean more than four meaning that the design results were acceptable, but improvements could be made too.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Generally, all research works in all disciplines are problem-solving. The current way of writing, sending, transcription, and receiving paper-based formal letters has a lack of efficient service design problems. Due to this condition, we designed something useful digital and efficient lettering system platform for efficient service based on the design science research approaches. The proposed solution was designed based on user requirements and distributed structure to designate the solution of the gap between the current running paper-based letter and the era of technology as new artifact Appendix3 is the evidence of the work which is new and as can able to solve the problem.

Before this study, formal lettering service was conducted based on paper-based lettering and moved manually from source to destination for example using postman, and labor force. After proper analysis of these workflows of formal letters, a solution system was then designed and developed to meet up the needs of a more efficient service. The study was also designed and developed based on related works like google email, postal, and current paper-based lettering services.

The designed system platform is known as designing a digital and efficient lettering system to enhance lettering service in the online world, which helped in eliminating all the problems that the previous paper-based work was facing. With this proposed system platform artifact, different sectors for example university, hospitals, private sectors, and workers or employers can be brought together to enjoy a large number of functionalities and access a vast amount of information, thereby making writing, e-mailing, transcription, forwarding and receiving of the formal letter a lot easier and faster.

Generally, we say that the proposed digital and efficient lettering platform is a scientific investigation that is not naturally present but occurs as a result of the performing of this study which is more efficient in time and resource usage. So we can say that the proposed

system platform automated lettering system platform is highly efficient and uses fewer resources for lettering service.

5.2. Contribution

In this study, we have three fundamental contributions such as scientific contribution, organizational contribution, and resource optimization contribution.

As a scientific contribution to the scientific world and knowledge, the proposed digital and efficient lettering system offered a systematic approach in automating paper-based and traditional lettering service. Considering the functionalities of the platform, we perform user acceptance testing, functional testing using Katalon studio, and performance testing using the J-meter application.

We also propose a new artifact on using and adopting digital technology on challenging and resource consumption problems that are capable of encouraging the systematic or wise use of resources and getting on an efficient and secure working environment. And the last, we contribute a distributed infrastructure system service that provides an efficient, secured, and simplified (user-friendly) working environment as an artifact. The result of the study indicates using the proposed formal letter service was better with minimum costs and internet that you can access everywhere, Avery time, whenever and whatever for higher institutions.

5.3. Recommendation

In this study, the fundamental component of a digital and efficient lettering system platform that enhances lettering service was designed and developed with the future in mind and it is therefore scalable and can easily be transformed into a cloud server that various institutions can tap into and get required data and utilize various functionalities. On a short-term basis, however, we are looking into designing a digital and efficient lettering platform for letter mailing service in the online world integration, where alerts and notifications can be sent to the user's mobile phone. Therefore scalable and transformed into a cloud server and the comparison of the performance and functionality of the proposed to automate mailing service requires additional work.

References

Layered Architecture for Web Applications. (2020, 05 12). Retrieved from gyires: https://gyires.inf.unideb.hu/GyBITT/08/pt02.html

Alex, M. (2018). *Web Application Architecture Guid.* Microsoft patterns & practice.

altexsoft. (2020, 5 26). Retrieved from Web Application Architecture: How the Web Works: altexsoft.com/blog/engineering/web-application-architecture-how-the-web-works/

Ave Adriana Pinem, et al. (2020). Designing a health referral mobile application for high-mobility end users. *Heliyon*, 3.

ben-morris.com. (2020, 5 26). Retrieved from ben-morris.com: https://www.ben-morris.com/what-do-we-actually-mean-when-we-say-business-logic/

Buzan, D. (2019, 8 02). *Web Dev Zone* . Retrieved from Web Application Architecture: Definitions, Types, and Components: https://dzone.com/

Cathal et al. (2016). A design science research (DSR) case study: building an. *Journal of Decision Systems*, 3.

Compatibility Testing. (2020, 5 20). Retrieved from guru99.com: https://www.guru99.com/compatibility-testing.html

Corporation, M. (2008). *Web Application.* Microsoft Corporation.

Digital Denmark. (2016). Denmark: The Government / Local Government Denmark / Danish Regions /.

DMM Revision: Automation Prices for Letter-size Mailpieces With Enclosed Discs. (2019, octover 21). Retrieved from Mailing Standards of the United States Postal Service, Domestic Mail Manua: https://about.usps.com/postal-bulletin/2008/html/pb22239/html/updt1_008.html

Dunn, G. a. (2020, 8 22). *virtual knolowdge senteer to end violence*. Retrieved from http://www.unwomen.org/: http://www.unwomen.org/

Formal Letters. (2019). Retrieved from www.toppr.com: https://www.toppr.com/guides/english/writing/formal-letters/#:~:text=E%2Dmails%2C%20texts%2C%20etc,and%20language%20of%20formal%20letters.

formalletter.net. (2013, may 9). Retrieved from formalletter.net: https://formalletter.net/rules-for-writing-formal-letters/

Frehner, C. D. (2013). Email communication. *ResearchGate*, 36.

Galbriath, P. (2009). *developing web application with apache.*

Gibb, R. (2020, 5 26). *stackpath*. Retrieved from What is a Web Application: https://blog.stackpath.com/web-application/

Glen, S. (2020, 11 3). *Composite Reliability: Definition*. Retrieved from StatisticsHowTo.com:: https://www.statisticshowto.com/composite-reliability-definition/

guru99. (2020, 06 24). Retrieved from Difference between Website and Web Application: https://www.guru99.com/

guru99.com. (2020, 5 21). Retrieved from Performance Testing: https://www.guru99.com/performance-testing.html

Hacke, D. (2006). Sample MLA Formatted Paper. In D. Hacke, *Sample MLA Formatted Paper.*

http://weblog.tetradian.com/. (2020, 5 23). *http://weblog.tetradian.com/*. Retrieved from TEDRADIAN: weblog.tetradian.com/2009/10/09/architecture-versus-design/

Interface Testing. (2020, 5 26). Retrieved from guru99.com/: https://www.guru99.com/interface-testing.html

J.D. Meier Alex Homer et al. (2018). *Web Application Architecture Guid.* Microsoft patterns & practice.

Kohan, B. (2020, 2 11). *Guide to Web Application Development*. Retrieved from comentum 360: https://www.comentum.com/guide-to-web-application-development.html

Lech MADEYSKI, M. S. (2005). ARCHITECTURAL DESIGN OF MODERN WEB APPLICATIONS. *The View and the Controlle*.

letter stream. (2019). Retrieved from CERTIFIED MAIL OPTIONS: https://www.letterstream.com/certified-options

LIBRARY, D. W. (2020, 10 1). *research guides*. Retrieved from AMK: URL: https://libguides.macalester.edu/data1

listlink. (2019 , August 01). *listlink*. Retrieved from Web Application Architecture: Best Practices and Guides: https://litslink.com/blog

Malkoc, A. M. (2015). letetr writting in english. In A. M. Malkoc, *letetr writting in english* (p. 30). usa: USA information egency.

MARK DOUGLAS JACYNTHO, D. S. (2012). SOFTWARE ARCHITECTURE FOR STRUCTURING COMPLEX WEB APPLICATIONS. *Journal of Web Engineerin*.

Mark et al. (2002). A SOFTWARE ARCHITECTURE FOR STRUCTURING. *Journal of Web Engineering (JWE)*.

Palme, J. (2019). *Electronic mail.* Boston • London: Artech.

Pechota,et al. (2017). The trend of cost of universal services provided by national postal. *Procedia Engineering* (p. 1). Slovakia: ScienceDirect.

Prof. Dr. Roel Wieringa. (2016). *Design Science Research Method.* Netherland: University of Twente.

Prof. Dr.Wieringa. (2016). *Research methodology accross the disciplines.* Netherland: University of Twente.

r, L. e. (2013). *We b A p p l i c a t i o n A rc h i t e c t u re.* England: J o h n Wi l e y & S o n s L t d ,.

R.J.Wiering. (2016). *Design Science Research Methods and Writing Research Paper.* University of Twente, The Netherland.

Road, S. (2006). letter writting . In S. Road, *letter writting* (p. 51). Junior Certificate School Programme Support Service.

Sommer, D. H. (2019). Formal letter. In D. H. Sommer, *Formal.*

Sommerville. (2020, 5 21). *Software Engineering*. Retrieved from https://cs.ccsu.edu/: https://cs.ccsu.edu/~stan/classes/CS410/Notes16/05-SystemModeling.html

Staff, P. E. (2020, 05 12). *Packt Editorial Staff*. Retrieved from Packt : https://hub.packtpub.com/category/web-development/

Stochmiałek, L. M. (2015). Architectural design of modern web applications.

T, W. (2020, 9 23). *PSSUQ (Post-Study System Usability Questionnaire)*. Retrieved from UIUX trend: https://uiuxtrend.com/pssuq-post-study-system-usability-questionnaire/#interpretation

T, W. (2020, 11 2). *PSSUQ Calculator*. Retrieved from Article, UX Research: https://uiuxtrend.com/pssuq-calculator/

techopedia. (2020, 5 25). Retrieved from techopedia.com: https://www.techopedia.com/definition/8955/presentation-layer

topper . (2019). Retrieved from Formal Letters: https://www.toppr.com/guides/english/writing/formal-letters/

United States Postal Service (USPS). (2019). Retrieved from share a refund: https://www.sharearefund.com/pros-and-cons-of-using-the-u-s-postal-service-to-ship-small-parcels/

Usability Testing. (2020, 4 24). Retrieved from usability.gov: https://www.usability.gov/how-to-and-tools/methods/usability-testing.html

usps.com. (2019). Retrieved from usps.com: https://pe.usps.com/?_ga=2.40830250.94881619.1571727711-614708416.1571727711

Vijay Vaishnavi, B. K. (June 30, 2019). *DESIGN SCIENCE RESEARCH IN.*

Vogels, R. (2020, 2 12). *usersnap*. Retrieved from A 6-Step Guide to Web Application Testing: https://usersnap.com/blog/web-application-testing/

Web application. (2020, 06 24). Retrieved from computer hope: https://www.computerhope.com/

Web Application Architecture: Best Practices and Guides. (2020, 05 26). Retrieved from LITSLINK: https://litslink.com/blog/web-application-architecture

Wieringa, P. D. (2016). Design Science Research Methods. In P. D. Wieringa, *Design Science Research Methods* (p. 28). Netherlands.

Appendix 1

የደብዳቤ አጻጻፍ ስርአት PSSUQ መጠይቅ

ወደ ሲስተሙ እንደ ቅርንጫፍ መስሪያቤት በመግቢያ ስም “belay” የይለፍ ቃል 1212 እና እንደ አባል መግቢያ ስም “selam” የይለፍ ቃል “1212” ከገቡ እና የሲስተሙ ስራውችን ካዩ በኋላ የሚከተሉትን መጠይቆች ይመልሱ በጣም አስማማለሁ ከ1 እስከ 7 በጣም አልስማማም በማለት። ተጨማሪ ሃሳብ ካለዎት በጽሁፍ ያስቀምጡ

እድሜ 24–30 □, 31–40 □ >40 አመት □ ጾታ ወንድ□ሴት □

በጥብቅ አልስማማም .....በጣም አስማማለሁ

No.	PSSUQ	1	2	3	4	5	6	7	N.A.
1	በአጠቃላይ እኔ ይህንን ስርዓት ለመጠቀም ምን ያህል ቀላል እንደሆነ ተረድቻለሁ ::								
2	ይህንን ስርዓት ለመጠቀም ቀላል ነበር ::								
3	ይህንን ስርዓት በመጠቀም የተከናወኑ ተግባሮችን እና ሁኔታዎችን በፍጥነት ማጠናቀቅ የሚያስችል ነው:::								
4	ይህንን ስርዓት በመጠቀም ምቾት ይሰማኛ ብየ አስባለሁ ::								
5	ይህንን ስርዓት ለመጠቀም ቀላል ነው ::								
6	ይህንን ስርዓት በፍጥነት በመጠቀም ምርታማ መሆን እችላለሁ ብዬ አምናለሁ ::								
7	የደብዳቤ አጻጻፍ ችግሩ እንዲት መፍታት እንዳለበት በስርዓቱ በግልጽ ተረድቻለሁ።								
8	ስርዓቱን በመጠቀም ስህተት ባደረግሁ ቁጥር በቀላሉ እና በፍጥነት ማገገም እችላለሁ::								
9	በዚህ ስርዓት የተሰጠው መረጃ (እንደ የመስመር ላይ እገዛ ፣ በማያ ገጽ ላይ ያሉ መልእክቶች እና ሌሎች ሰነዶች) ግልፅ ነበር ::								
10	እኔ የምፈልገውን መረጃ ማግኘት ቀላል ነበር ::								
11	መረጃው ተግባሮችን እና ሁኔታዎችን እንዳጠናቅት ይረዳኛል።								
12	በስርዓት ማያ ገጾች ላይ የመረጃ አደረጃጀት ግልፅ ነበር ::								
13	የዚህ ሥርዓት በይነገጽ አስደሳች ነበር።								
14	የዚህን ስርዓት በይነገጽ መጠቀሙን ወደድኩ።								
15	ይህ ሥርዓት እንዲኖሩት የምጠብቃቸው ሁሉም ተግባራት እና ችሎታዎች አሉት :								
16	በአጠቃላይ በዚህ ስርዓት ረክቻለሁ								

Appendix 2

```
<head>
<title>ALP</title>
                <meta name="description" content="Digital and Efficient Lettering System ">
                <meta name="keywords" content="Digital and Efficient Lettering System ">
                <meta name="author" content="Belay Alamneh and Dr. Gebeyehu Belay">
                <meta charset="UTF-8">
<!-- Bootstrap -->
                <link href="admin/images/favicon.ico" rel="icon" type="image">
<link href="admin/bootstrap/css/bootstrap.min.css" rel="stylesheet" media="screen">
<link href="admin/bootstrap/css/bootstrap-responsive.min.css" rel="stylesheet"
media="screen">
<link href="admin/bootstrap/css/font-awesome.css" rel="stylesheet" media="screen">
<link href="admin/bootstrap/css/my_style.css" rel="stylesheet" media="screen">
<link href="admin/bootstrap/css/print.css" rel="stylesheet" media="print">
<link href="admin/vendors/easypiechart/jquery.easy-pie-chart.css" rel="stylesheet"
media="screen">
<link href="admin/assets/styles.css" rel="stylesheet" media="screen">
                <!-- calendar css -->
                                        <scriptsrc="admin/vendors/jquery-
1.9.1.min.js"></script>
<script src="admin/vendors/modernizr-2.6.2-respond-1.1.0.min.js"></script>
                <!-- data table -->
                <link href="admin/assets/DT_bootstrap.css" rel="stylesheet" media="screen">
                <!-- notification  -->
                <link href="admin/vendors/jGrowl/jquery.jgrowl.css" rel="stylesheet"
media="screen">
                <!--wysiwug  -->
                <link rel="stylesheet" type="text/css" href="admin/vendors/bootstrap-
wysihtml5/src/bootstrap-wysihtml5.css"></link>
                <link href="admin/vendors/jGrowl/jquery.jgrowl.css" rel="stylesheet"
media="screen">
                <scriptsrc="admin/vendors/jGrowl/jquery.jgrowl.js"></script>
                <script src="validator.js"></script>
</head>
<?php include('admin/dbcon.php'); ?>
```

Appendix 3

የኢትዮጵያ አእምሯዊ ንብረት ጽ/ቤት
Ethiopian Intellectual Property Office

የቅጅና ተዛማጅ መብቶች የሚያስገኙ ስራዎች ምዝገባ የምስክር ወረቀት
Copyright & Neighboring Rights Registration Certificate

የማመልከቻ ቁ.፡-2187/2012
Application No.

1. የመብት ባለቤት / Right owner's
   1.1. ስም / Name:- በላይ አላምነህ ውቤ እና ዶ/ር ገበየሁ በላይ ገ/መስቀል
   1.2. ጾታ / Sex:- ወንድ ዜግነት/ Nationality:- ኢትዮጵያዊ
   1.3. አድራሻ /Address

   ሀገር / Country:- ኢትዮጵያ ክልል/Regional State : አማራ

   ክ/ከተማ/Sub-city/ ዞን/Zone/: - ባህር ዳር

   ወረዳ /Woreda/:- ቀበሌ/Kebele: ቤ ቁ./ House No:-

   ስልክ ቁጥር /TeNo:- +2519 66 78 49 64/09 18 72 85 11 ፖ.ሳ.ቁ/ P.O.Box:-

2. የፈጠራ ሥራው / Creative Work.
   2.1. ርዕስ/ Title; ዲጂታል ሲተሪንግ ሲስተም
   2.2. ምድብ/ Type :- የኮምፒውተር ፕሮግራም ንዑስ ምድብ /Sub-type;-
   2.3. የምዝገባ ቀን / Registration Date 30/06/2012 ዓ.ም
   2.4. የምዝገባ ቁጥር / Registration No:- 5/0405
   2.5. የምስክር ወረቀቱ ህጋዊነት የሚያበቃበት ቀን/ Certificate's Date of Expiry:- 29/06/2017 ዓ.ም

3. የመብት ወሰን / Scope of right

በቅጂና ተዛማጅ መብት ጥበቃ ለማድረግ የወጣ አዋጅ ቁጥር 410/1996 የተዘረዘሩት የኢመንጪ መብት በሙሉ።

ምዝገባውን ያፀደቀው ኃላፊ / Signed by

ቀን/ Date 30/06/2012 ዓ.ም

ማሳሰቢያ፡- * ይህ የቅጅና ተዛማጅ መብት የሚያስገኝ ስራ ምዝገባ የምስክር ወረቀት ቀዳሚ የባለቤትነት ማስረጃ በመሆን ያገለግላል።

* ይህ የምስክር ወረቀት በባለምስት ዓመቱ መታደስ አለበት።

Note:- * This copyright & neighboring right registration certificate serves as prima facie document of right ownership.