

2021-08

Development of a mobile application system for raha beverages company limited management communication at different levels

Daudi, Ngollo

NM-AIST

<https://doi.org/10.58694/20.500.12479/1343>

Provided with love from The Nelson Mandela African Institution of Science and Technology

**DEVELOPMENT OF A MOBILE APPLICATION SYSTEM FOR RAHA
BEVERAGES COMPANY LIMITED MANAGEMENT COMMUNICATION AT
DIFFERENT LEVELS**

Ngollo Daudi

**A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Embedded and Mobile Systems of the Nelson Mandela African
Institution of Science and Technology**

Arusha, Tanzania

August, 2021

ABSTRACT

The existing forms of communication at Raha Beverages Company Ltd are not effective enough hence bringing about the demand for an effective communication system in the company. The Raha Application is a system that supports internal communication across all levels of the company. As the company expands through the means of strategic planning in a certain time frame, these transitions bring about change in the company structure as well as processes ranging from production, transportation, the workforce to communication which runs in parallel. Forms and methods of data collection described involved were interviews, observations, document analysis, joint application design, brainstorming and prototyping. Interview and observation were the main used forms. This system was implemented using agile software development, which defines software development from program specification, design, implementation, and testing which are interleaved that support frequent delivery of new versions for evaluation. The mobile application is designed for internal communications at different levels among employees. Each employee will have to be given initial login credentials to enable first-time login but will be recommended to change the credentials once logged in according to their preferences. The mobile application system developed was tested and evaluated to assess its usability for effective communication. The system provided benefits like better management control, better decision making, improved efficiency in communication, a faster way of reporting, easy access and availability of information. Therefore, this study presents a mobile application system solution that will support sustainability in communication throughout the entire company for effective company communication.

DECLARATION

I, Ngollo Daudi do hereby declare to the senate of the Nelson Mandela African Institution of Science and Technology that this project report is my original work and that it has neither been submitted nor being currently submitted for degree award in any other institution.



Ngollo Daudi

Name and signature of the candidate

06/08/2021

Date

The above declaration is confirmed

Dr. Anael Sam

Name and signature of the supervisor

Date



Dr. Devotha Nyambo

Name and signature of the supervisor

07/08/2021

Date

COPYRIGHT

This project report is copyright material protected under the Berne Convention, the Copyright Act of 1999 and other international and national enactments, in that behalf, on intellectual property. It must not be reproduced by any means, in full or in part, except for short extracts in fair dealing; for researcher private study, critical scholarly review or discourse with an acknowledgement, without the written permission of the office of Deputy Vice Chancellor for Academic, Research and Innovation on behalf of both the author and Nelson Mandela African Institution of Science and Technology (NM-AIST).

CERTIFICATION

The undersigned certify that, they have read and hereby recommend for acceptance by the Nelson Mandela African Institution of Science and Technology a dissertation titled “*Development of a Mobile Application System for Raha Beverages Company Limited Management Communication at Different Levels*” in partial fulfillment of the requirements for the degree of Masters of Science in Embedded and Mobile Systems of the Nelson Mandela African Institution of Science and Technology.

Dr Anael Sam

Name and signature of the supervisor

Date

Shah

Dr Devotha Nyambo

Name and signature of the supervisor

07/08/2021

Date _____

ACKNOWLEDGEMENTS

Before anything else, I am grateful to God the Almighty, who enabled me to be part of the master's program at Nelson Mandela African Institution of Science and Technology (NM-AIST). More so, I thank Him for granting me health, determination, and strength during my studies which is the motive for this greatest attainment of mine.

I would like to acknowledge and thank the continued support from my mother, Miriam Lameck Masunga for financing my years of study and project work because it hasn't been easy as a private candidate.

Special credit to my immediate project supervisors, Dr Anael Sam and Dr Devotha Nyambo for their continued guidance and support throughout the industrial outreach and internship project, as well as for offering guidance in the right direction.

In special way, I would also like to acknowledge Raha Beverages Company (RABEC) for their support and acceptance in conducting my entire industrial project at their company. My industrial supervisors Eng. Nicholous Proches, and Mr Mohammed Mfinanga; I am greatly and gratefully beholden to them for their important and constructive support on this project while in the industry.

I am incessantly grateful to one and all who have accorded to my studies while at NM-AIST not limited to my lecturers, classmates, friends, and colleagues. You have all played a remarkable role because of your social, concerted and caring character during my studies and residence while at NMA-IST.

Ultimately, I would like to convey my tribute to the family of Eng. Mayunga Makanyaga, my grandmother Lucy Masunga and my relatives for conferring me with constant support, prayers and unceasing incitement throughout my entire years of studies.

Thank you.

DEDICATION

To you my cherished late father Mr Daud Yohana Ng'ollo, I dedicate my project work.

TABLE OF CONTENTS

ABSTRACT.....	i
DECLARATION	ii
COPYRIGHT.....	iii
CERTIFICATION	iv
ACKNOWLEDGEMENTS	v
DEDICATION	vi
TABLE OF CONTENTS.....	vii
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS AND SYMBOLS	xii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background of the problem.....	1
1.2 Statement of the Problem	2
1.3 Rationale of the Study	3
1.4 Research Objectives	3
1.5 Research Questions	3
1.6 Significance of the study	4
1.7 Delineation of the study	4
CHAPTER TWO	5
LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Why mobile application development?.....	6
2.3 Business communication and promotion using a mobile application	7
2.4 Mobile application in comparison to mobile web	7
2.5 Businesses using a mobile application	7
2.6 Our lives today and future with mobile applications	8
2.7 Related works.....	9
CHAPTER THREE	10
MATERIALS AND METHODS.....	10
3.1 Data collection methods	10

3.2	Requirements Analysis.....	11
3.3	Architectural Design	13
3.4	Development and Implementation of the proposed mobile application	23
3.5	Requirements for the developed mobile and web applications.....	27
CHAPTER FOUR.....		28
RESULTS AND DISCUSSIONS		28
4.1	Case Study Area’s Results and Discussion	28
4.2	Results and discussions for the developed applications.....	32
4.3	Validation	39
CHAPTER FIVE		44
CONCLUSION AND RECOMMENDATIONS		44
5.1	Conclusion.....	44
5.2	Recommendations	45
REFERENCES		46
APPENDICES		i

LIST OF TABLES

Table 1:	Functional Requirements	11
Table 2:	Non-functional Requirements.....	13
Table 3:	Use case requirement description	18
Table 4:	System testing results for both web-based and mobile application	40
Table 5:	Operational user acceptance test for the system	42
Table 6:	User acceptance testing results for the mobile application.....	42
Table 7:	Web application testing results	43

LIST OF FIGURES

Figure 1:	General conceptual framework	14
Figure 2:	Block diagram Raha Management Communication at different levels	15
Figure 3:	Application flow chart diagram.....	16
Figure 4:	Application Use Case diagram	17
Figure 5:	Application Context diagram	19
Figure 6:	Application Data Flow Diagram level 1.....	20
Figure 7:	Shows an Entity Relationship Diagram.....	21
Figure 8:	Structural representation of the database.....	22
Figure 9:	Android development: Activity Life Cycle.....	23
Figure 10:	Scrum sprint cycle	24
Figure 11:	Shows the android studio editor layout	26
Figure 12:	The demographic information of respondents.....	28
Figure 13:	Correspondents' age ranges	29
Figure 14:	Correspondents' educational status.....	29
Figure 15:	Communication platforms used in the company	30
Figure 16:	Correspondents' recommendations and suggestions	31
Figure 17:	Smartphone ownership.....	31
Figure 18:	Mobile app usage.....	32
Figure 19:	User login interface for mobile application.....	33
Figure 20:	Home interface of the application	34

Figure 21: Display of the navigation drawer	35
Figure 22: Login page for the administrator	36
Figure 23: Home page of the web application	36
Figure 24: Events upload web page	37
Figure 25: Shows a web page for updating announcements.....	38
Figure 26: User registration web page	38

LIST OF ABBREVIATIONS AND SYMBOLS

API	Application Programming Interface
App	Application
Co	Company
DFD	Data Flow Diagram
GB	Gigabyte
GPS	Global Positioning System
ICT	Information and Communication Technology
IT	Information Technology
iOS	iPhone Operating System
JDK	Java Development Kit
JRE	Java Runtime Environment
Ltd	Limited
OSs	Operating Systems
PHP	Hypertext Preprocessor
RABEC	Raha Beverages Company
RAM	Random Access Memory
SAP	Systems Applications and Products
SDK	Software Development Kit
UIs	User Interfaces

XML Extensible Markup Language

CHAPTER ONE

INTRODUCTION

1.1 Background of the problem

Raha Beverages Company Limited, which was formerly known as Banana Investments Limited was a home-grown venture travelling back to the early year 1990, being a backyard maker of wine which is extracted from banana fruits. Whereas the originality of the idea was to make wine for household consumption purposes; it obtained its favour hence thriving from a homemade wine to vastly undertaken varieties of banana alcoholic beverages made in a more classified and an accepted process to a national level. The company was first registered formally in the year 1993, bearing the name of Arusha Agricultural Products Enterprises, and recruiting only around 13 members. In the year 1996, the company was embodied as Banana Investments Limited and began manufacturing and distributing banana alcoholic beverages across the country (Blackburn & Brush, 2009; Belohlavek, 2015).

Raha Beverages Company (RABEC) is an outcome of the re-branding of Banana Investments Limited, whereby the name was adopted effectively from the date 31st December 2019.

The main reason for the re-branding and name replacement is to have a company name reflecting company activities ranging from the production and distribution of beverages.

Since the company's inception in the year 1996, several producers manufacturing similar products have transpired. However, the enterprise stands as the prime producer and distributor of banana alcoholic beverages in Tanzania. The main brands produced by the company include Raha Gold, Raha Poa, Raha, and Raha Pet. Currently, these products are popular in fourteen regions namely; Tanga, Kilimanjaro, Arusha, Dar-es-Salaam, Coastal region, Manyara, Simiyu, Singida, Shinyanga, Dodoma, Geita, Mwanza, Mtwara and Mara.

Throughout the company's journey of progress from a family-owned business venture, the company has moved to a more organized and nationally recognized business venture. Raha Beverages Company Limited adopted its five-year of strategic plans in the year beginning 2008.

This means that its first strategic plan was developed and implemented from the year 2008 to 2012, which aimed at reorganizing the business formation of the company from a family owned business to match public companies to increase productivity, while the second strategic plan was developed and implemented between the year 2013 and 2017, enhancing the quality of its product, expanding the production line, and inducing new varieties as well as new products. This plan also focused in stretching product markets both locally and abroad, mostly in the Eastern, and Central African countries, intending to maximize revenue and profitability. Currently, the company is developing as well as implementing concurrently its third strategic plan that covers the period of 2018 and 2022 (Mujtaba, 2007).

Therefore, as the company is expanding, there is also a need to have an effective communication system that facilitates internal cross-sectional processes among different departments for effective communication. The mobile application developed consists of a common user friendly interface that cuts across and usable by all employees. The App's features include; a home interface, a navigation drawer, and it also allows the user to log in and out for security purposes and prevent unauthorized access to the company's information.

1.2 Statement of the Problem

The existence of cybercrimes and breach of information in most generic software has become rampant hence bringing about infringement of the privacy policies in companies. Most of these softwares are owned by organizations that are a major target to hackers. So adoption by many companies towards developing their own application systems reduces the exposure to these attacks. The current methods of communication used at Raha Beverages Company Ltd include emails, WhatsApp, notice-board, the workforce system, Systems Applications and Products which is an enterprise resource planning software product that includes important business functions. These are outsourced and sometimes the company may need to re-develop or carry out modifications thus, limiting the possibility to evolve the software. At times, the company may incur very high costs to maintain the software. Another concern is that sometimes the company needs to adjust according to its own standards and policies of communication, which may be difficult to customize the outsourced software applications. So, there is a driving need to have a company-owned product, which can be adjusted according to the company's specifications. Therefore, in this study the RABEC application system was proposed to have an internal integrated mobile application system effective for

communication and address the challenges of security, and cut down the high costs of outsourcing the software applications.

1.3 Rationale of the Study

The technologies of mobile applications have revolutionized methods of communication and control of processes, such as social media mobile applications which include; Facebook, WhatsApp, Twitter, Instagram, WeChat, Snapchat, among many existing applications (PDF) Mobile Application and Its Global Impact, n.d. However, most of these applications like emails, WhatsApp, telegram, have been widely adopted by many companies for their internal communication processes, and this creates doubt of privacy and breach of security in case of a cyber-crime hence exposing private information of many companies. The Raha management communication mobile application is proposed to solve the company's challenge in internal communication. It is an application that cuts across all levels of employees from top-level management to bottom level.

1.4 Research Objectives

The project aimed to develop a mobile Application system convenient for communication, which is supportive, user friendly and easy to manage through the following main and specific objectives defined below.

2.7.2 Main Objective

To develop a mobile application for RABEC internal communication.

2.7.2 Specific Objectives

- (i) To analyze the requirements for developing the RABEC internal communication.
- (ii) To develop a mobile application for RABEC internal communication.
- (iii) To validate the developed mobile application.

1.5 Research Questions

- (i) What are the functional and non-functional requirements for RABEC communication platform?

- (ii) What tools and supporting software will be used to develop a supportive and user-friendly mobile application?
- (iii) Will the developed mobile application be valid and useful for RABEC?

1.6 Significance of the study

The project is significant because it facilitates one of the most important processes in the company which is communication. The information is secured since it is transferred internally within the system and there is no integration with other external communication systems hence privacy.

1.7 Delineation of the study

In this study, it is assumed that all employees of RABEC have smartphones with the ability to download and install the mobile application. There is a need for improving the forms of communication, for effective results which increases production and motivates employees to put in more effort.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Throughout the continuous years in relation to the environmental impacts, the main focus of user interaction with computers has shifted relentlessly from desktops to laptops, to tablets and smartphones, which will transition onto to wearable devices such as smart watches, smart shoes, and smart clothing. similarly, the pressure becomes more and more intense on software development teams to 'mobilize' existing customer-facing and internal applications and to implement and develop brand-new mobile-first apps and services (Hischier & Wäger, 2014).

As the mobile market having being shared by several existing platforms/OS till the previous few years back, it was difficult for mobile app developers and companies to bring to existence mobile applications for all platforms. It needed a widely varied set of skills to develop, implement and maintain the mobile applications for each of the mobile platforms hence presenting cost and time-to-market challenges (Vohra, 2017). The substitute means and methods included creating the hybrid apps (which are web-based applications bundled up in native mobile app containers). Hybrid apps had several limitations and were inadequate in terms of speed, performance, user engagement and effective utilization of hardware device capabilities (Vohra, 2017).

Currently, our lives are mainly based around mobile applications (Jayatilleke *et al.*, 2018). Whether we wake up in the morning or do a quick contemplation or traverse the route to our daily activities, the apps have played a major playback. Mobile apps have made everything just a click away. And that is one of the main reasons for the prospering app business. In today's age of ICT system, many people are accustomed to using computers and computer applications. With mobile app uses and development being a rapid and newly growing sector, there exists a global positive influence of mobile application. The use of mobile applications is making developed countries facilitative as people and society of developing countries upgrade themselves, making a new kind of technological infrastructure. Mobile applications usually run on small handheld mobile devices which are movable and ubiquitous. In a single day, there is a numerous number of people who use mobile applications to contact friends,

browse through the internet, perform file content management activities, document creation and handling, as well as entertainment (Islam & Mazumder, 2010). A study on mobile application for ease of communication for a construction site management showed the benefit of effective communication throughout the project, which increased efficiency through improved speedy delivery of data, between the manager, the field office staff, and the mobile users (Kamaraj, 2019). A study based on the mobile application in the construction industry showed the results led to improved efficiency in contract and project management, better control of project, improved project operation coordination, better decision-making processes, a faster reporting, availability of adequate information for project participants, improvement in communication, enhanced storage of the project information in a single location, and finally improvement in contractual relationships (Kamaraj, 2019).

Since the early year of 1990, the company being a backyard producer of winery making from banana fruits, there were no existing mobile applications at the time and no smartphones were available. Therefore, the company adopted the existing possible communication means at that time. As the company moved to a more organized and nationally recognized business venture, intending to reorganize the business formation of the company from a family-owned business to match public companies to increase productivity, there was the need to have a company-owned mobile communication platform that could support communication within the company. Therefore, the Raha Mobile application idea came in to enhance and support the aim of the company and to enable the mobility of communication.

2.2 Why mobile application development?

The mobile app development field has been increasing very greatly at a fast rate, with a drastic rise on number of apps in different mobile smartphones and tablets (Baktha, 2017). This has been possible due to the increase in the production of smartphones with a far cheaper price that everyone can afford according to their specifications, preferences and uses. Therefore a single smartphone can support numerous mobile applications that are downloaded and installed to support a specific functionality within the phone by the users (Islam & Mazumder, 2010).

Android and iOS mobile application development is a good option for a software engineering project that introduces the essential basics of development of process activities that include designing, implementing, and testing (Grgurina *et al.*, 2011). The android mobile application

is relatively simple and one can easily grasp the fundamental development concepts, resources and techniques within a short time to produce whole new and innovative mobile applications that create a wide interest in the market (Grgurina *et al.*, 2011).

2.3 Business communication and promotion using a mobile application

As a result of the existence of mobile applications like Twitter, Gmail, Telegram, Messenger, Google Talk, Skype, Facebook, these have become essential and helpful to society as people use them for communication purposes with each other. People also can get in touch with one another despite the geographical distance and location. Therefore, the social relation is improved and made stronger which is good for families, friends and societies (Islam & Mazumder, 2010; Brunette *et al.*, 2015).

2.4 Mobile application in comparison to mobile web

During the time when mobile phones first came out, the only available function was calling. Currently, they have surpassed even personal computers. With a range of functionalities thus, shopping, browsing, checking e-mails, and finding your way through Google maps. All this is done on the smartphone with supportive native mobile applications (Jobe, 2013).

Smartphone users can choose either to open the browser to have access to information via mobile websites or launch the mobile app. Each of these mobile tools has its advantages. The mobile apps have to be downloaded while the accessibility of mobile sites are on every device, which enables users to interact with their devices while on move (Harrison *et al.*, 2013; Gazzawe, 2017). Along with the download comes the issue of extra storage space on your smartphone. On the other hand, the user is entitled to only one click to open the mobile app, whereas navigating through a certain mobile website, one has to open a browser, search content and clicks enter (Gazzawe, 2017). Another benefit of using a mobile application is the availability to use while offline and have access to more features on the mobile phone (like GPS, camera, images to mention a few), (Gazzawe, 2017).

2.5 Businesses using a mobile application

Many companies continue investing in developing applications, mainly for marketing as well as information communication reasons, including a closer connection with customers and staff, understanding of consumers and staff, increased loyalty and, sometimes, more efficient

promotion for new services or products (Pinzaru & Zbucnea, 2017). Nowadays, mobile apps have made it possible to work out of the office area, through virtual meetings; online conferences and these have reduced costs incurred in meetings, but rather increase profits and productivity. Hence, e-commerce has proved more successful with mobile applications making life easy for customers to purchase products anywhere around the globe (Islam & Mazumder, 2010).

2.6 Our lives today and future with mobile applications

Different mobile applications have brought about a tremendous change in the way we live, interact as well as conduct our schedules of activities. Today, mobile applications have been accepted and span a wide area of our wellbeing which includes lifestyle, health, military, public institutions, education institutions, and businesses. In education, mobile apps have made it possible to conduct classes, seminars and conferences which improve the education system. In health, there are several mobile applications available that help to track our daily exercises, diet, stress levels, blood pressure, heart rates, and weight. These have brought about a change in the health sector (Sarwar & Soomro, 2013).

In the future, our treatment and health will be facilitated by mobile applications to facilitate prescriptions by doctors, offer options for treatment, monitor patient health daily, as well as patients obtaining first-hand information in general (Sarwar & Soomro, 2013).

People with special needs and elderly have been able to live independently since most mobile applications developed have the capabilities to support their needs. For instance, recognizing speech from blind people, send messages, translate different languages offer locations services, image recognitions which eases interactions with the society (Sarwar & Soomro, 2013).

According to the society ethical point of view, mobile apps have made people feel each other's presence no matter the geographical distance, a factor that makes families, friends and societies strengthen their relationships and unity (Islam & Mazumder, 2010).

2.7 Related works

2.7.1 Slack

This software offers a strong and comprehensible multipurpose chat tool for businesses. It enables instant messaging of one to one as well as group chat. It also supports audio calls and video conferencing calls together with instant messaging (Lomas *et al.*, 2008). Alongside the free version which is limited in features, slack comes with a paid version which has more features included. This has limits to the company preferences because the proposed application system comes with free charges and outsourcing this software come along with trust issues of data, as well as the software is too generic to fit the company specifications of the proposed features for development.

2.7.2 Collaboration Aligned Flowdock

This is a communication software system that includes chat and inbox platform to let teams collaborate maintain accessibility of communication in a unified place. It also offers one to one private chat as well as group chat (Lopes *et al.*, 2015; Corpuz, 2016). This software also offers customer support which brings us to proposed software system which is meant for strictly internal company communications without involving the outside. However, the flowdock lacks important features like announcements feature, events feature, company structure feature which are most vital to the application hence not customized to suit the specific company preferences making it too generic.

2.7.3 Discord

This software chat tool is specifically designed to support voice communication for businesses. It is designed to help workers communicate over voice rather than messaging (Geerts, 2006). However, the proposed mobile application comes in with more features allowing message chat compared to this software. Therefore, discord has limited features which do not suit the company communications specifications and preferences.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Data collection methods

During the industrial outreach and internship, data was collected in the period of four weeks from August to September in 2020. The techniques used in this study were interviews, observations, document analysis, joint application design, brainstorming and prototyping as described below:

3.1.1 Interviews

Organized interviews with guide questions were used involving RABEC employees from operations, the human resource office, and the IT office. The main objective idea was to understand and perceive the history of the company, their forms of communication used within, and the trend of the technology used within the company to conduct its activities.

3.1.2 Observations

This was performed throughout the entire study, to discern how the information is being circulated within the company, how an employee can get access to information, how fast can the information reach the individual and how the information was stored.

3.1.3 Document Analysis

This involved reviewing documents to interpret content. The aim was to further understand their information communication.

3.1.4 Joint Application Design

This involved several employees within the IT department, head of IT office, operations manager, and some staff with the aim to get actual input of the design and functionality of the application.

3.1.5 Brainstorming

This involved sharing of ideas with the effort to come up with the specific designs and requirements for the application.

3.1.6 Prototyping

Here, processes and concepts were designed to show how the actual application looked like, from the proposed ideas.

3.2 Requirements Analysis

This involves defining the user needs first, and then development of a new or modifying a product follows. Therefore, in this study detailed user requirements were gathered to formulate the Functional and Non-functional requirements which have been described.

3.2.1 Functional Requirements

Functional requirements are expressions of the services that the system provides, how the system reacts to certain inputs given and how the system behaves in particular situations such as allow user log in, add user, and delete content.

Table 1: Functional Requirements

Requirement	Description
Register employee, include departments, include directory, add notice, add events	The System Administrator will be responsible to register staff, departments, upload notice, uploading events, and upload directory into the application.
Login (Mobile Application)	The employee given access to enter the application using the email address and password provided.
View notice	Employees will be able to view announcements made within the company.
View events	Employees will be able to view upcoming events involved in the company.

Write, edit, share, delete notes	Each employee will have access to their diaries where they can write down minutes and personal information.
View directory	The employee will be able to view the company directory which contains office telephone extensions.
View department	Each employee that belongs to a specific department will be able to view different activities involved in their respective departments.
View structure	Employees will be able to view the organizational structure of the company and be able to learn how well the company is organized.
Send messages	The employee will be able to send messages to each other within the application.
Create to-do list	Employees will be able to create their series of activities to do in the company and the application will be able to track every activity.

3.2.2 Non-functional requirements

Non-functional requirement involves constraints on the functions offered by the system.

Table 2: Non-functional Requirements

Requirements	Description
Usability	The system is simple and easy to learn.
Performance	The system's response to user interaction is fast. Response to login and logout activity responds quickly.
Security and safety	The user's login credentials are secure.

3.3 Architectural Design

The entire section explores the detailed design of the proposed solution which furthermore presents the conceptual framework of the system, block diagram, flow chart diagram, use case diagram, data flow diagrams, Entity Relationship diagram, and activity life cycle diagram.

3.3.1 Conceptual Design

This presents the details of the structure and components of the system. It gives the overall picture of the required final product. Here, organized and strong ideas in this conceptual structure can simplify the general process of coming up with real applications. Therefore, on the basis of the study findings, observations were made to have the need of integrating two systems which are web-based and mobile-based applications to support internal company communication.

(i) Mobile Application

The mobile app is designed specifically to facilitate communication within the company. It enables users to create content, share content, send messages, receive announcements and notify on the series of events that are yet to take place in the company.

(ii) Web-based System

This is designed to be used by the system administrator who has access to all functionalities. The administrator has been granted privileges to add users and create user login credentials in the web-based application, as well as add content that needs to be displayed in the mobile application. Figure 1 is an illustration of an overall conceptual framework showing how users receive information from the central database to their mobile applications and how the administrator enables a content web-based system.

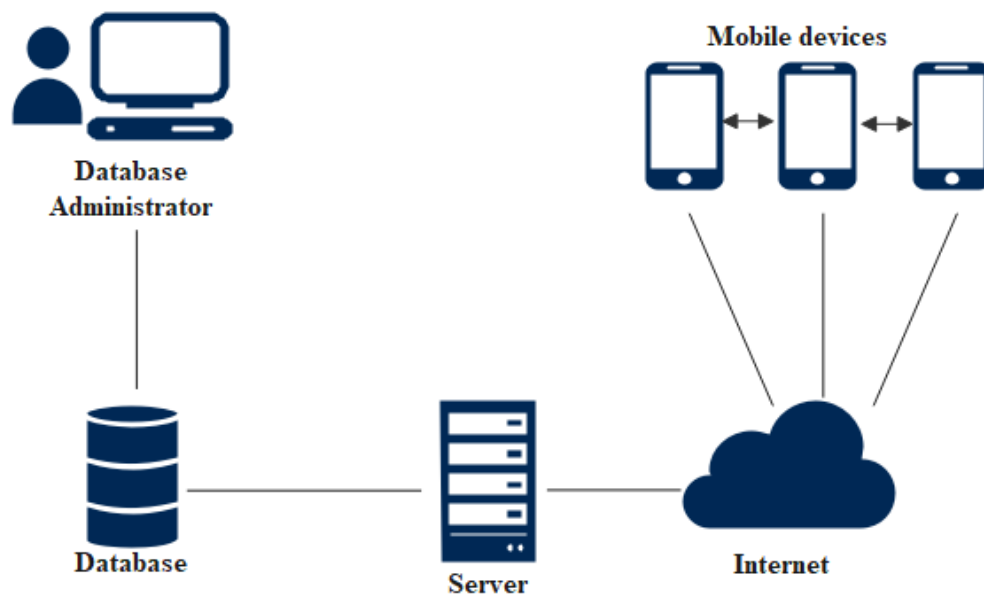


Figure 1: General conceptual framework

3.3.2 Database design

This is an aggregate of data that is categorized so that it can be easily accessed, managed and updated. The application comprises two databases:

(i) SQLite database

This is a lightweight database that stores light data on the mobile phone, which can easily be accessed offline when the user is not connected to the internet. The content to be stored includes; upcoming events details, notice content, contents in my notes and directory content. This database later updates its content from the server once the user is connected to the internet.

(ii) Remote Database

This is a database that uses an application to provide services to the mobile application. This stores all the information availed in the application which includes; user name, passwords, profile pictures, notes content, notice content, among many. It stores its contents in the cloud which involves a vast amount of data stores and can be accessed once the user is connected to the internet.

3.3.3 Framework (block diagram)

Figure 2 below shows the summary of how the user interacts with the application at the front end of UI, whereby the user has to be validated through the input of username and password to log in. Then a display of the content of the main interface is displayed to allow user navigation across different widgets of the application. In the session of user log out, a menu of the navigation drawer is clicked and a log out option at the bottom is clicked, hence allowing the user to successfully log out.

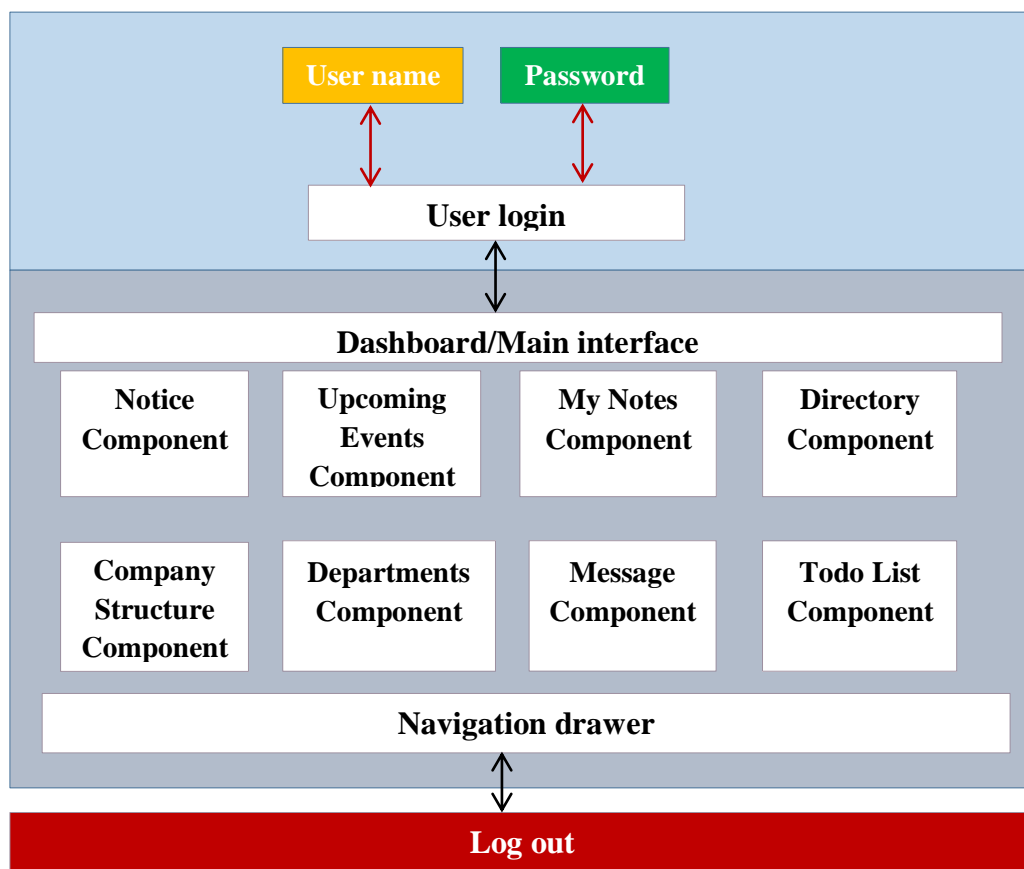


Figure 2: Block diagram Raha Management Communication at different levels

3.3.4 Application Flowchart

Figure 3 below shows a step-by-step process of how a user navigates through the mobile application. The flow chart is presented in a simple way for a user to get the concept flow easily. This workflow or process reveals the interconnection between actions that the system performs.

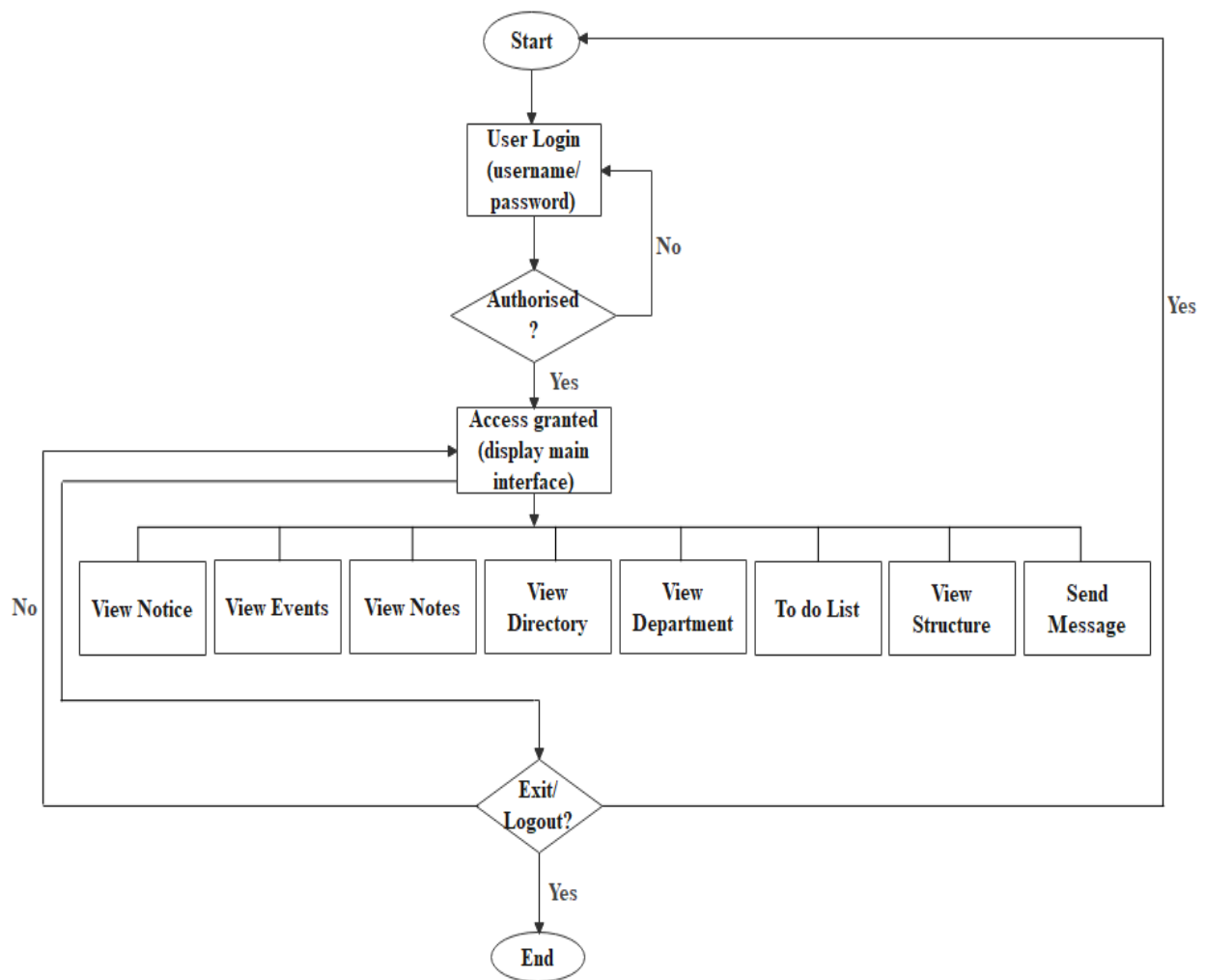


Figure 3: Application flow chart diagram

3.3.5 Use case diagram

This is a Unified Modeling Language (UML) diagram that represents interconnections between the system and the user to achieve the preferred goal. The use case draws the actions that the user can perform within the system. Figure 4 explains the actions performed by the actors.

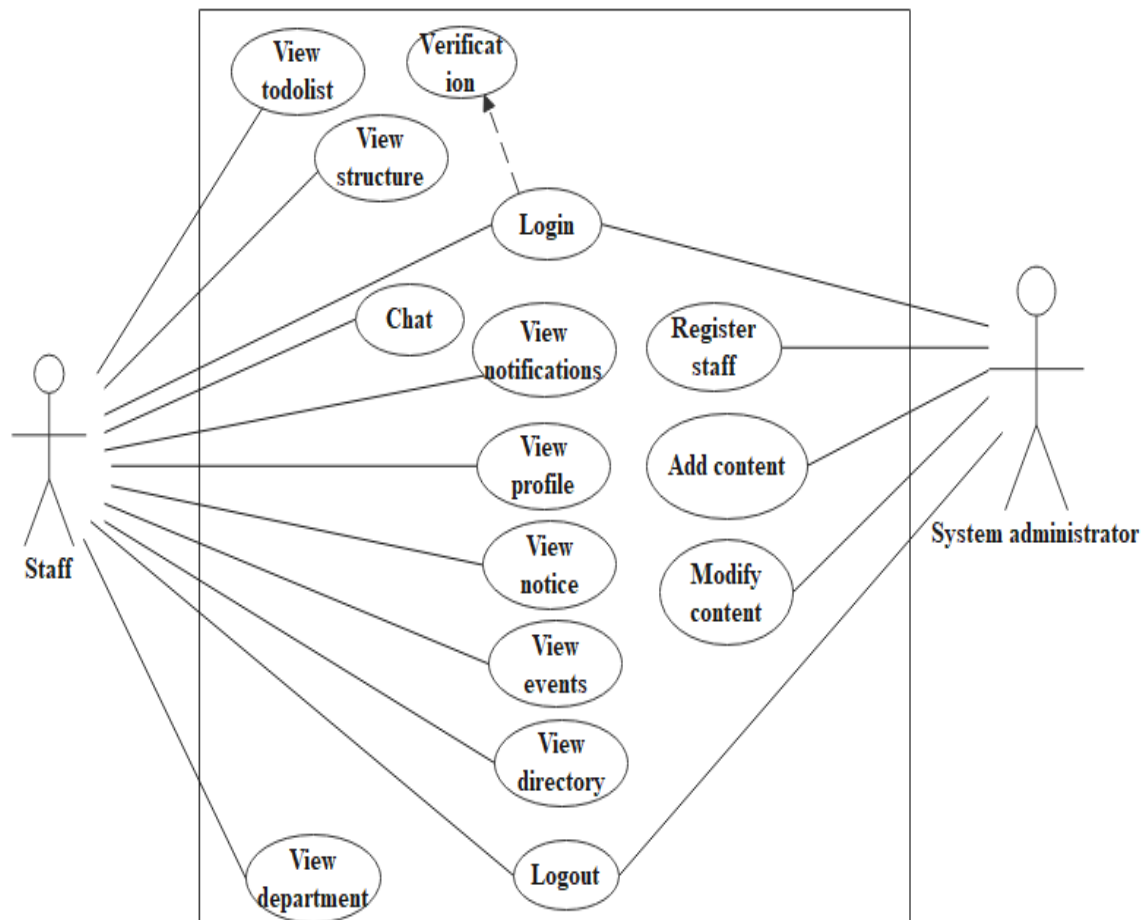


Figure 4: Application Use Case diagram

The actors of the suggested application system are the system administrator and staff. The use cases are login, view notifications, view notice, view events, view directory, chat, view department, view structure, view to-do list, register staff, add content, modify content, view directory, view profile, and log out.

Table 3: Use case requirement description

Use case	Description
Log in	The system admin should be able to log in to the system. And staff should be able to log in after being registered.
Register staff	The administrator should be able to register staff and provide their login credentials.
Add content	The system admin should be able to add information to the system.
Modify content	The administrator should be able to add, edit and delete information in the system.
View notice	The staff should be able to view announcements made within the application.
View events	Staff should be able to see the list of events that are yet to happen in the company within the system.
View directory	The staff should be able to see office telephone extensions in the application.
View department	Staff members should be able to view their specific departments and associated events.
View structure	Staff should be able to see the organizational structure of the company.
Chat	The staff should be able to send messages to each other through the application.
View to do list	The staff should be able to create their series of activities which can be daily, weekly or monthly and that users can weigh themselves according to the accomplished tasks.
View notifications	Staff should be able to view and get any necessary notifications that are related to the application.
View profile	Each staff should be able to view their

Log out

profiles and edit information where need be.

An administrator should be able to log out of the web-based system and staff should be able to log out of the mobile app as well.

3.3.6 Context diagram (DFD level 0)

This is also referred to as Data Flow Diagram Level 0. It depicts the outline of the proposed application system. It involves a central system that interacts with external entities through the identification of the flow of information. Therefore the diagram is a representation of the high-level view of the system. Figure 5 below reveals the context diagram of the application system.

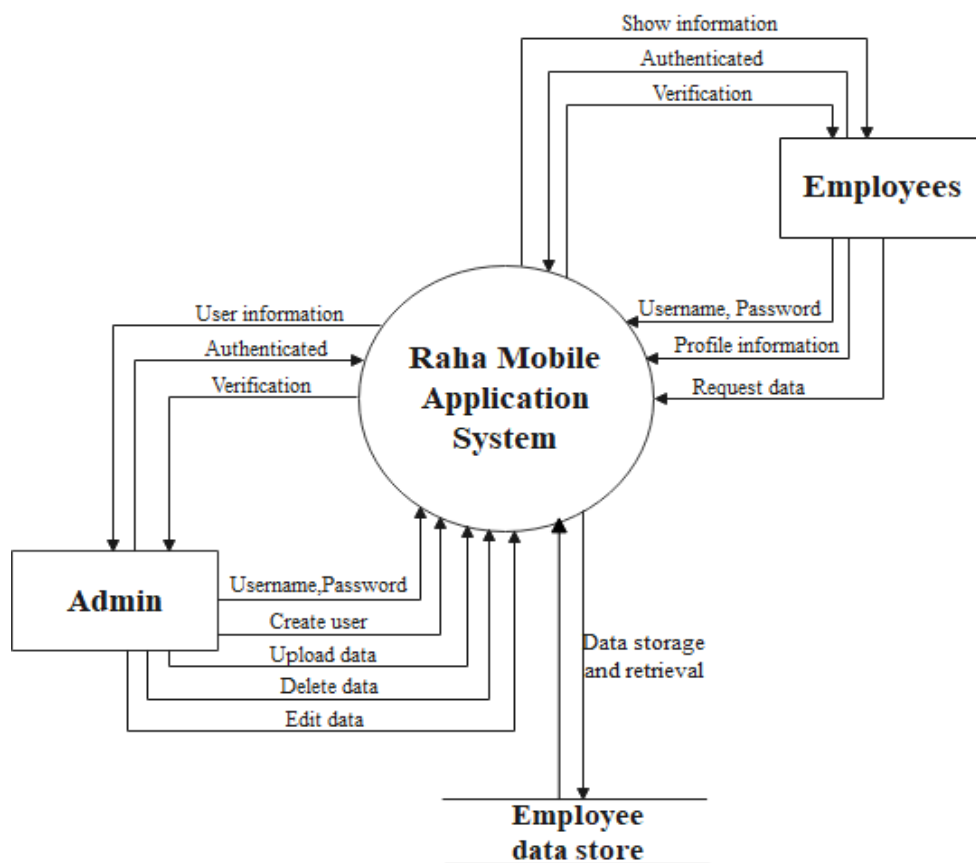


Figure 5: Application Context diagram

3.3.7 Data Flow Diagram Level 1

The Data Flow Diagram Level 1 breaks down a single process defined in the context diagram. This decomposition that occurs brings about the need for data stores and data flows to link them together. Figure 6 below shows the DFD Level 1.

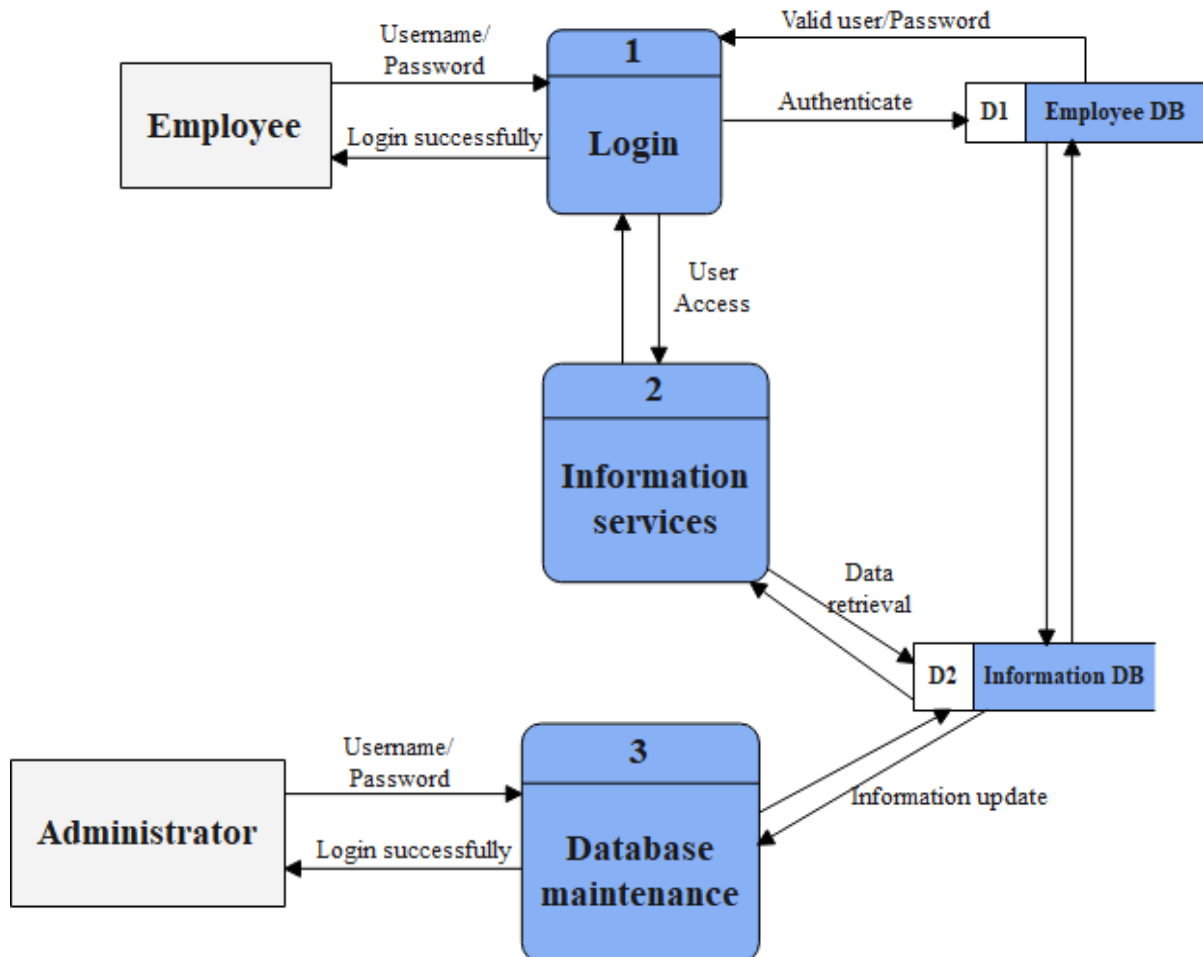


Figure 6: Application Data Flow Diagram level 1

3.3.8 Entity Relationship Diagram

This is a diagram that shows the relational structure to be used in the database design architecture. It gives a graphical representation view of the database system and the inter-relation of data to be stored within the system. This Entity Relation Diagram with its related tables and attributes of the developed application is shown in Fig. 7.

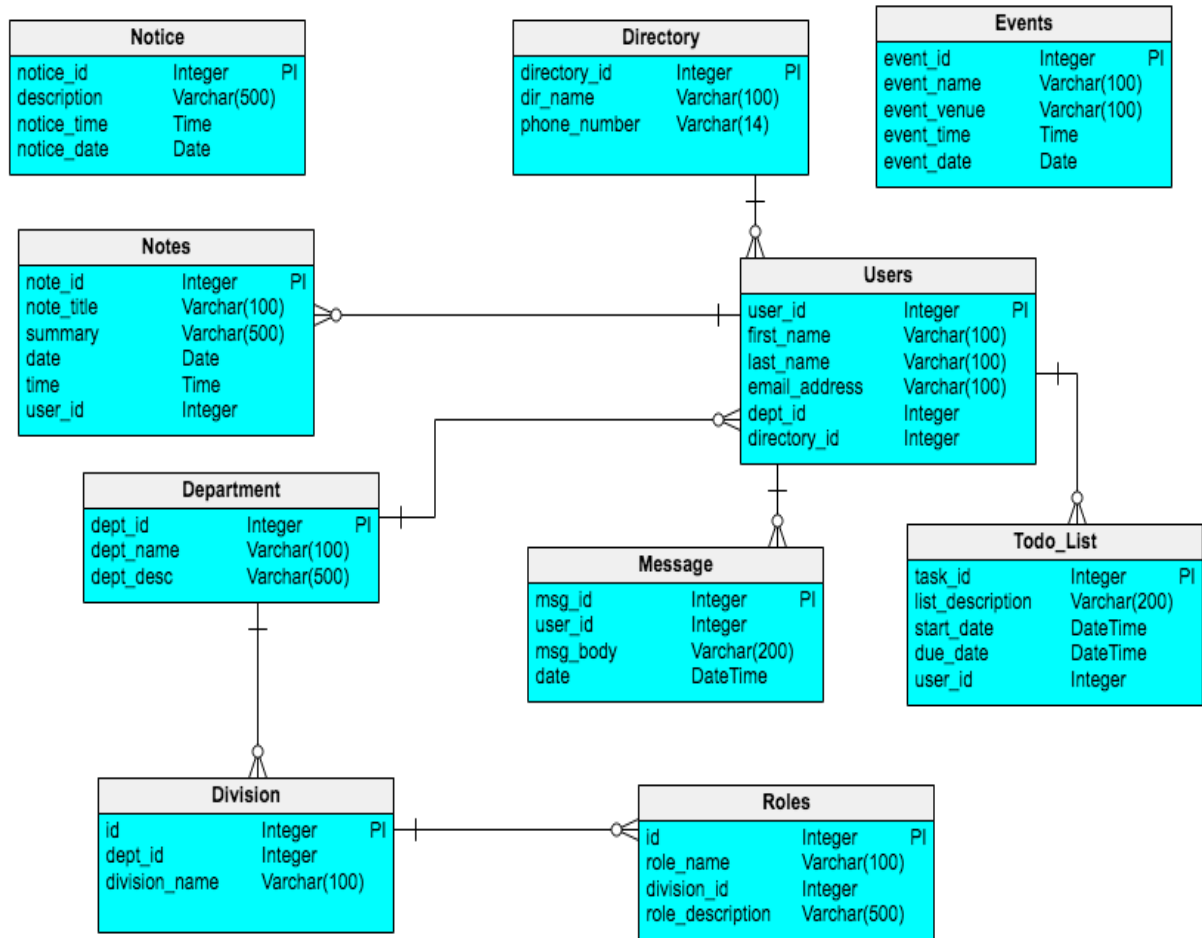


Figure 7: Shows an Entity Relationship Diagram

3.3.9 MySQL database

This is a database that uses an application to provide services to the mobile application. This stores all the information availed in the application which includes; user name, passwords, profile pictures, notes content, notice content, among many. It stores its contents in the cloud which involves a vast amount of data stores and can be accessed once the user is connected to the internet. It contains different table that stores each data according to their categories. Figure 8 shows the structural representation of the database with its related tables.

Table	Action	Rows	Type	Collation	Size	Overhead
<input type="checkbox"/> department		0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> directory		0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> division		0	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> events		0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> message		0	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> notes		0	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> notice		0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> roles		0	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> todoist		0	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> users		0	InnoDB	utf8mb4_general_ci	48.0 KiB	-
10 tables	Sum	0	InnoDB	utf8mb4_general_ci	272.0 KiB	0 B

Figure 8: Structural representation of the database

3.3.10 Activity Life Cycle

This represents a set of states a particular activity follows in its lifetime. The activity depicts a single screen in android. Therefore as the user gets to interact with an application and other applications on the mobile device, the activities move into different states. Figure 9 shows the activity life cycle of the application behaviour on a mobile device.

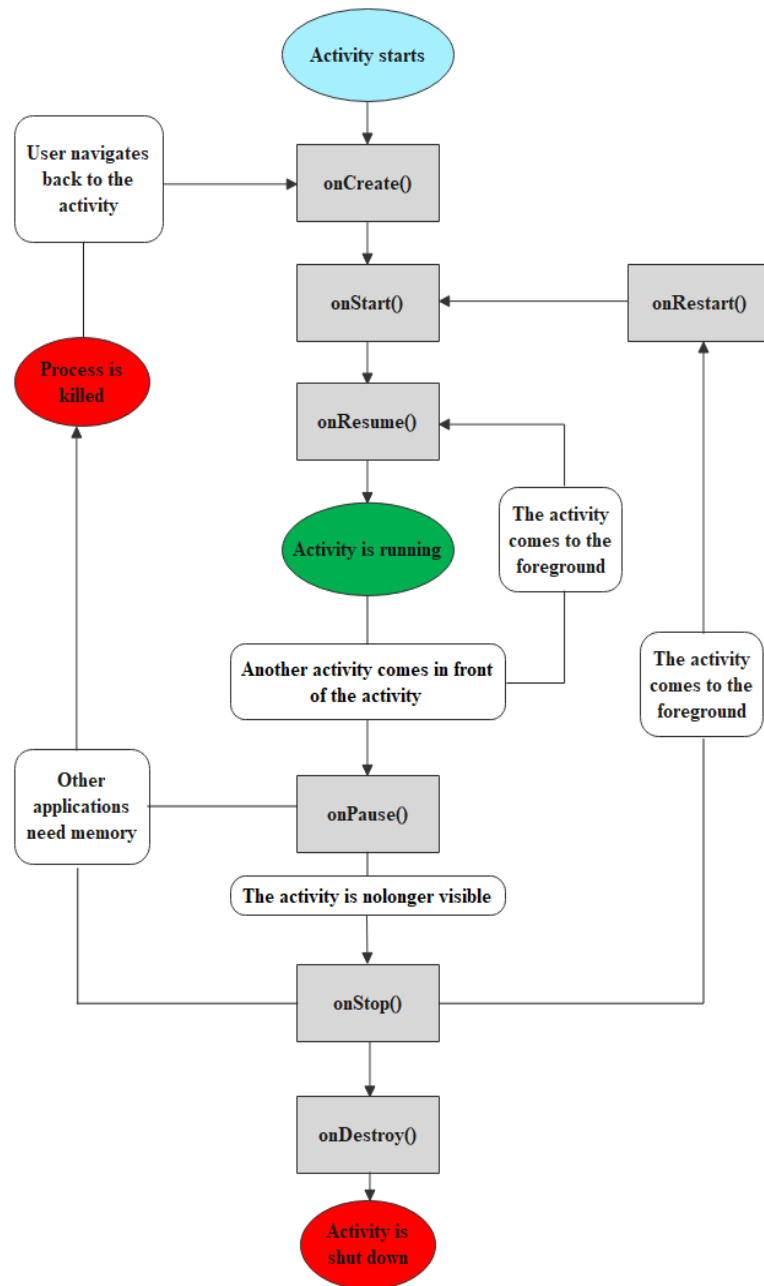


Figure 9: Android development: Activity Life Cycle

3.4 Development and Implementation of the proposed mobile application

The Raha management communication app was developed and implemented by following a series of activities as explained.

3.4.1 Development Approach

This project was implemented using agile software development, which defines software development from program specification, design, implementation, and testing which are interleaved. Agile development involves frequent delivery of new versions for evaluation. It involves various techniques like; Extreme programming, Scrum, among many others but in this proposed project, the technique used is the Scrum technique.

Scrum is an agile method that defines the first phase as a layout planning stage where the general objectives are established for the project and design of the software architecture. Then followed by a progression of development iteration sequence (sprint cycles), where each sequence develops an increment of the system, and the project finishing phase encloses up the project to complete the required documentation. The advantage of choosing scrum when compared to other methods is: (a) Unstable requirements do not hold up the application software development progress, (b) The developed product is disintegrated into a set of feasible and comprehensible chunks, (c) The whole team has transparency of every progress and frequently team communication is improved, (d) Clients see on-time dispatch of increments and get feedback on how the product works, and (e) It creates assurance between customers and developers with a positive value being established whereby everyone expects the project to succeed.

This is all demonstrated in Fig. 10, which defines the scrum development iteration cycle.

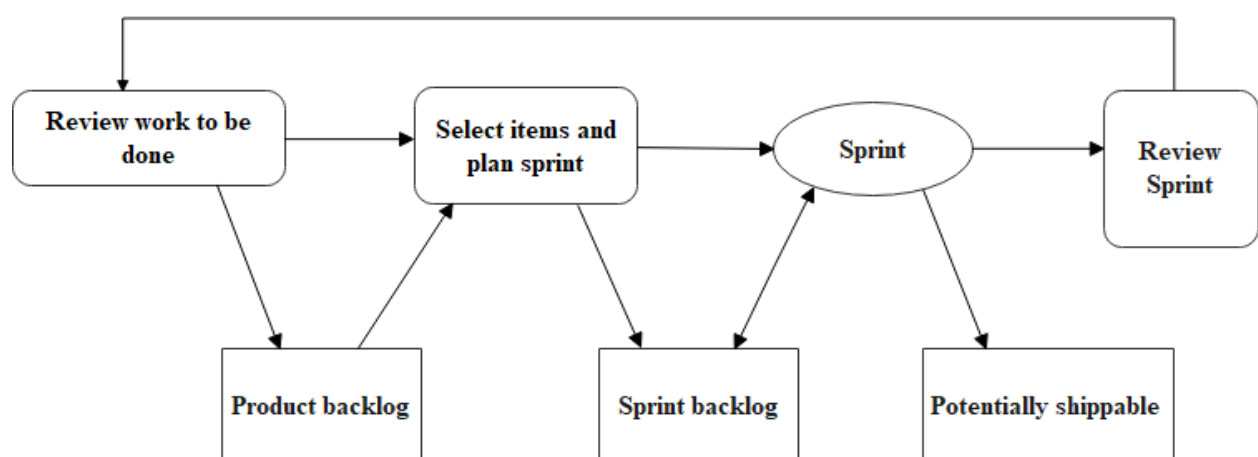


Figure 10: Scrum sprint cycle

3.4.2 Development tools and technologies used

This requires durable hardware and software. The hardware required is a computer with 4GB RAM minimum and 8GB RAM recommended, 2GB of available disk space minimum, a smartphone with at least 2GB RAM with its supporting capabilities for testing and running the code. The software required is a supported operating system such as Windows 8 and 10, Mac OS X 10.10 or higher up to 10.14. The following were the necessary supporting activities and tools that needed to be established.

(i) The Android Development Environment (ADE)

This involves setting up software tools and libraries. The supported environment consists of the following: (a) Android SDK: Contains all android libraries and tools needed for developing Android Apps, (b) Android Studio: Developers editor, give an interface to the android libraries and developing tools, (c) JRE and JDK: Provide java platform tools and libraries needed, and (d) Flutter plugins: This is a development software kit used to develop android, iOS, web, and windows from a single codebase. It uses the dart programming language to build the User Interface (UI). The mobile application development process was implemented through the dart programming language similar to XML and Java programming languages which supports both the UI design thus look and feel of the App, as well as the functionality and advanced UI features.

It is recommended to firstly install JRE and JDK, then Android studio for smooth integration to achieve a complete Integrated Development Environment (IDE), and finally installing flutter plugins. Figure 11 shows the android studio layout editor used for mobile app development.

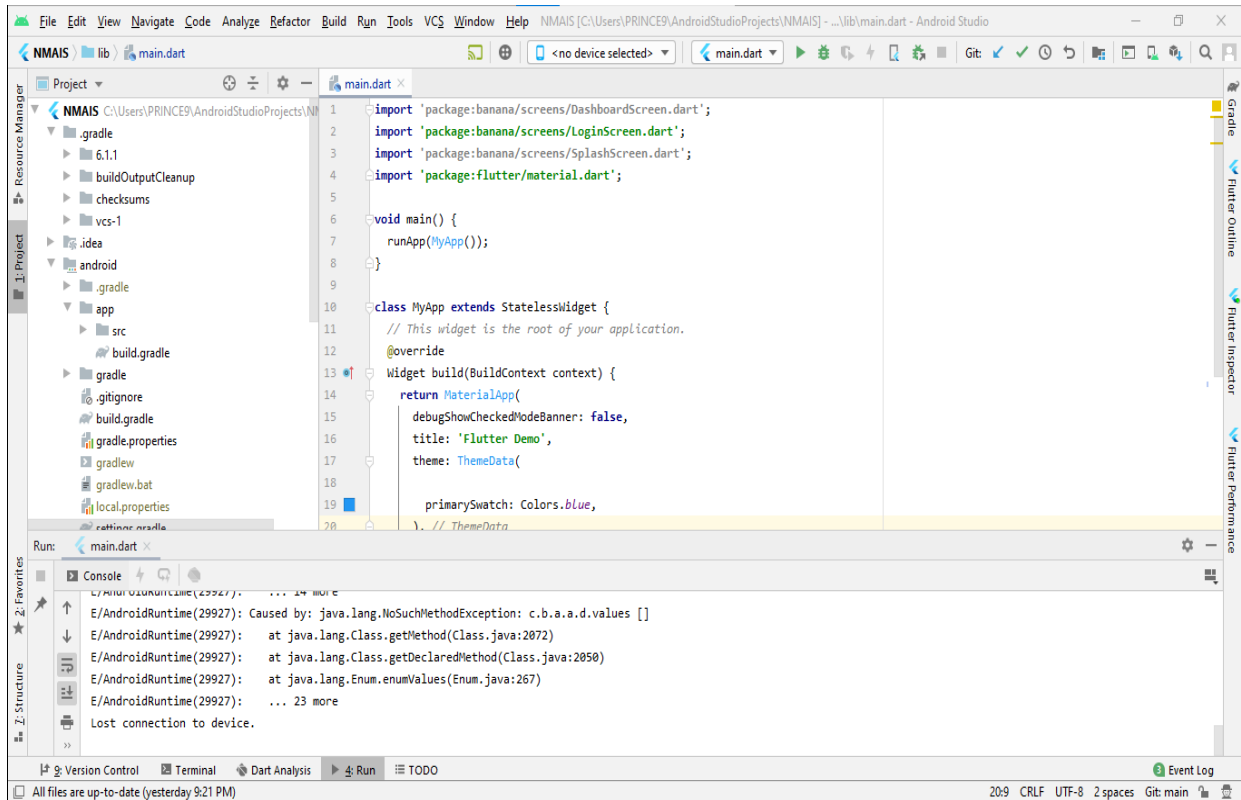


Figure 11: Shows the android studio editor layout

(ii) The Laravel PHP framework

This was used which is a powerful free open-source PHP framework for web application development. It is used mainly because it supports a rapid development web framework for building websites and is understood easily. Similarly, it reuses the components that exist from several other frameworks to create web-based applications. The project is preferably developed in laravel because it supports faster development of projects and does not necessarily need starting from scratch. Therefore, websites developed in laravel offers security and prevents against web attacks. The major features offered include: (a) Offers modularity: It provides twenty modules and built-in-libraries which help to enhance the application. Each module integrates with composer dependency manager that eases updating, (b) Offers testability: It includes features that help to test throughout different test cases hence maintaining the code to the requirements, (c) Offers routing: It provides the user with a flexibility approach to define routes in the web application for a better performance, and (d) Offers authentication: This is one of the commonly feature in web-based applications. So laravel eases to design authentication because it includes features like user registration, forgot password as well as sending password reminders.

(iii) Cascading style sheet (CSS) and Hypertext Markup Language (HTML)

The CSS is used to describe the HTML document. It describes and gives HTML components and appearance in a page display. Similarly, HTML is the standard language that is used for web application interface development. It gives support to the structure of web pages. Therefore this study employs CSS and HTML to format the web application interface.

3.4.3 Other requirements

- (i) Stable internet connectivity
- (ii) Web-browser; chrome and Mozilla Firefox

3.4.4 Assumptions and dependencies

- (i) There is adequate internet connectivity for the administrator to upload contents and register users.
- (ii) All employees afford and own a smartphone.
- (iii) All employees acting as mobile app users have the capability to use the mobile app.
- (iv) There is an adequate internet connection to enable users to access the mobile app.

3.5 Requirements for the developed mobile and web applications

Initially, the proposed project involved requirements gathering which focused on both user and system. Based on the requirements gathering from the data collection methods done at RABEC discovered that there is a lot of paperwork involved during their communication processes. Many announcements were pinned on the noticeboard, and some staff members created groups on social media platforms which at times were filled up to accept new members joining. Information reach to all employees was insufficient which left some staff members uninformed. So Raha Beverages Company saw the opportunity to have a company-owned mobile application that could solve all the burdens related to communication within. Therefore, the requirements mentioned mainly concentrate on both the functional requirements and non-functional requirements. On the systems' side, it defined detailed descriptions of the systems' functions which play a significant role in developing a mobile and web application to facilitate communication at RABEC.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Case Study Area's Results and Discussion

The results of data collection methods involved from data collection methods discussed in chapter three were majorly positive. This brought about a need to develop a mobile app with more features like announcements, events feature, directory feature which lacked in most software presented in the literature review for the company based on the respondents' feedback. A convenience sampling method with a sample size of 23 employees out of 112 overall employees was involved in participation to respond to some interview questions filled in forms sent to their emails. These respondents involved were both men and women according to their ratio as discussed below.

4.1.1 The Demographic Information of the respondents

All the respondents were able to fill out the forms successfully and none was left out. Among the 23 respondents, 16 (69.6%) were males and 7 (30.4%) were females. Most of the respondents that turned in for the interview were the males leaving few females behind. The result is presented in the pie chart below of Fig. 12.

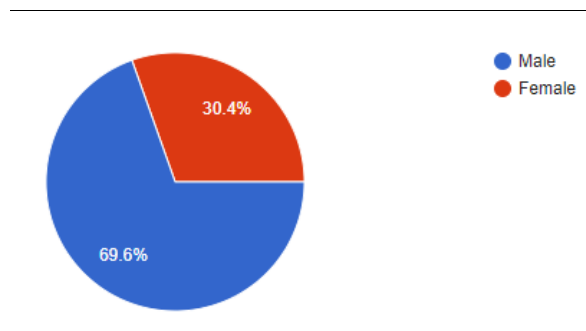


Figure 12: The demographic information of respondents

4.1.2 The age and educational levels of the respondents

The major reason for age and education status was to be aware of the type of employees that the study was dealing with, to help simplify on how to design the suggested application to fit within the community. Since all the respondents participated, therefore there was 100% of the total of all sections on the pie charts shown.

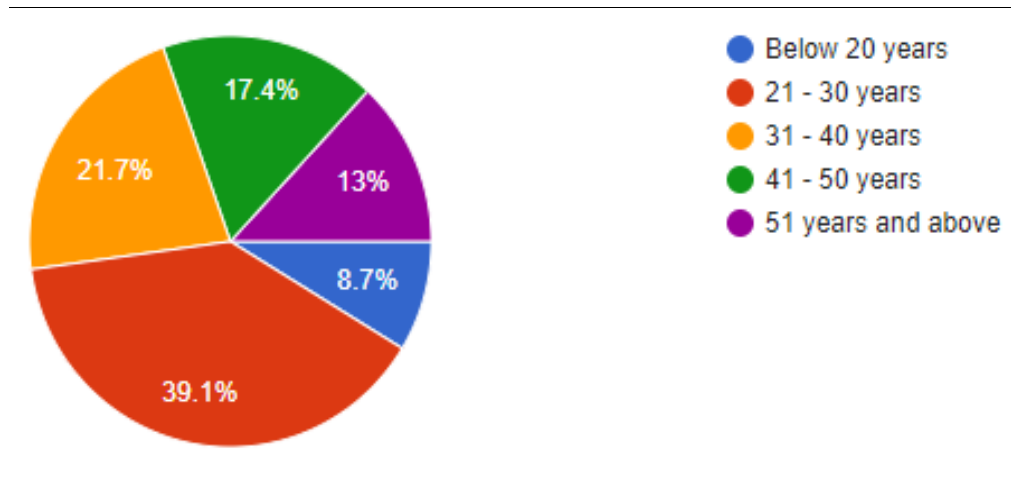


Figure 13: Correspondents' age ranges

Figure 13 shows that 9 (39.1%) of the correspondents were between 21 to 30 years, 5 (21.7%) were between 31 to 40 years, 4 (17.4%) were between 41 to 50 years, 3 (13%) were 51 years and above, and finally 2 (8.7%) were below 20 years of age. This means that the middle aged were the majority, hence a vibrant group of people who are enthusiastic to grab and learn about new technology which makes the application easy to use.

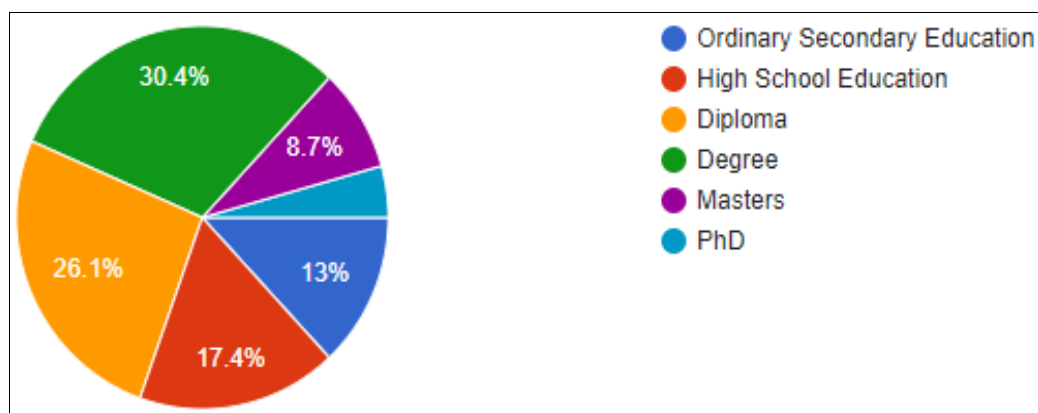


Figure 14: Correspondents' educational status

Figure 14 shows that 7 (30.4%) of the correspondents were degree holders, 6 (26.1%) were diploma holders, 4 (17.4%) were high school leavers, 3 (13%) were ordinary secondary school leavers, 2 (8.7%) were masters' holders, 1 (4.3%) was a PhD holder and none was below secondary school. This implies that majority of the employees are educated which makes the suggested application use way easier within the company domain.

4.1.3 The forms of communication and correspondents' recommendations

In the study findings, there were several platforms mentioned by different correspondents concerning the forms of communication used within the company, and recommendations made about whether to develop the mobile app or not. These are presented in both Fig. 15 and Fig. 16.

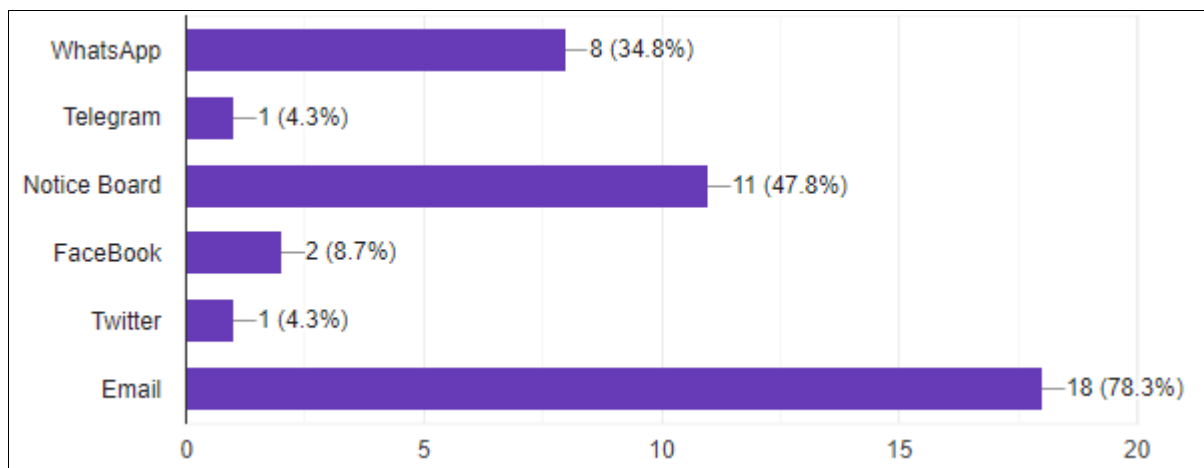


Figure 15: Communication platforms used in the company

The results given by correspondents in Fig. 15 are the different forms of communication used, whereby the question involved check boxes in which one individual was able to select one or more options. Email was the most probable means of communication used with 18 (78.3%) selections, notice board with 11 (47.8%) selections, WhatsApp with 8 (34.8%) selections, Facebook with 2 (8.7%) selections, Telegram with 1 (4.3%) selection and finally Twitter with also 1 (4.3%) selection. This means that the company needed a single internal communication application which is the suggested solution.

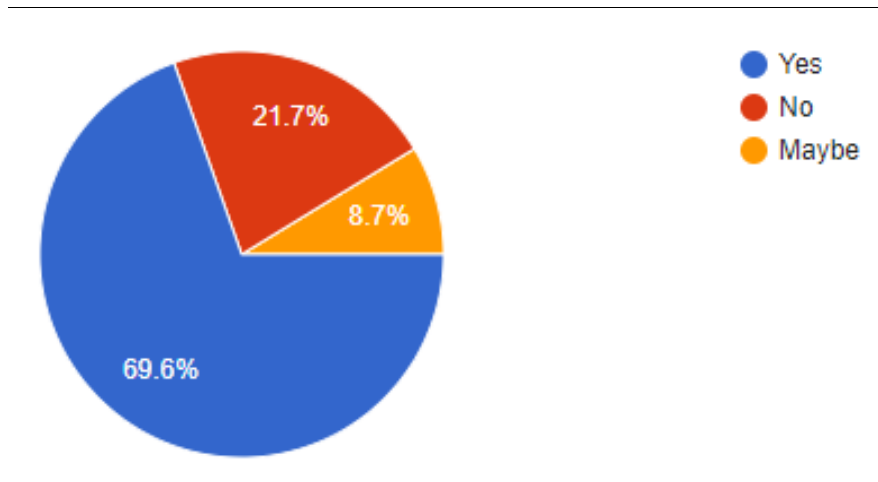


Figure 16: Correspondents' recommendations and suggestions

In reference to the asked question, Fig. 16 presents the correspondents' response recommending the mobile application development. Therefore, 16 (69.6%) responded with a 'yes' which meant that they agreed with the proposed application, 5 (21.7%) responded with a 'no' which meant that they disagreed with the proposed solution, and 2 (8.7%) responded with a 'maybe' which meant that they were not probably sure with their answers. Therefore, majority of the correspondents recommended the suggested mobile application to be developed.

4.1.4 Company smartphone ownership

In the findings, the results were given by the correspondents about the majority employees owning smartphones, and the response is illustrated in Fig. 17 below.

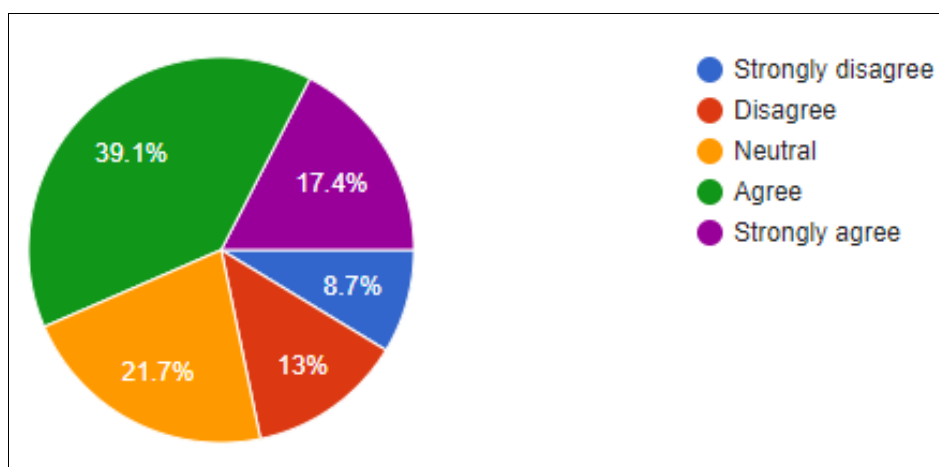


Figure 17: Smartphone ownership

In Fig. 17, the results from the correspondents show that 9 (39.1%) agreed that majority of the employees had smartphones, 5 (21.7%) where not sure, 4 (17.4%) strongly agreed, 3 (13%) disagreed, 2 (8.7%) strongly disagreed. This means that the suggested mobile app can be used effectively.

4.1.5 Mobile Application usage and suggested features

The correspondents gave their views regarding to whether or not if they had ever used a mobile app, and therefore suggestions were given regarding the features to be included in the mobile application. The suggested features included messaging, company structure, to do list, telephone extensions, announcements among many listed.

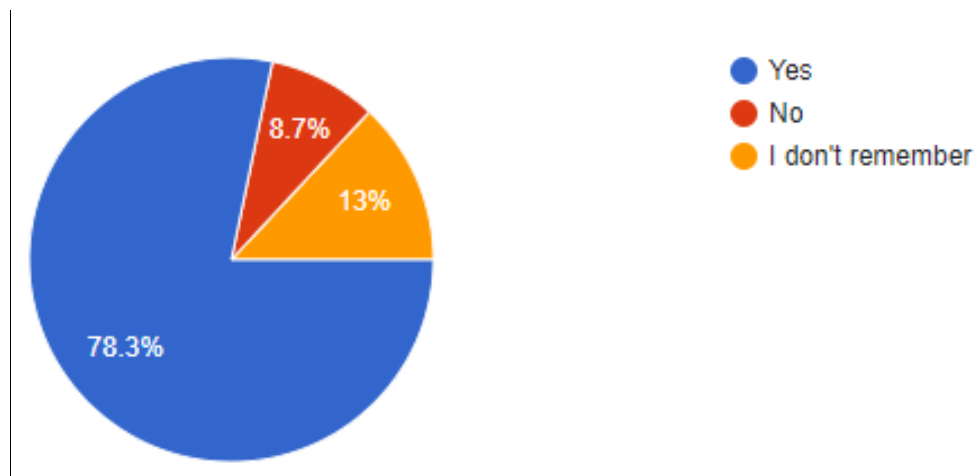


Figure 18: Mobile app usage

In Fig. 18 above, the correspondents gave their view if they had ever used a mobile app. The results show that 18 (78.3%) replied with a 'yes' meaning they had ever user an app, 3 (13%) did not remember which probably means they did not know or understand the exact meaning of an application, and 2 (8.7%) replied with a 'no' meaning they had never user an application. This implies that majority know how to use mobile application which facilitates the suggested app.

4.2 Results and discussions for the developed applications

4.2.1 The developed mobile application

The proposed mobile app comprises five main components which include splash screen, login screen, dashboard/main interface, navigation drawer, and database. The integrated

mobile application has been designed specifically to enable data transfer from the database to provide information to users hence enhancing company communication. This application is designed for internal communications at different levels among employees. Each employee will have to be given initial login credentials to enable first-time login but will be recommended to change the credentials once logged in, for security purposes and user preferences. The App is designed to display the user profile at the navigation drawer to make the user feel comfortable and of value while navigating through the application. Therefore, the main components are explained below.

(i) Login screen

This is an interface that prompts the user to insert credentials (username and password), which enables the user to proceed to the main interface. The password is hashed with cryptographic hash function and values stored for comparison later. This enables the application system to be secure and free from intrusion. Figure 19 presents an interface to log in to the mobile application.

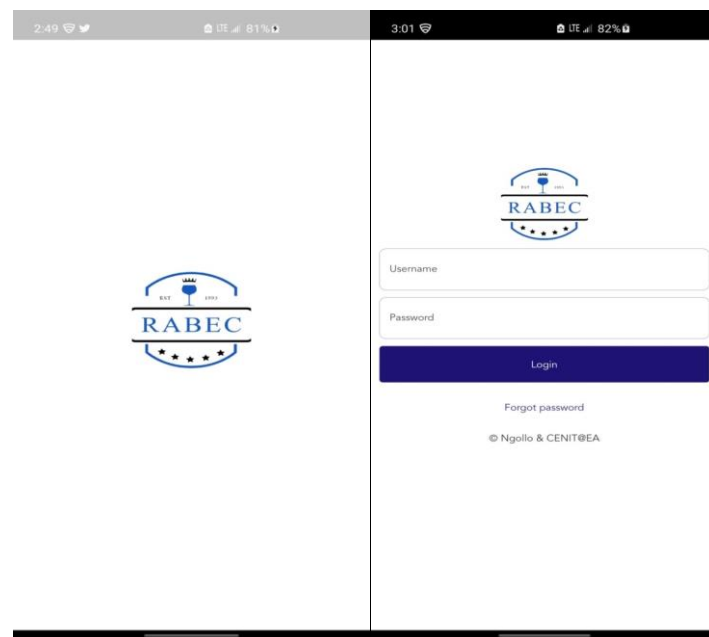


Figure 19: User login interface for mobile application

(ii) Dashboard/Main interface

This is the user's homepage that comprises different widgets of which the user chooses to navigate through. It contains various categories of components with their personalized icons and these include among the following; notice component, upcoming events component,

notes component, directory component, department component, company structure component, to-do list component, messaging component. Figure 20 presents the main screen interface.

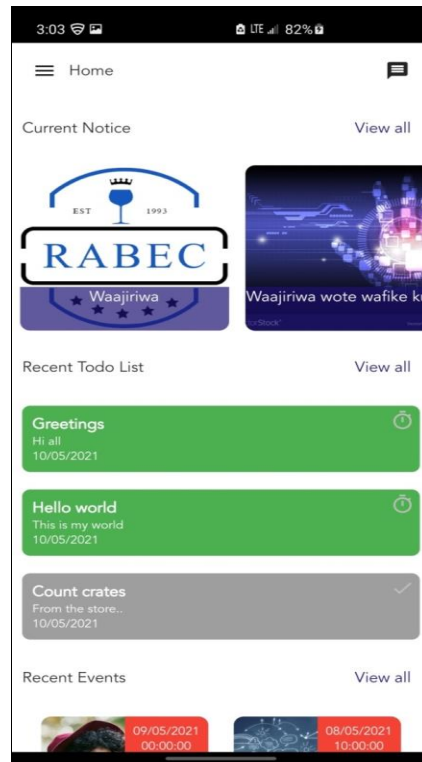


Figure 20: Home interface of the application

(iii) Navigation drawer

This is a hidden pop-up interface that comprises a user profile picture displayed, user name, and email address on top, and other components at the bottom for the user's easy access. It also contains a logout component that enables the user to exit the app. Figure 21 shows the navigation drawer interface.

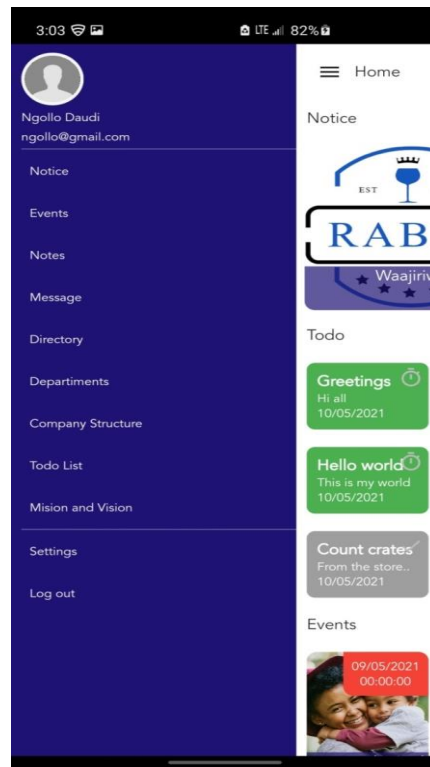


Figure 21: Display of the navigation drawer

4.2.2 The developed web application

This is accessible through browsers running on a desktop system and is accessible through the internet. The main difference from a mobile app is that it has to be downloaded and is installed on the employee's smartphone and connects with the centralized database through the internet.

The web-based system is designed to be used by the system administrator who has access to almost all menus. The administrator has been granted privileges to add users and create user login credentials into the application, as well as additional content that need to be displayed in the mobile application.

(i) Log in web page

This is an interface that allows the administrator to enter login credentials, to gain access to the web application. At the frontend, it is developed using vue.js which is a JavaScript framework for user interface development, whereas the backend is developed using Laravel framework. The API is developed using Laravel secured by passport token authenticator which is responsible for generating tokens per user login session for verification and

authentication into the system. This ensures security of the application. Figure 22 displays the login screen of the web application.

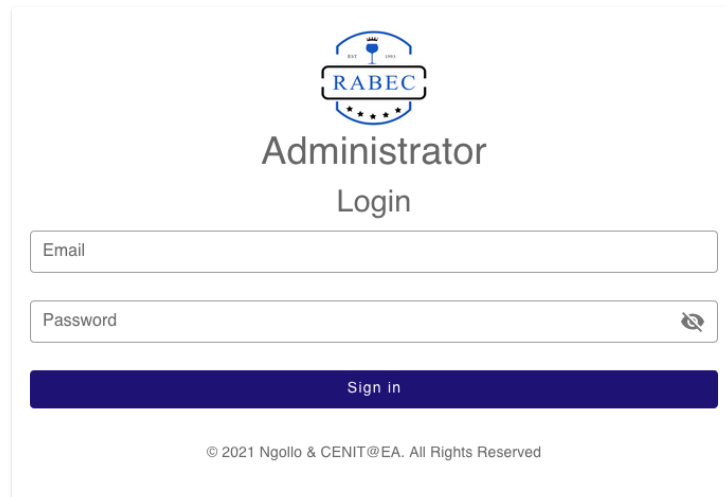
The image shows a login page for an administrator. At the top center is a logo for 'RABEC' with the years 'EST. 1992' on either side. Below the logo, the text 'Administrator' and 'Login' are centered. There are two input fields: 'Email' and 'Password'. The 'Password' field has a toggle icon on the right. Below these fields is a dark blue button with the text 'Sign in'. At the bottom, there is a copyright notice: '© 2021 Ngollo & CENIT@EA. All Rights Reserved'.

Figure 22: Login page for the administrator

(ii) Administrator homepage

This displays a home screen for the administrator. It enables the administrator to navigate through different activities within the web application. Figure 23 shows the administrator homepage.

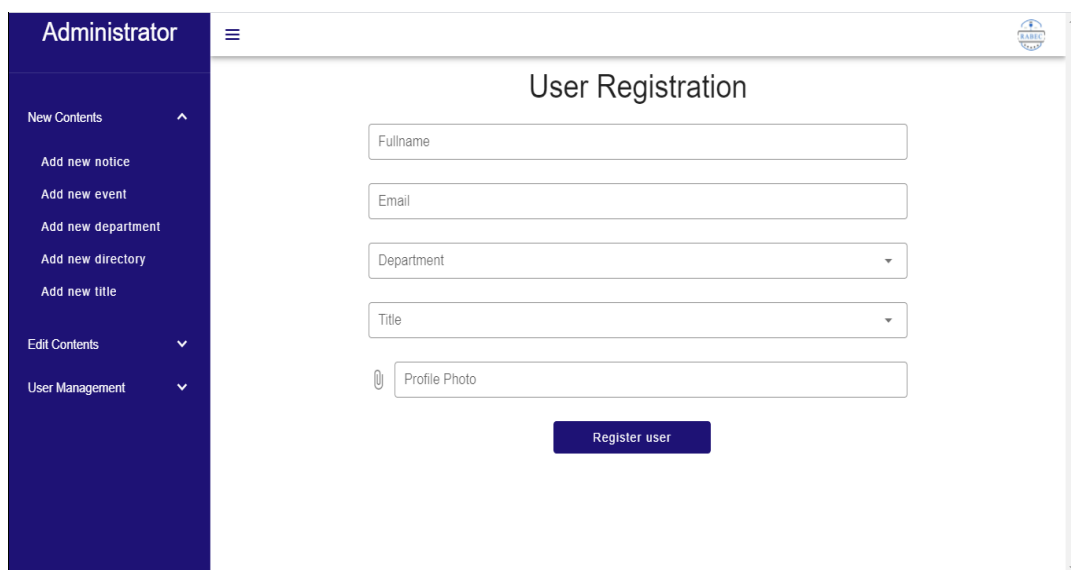
The image shows the administrator homepage. On the left is a dark blue sidebar with the title 'Administrator' and a hamburger menu icon. The sidebar contains three main sections: 'New Contents' with a list of options (Add new notice, Add new event, Add new department, Add new directory, Add new title), 'Edit Contents', and 'User Management'. The main area of the page is titled 'User Registration' and contains a form with fields for 'Fullname', 'Email', 'Department' (a dropdown menu), 'Title' (a dropdown menu), and 'Profile Photo' (with a camera icon). A dark blue button labeled 'Register user' is at the bottom of the form.

Figure 23: Home page of the web application

(iii) Events upload web page

The Administrator is responsible for uploading a series of upcoming events that are related to the company which can be viewed by the employees through their smartphones. These events can later on notify the user when the right date approaches about a particular event. Figure 24 below shows the events upload page.

The screenshot displays the 'Add new event' web page for an Administrator. The interface includes a dark blue sidebar on the left with the title 'Administrator' and a hamburger menu icon. The sidebar contains the following sections:

- New Contents** (expanded):
 - Add new notice
 - Add new event
 - Add new department
 - Add new directory
 - Add new title
- Edit Contents** (collapsed)
- User Management** (collapsed)

The main content area is titled 'Add new event' and contains the following form elements:

- Title**: A text input field.
- Event date**: A date input field with a calendar icon and placeholder text 'mm/dd/yyyy'.
- Event Time**: A section featuring a circular analog clock interface for selecting the time.

Figure 24: Events upload web page

(iv) Notice update web page

This interface web page grants the system administrator to update announcements that appear on the employee's home screen on the mobile application under the notice component. It enables daily announcements to be passed to the employees. Figure 25 shows announcement posts web page for the administrator.

The screenshot shows the 'Add new notice' page within an Administrator dashboard. The dashboard has a dark blue sidebar on the left with the title 'Administrator' and a hamburger menu icon. The sidebar contains three main sections: 'New Contents' with sub-items 'Add new notice', 'Add new event', 'Add new department', 'Add new directory', and 'Add new title'; 'Edit Contents'; and 'User Management'. The main content area is white and titled 'Add new notice'. It contains three input fields: 'Title', 'Descriptions', and 'Image' (with a paperclip icon). A dark blue button labeled 'Register notice' is positioned below the input fields. A small circular logo is visible in the top right corner of the main content area.

Figure 25: Shows a web page for updating announcements

(v) Employee registration page

The system allows the employees to be registered by the administrator. On each registration, the administrator provides a username and password to the staff so that they can log into their applications downloaded on their smartphones. Figure 26 below shows the user registration web page.

The screenshot shows the 'User Registration' page within the same Administrator dashboard. The sidebar is identical to Figure 25, but the 'User Management' section is expanded, showing sub-items: 'Register User', 'Update User Info', and 'Reset Password Requests' (which has a red notification badge with the number '1'). The main content area is white and titled 'User Registration'. It contains five input fields: 'Fullname', 'Email', 'Department' (a dropdown menu), 'Title' (a dropdown menu), and 'Profile Photo' (with a paperclip icon). A dark blue button labeled 'Register user' is positioned below the input fields. The same circular logo is in the top right corner.

Figure 26: User registration web page

4.3 Validation

Validation refers to the process whereby the software is assessed during its development process. It gives the actual proof of whether the system meets the user requirements. Testing of the software was carried out during the validation process to establish evidence of the desired results so as to enhance the quality of the software. Under mobile application testing, it is intended to show that a program does what it is planned to do and to locate program defects before it is put into use. It is done as part of a more general verification and validation process. The Raha application system was validated through a series of test activity stages namely; unit testing, integration testing, system testing and user acceptance testing.

4.3.1 Unit testing

This is usually done by the developers which mainly involves code-based software testing. Each individual components of the mobile application are tested independently. During the development, unit testing was conducted on the proposed application system for every individual functional unit of the system such as user login, user log out, view user profile, display user content, user authentication, data retrieval from the database, notifications among many existing units. The testing was done successfully and yielded positive results.

4.3.2 Integration testing

This is where the existing individual units or components are combined and tested as a group. It involved combining different units with their related functionality to check whether they are working properly. Both the web and mobile app login and logout procedures were tested together in connection to each other to see whether they were responding correctly as expected hence it was a success. Information sharing and exchange between the web app and mobile app were tested together to see if they correlate and that the right information is reflected in the mobile application.

4.3.3 System testing

System testing involves testing the system as a whole. The testing is done on a fully functional and complete system to determine whether the system meets the specific requirements and that functions perform according to the requirements. Testing of the web and mobile application was done to verify the submitted information into the database at the

web-based application page could prove a successful retrieval by mobile application and vice-versa.

Table 4: System testing results for both web-based and mobile application

System testing criteria	Test Result	Assessment
Web application login	Use of credentials to log in to the web application	PASS
Register employee	Registration of full user names, department and password	PASS
Include departments	Adding up departments to the databse to be reflected in the mobile application	PASS
Include directory	Adding of telephone extensions to the database so as to be reflected in the mobile application	PASS
Add notice	Uploading of announcements to the database to be shown on the mobile application	PASS
Add events	Uploading upcoming events content to the database to be reflected in the mobile application	PASS
Mobile application login	Log in to the mobile application using username and password generated from the web application	PASS
View notice	Viewing the uploaded announcements in the mobile app uploaded from the web application	PASS
View events	Viewing the upcoming events information in the mobile application uploaded from the web application	PASS
Write, edit, share, delete notes	Manipulating information created from the note component in the mobile application	PASS
View directory	Viewing office telephone extensions in the mobile application uploaded from the web application	PASS
View department	Viewing of department in the mobile application	PASS
View structure	Viewing the organisational structure of the company	PASS
Log out	Logging out from both web based application and mobile application	PASS

4.3.4 User acceptance testing

This involves testing with employee data to inspect that the system meets the customer's demands by involving the anticipated customers or users of the developed software. Under this, the different levels of management had to test the mobile application to determine whether or not if it was ready to be accepted for use from the mobile application developer and deployed in the client's environment. The respondents found the system to be impressive and had the potential to yield positive results. The system was found out to offer great contributions such as improved efficiency at different levels of the organization, better management control, better decision making, improved company communication, a faster way of reporting, easy access and availability of information anywhere at any place, improved coordination of the company's operations and employees.

The mobile application developed allows services to interact with one another in order to accomplish tasks that are impossible to complete alone. The project aims to develop a mobile app that has the major functionality of apprehending and uploading the results, also a web service that controls the communication between the mobile app and the database of the server. Extra functionality could then be added according to what is most useful to do on a mobile application and as well as increase in requirements. The appearance of the app colour is user friendly and is good to capture the user's attention which is also the company's theme colour. User experience is another area to have an effect on mobile app development. Users may have a different expectation for a native mobile application. There is no need for the user to be connected to the internet the whole time the application is running but the app can function offline as well as online.

User test scenarios for application login functionality:

- (i) Check system behavior when valid email id and password is entered.
- (ii) Check system behavior when invalid email id and valid password is entered.
- (iii) Check system behavior when valid email id and invalid password is entered.
- (iv) Check system behavior when invalid email id and invalid password is entered.
- (v) Check system behavior when email id and password are left blank and sign in entered.

(vi) Check Forgot your password is working as expected

Table 5: Operational user acceptance test for the system

Usability Factors	Usability Features	Remarks
Service Quality	Ease-of-use	Excellent
	Efficiency	Very good
Technical Quality	Interaction	Good
	Navigation	Good
Information Quality	Memorability	Very good
	Learnability	Average
System Quality	Responsiveness	Good
	Satisfaction	Good

Both the mobile and web apps were tested with different usability factors of operations and they both performed as expected, as shown in Table 5.

Table 6: User acceptance testing results for the mobile application

	Strong agree (%)	Agree (%)	Disagree (%)	Not sure (%)
The application is easy to use	72	28	0	0
The appearance of the mobile application application is simple and user friendly	100	0	0	0
The mobile application interfaces are well organized and easily accessible with minimal assistance	80	15	0	5
The mobile application will assist to make ease of communication in the company	75	20	0	5
I think I am satisfied with the overall performance of the mobile application system	80	20	0	0
The mobile application is comfortable to use	60	40	0	0

The data gathered from RABEC given out in Table 6 above was examined and showed the contentment and acceptance of the mobile application to the users. Since majority strongly agreed, the mobile application proved to be useful to the users.

Table 7: Web application testing results

	Strong agree (%)	Agree (%)	Disagree (%)	Not sure (%)
I think the web application is easy to use	100	0	0	0
I think I will be able to use this web application	100	0	0	0
The web based application will facilitate management of RABEC information	80	0	0	20
The web application will assist to upload content and manage users of the application	85	15	0	0
I think I am satisfied with the overall performance of the web based application system	80	20	0	0

On the other hand, data conveyed in Table 7 unveils the contentment of the web based application from the system administrator which proves with a strong agreement hence usefulness.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The attention of communication trend globally is well known and most commonly used; the volume of communication is rising and the demand for mobility is also increasing. As cities become congested mostly from developing countries, noise pollution becomes the order of the day. So, the demand intensifies on software development teams to 'mobilize' existing customer-facing and internal applications and to develop brand-new mobile-first apps and services to facilitate communication and conduct businesses without the need of physical location. Throughout the limitations of the mobile environment and mobile applications, these are becoming popular, useful and their uses are increasing every day with developers improving on their capacity, functionality as well as quality corresponding to desktop applications which are not the only solutions to justify. In regard to the challenges observed at RABEC, such as delay of information delivery to employees which at times they may not get the information at all, yet this information may be vital to most employees. In this study, it lays a foundation towards improving the mobile communication system to support internal company communication by use of ICT facilities and technologies that may fit our environment. Redevelopment and modifications of systems that exist may result to unexpected costs. The use of technology effectively at RABEC will help to minimize obstacles and problems in communication.

Therefore, the design and development of the Raha management communication mobile application progress and processes have been presented. The main point of this project is the design and development of a mobile application capable of handling communication at different levels of management, to support the easy production of Raha products. The application software proposed enables employees to use a mobile application to interact with the central database whereas the web application allows the administrator to interact with the same database through a web-based system. Besides, the application is simple to use and does not need any special skills to navigate through.

5.2 Recommendations

Mobile applications are always evolving with new features added from time to time. RABEC should put in more efforts and struggle towards embracing technology and its IT-related supporting tools. By supporting the communication app, there will be a greater improvement in information management within the company. The company should also offer support and encourage more and more of their employees to own smartphones and train them about the familiarity of ICT related tools and software.

More application features can be added for improved functioning of the mobile application, therefore the following can be considered when necessary to improve application design and quality: (a) Enabling phone calls via the app within the company application domain with reduced data calling costs for effectiveness and affordability to all employees, (b) End to end encryption of one to one, or group communication can be implemented in order to improve the application system security (Nabeel, 2017; Bai *et al.*, 2020), (c) Where need be, machine learning algorithms can be implemented to allow the mobile app make intelligent decisions for the user to increase application performance (Gligorijevic *et al.*, 2018), (d) Application personalization basing on the user's behaviour and preferences, (e) Also, the user should be able to make a speech command to direct the application on what to do to be more interactable. This is possible through sophisticated algorithms and machine learning (Mhapsekar *et al.*, 2012), (f) Where the need is, video calls can be implemented and enabled which may alternatively support company conference meeting, and (g) Biometric access control methods can be implemented on the application if necessary, such as finger unlock for fast performance and quick authentication.

REFERENCES

- Bai, W., Pearson, M., Kelley, P., & Mazurek, M. (2020). *Improving Non-Experts' Understanding of End-to-End Encryption: An Exploratory Study*. <https://doi.org/10.1109/EuroSPW51379.2020.00036>
- Baktha, K. (2017). Mobile application development: all the steps and guidelines for successful creation of mobile app: case study. *International Journal of Computer Science and Mobile Computing*, 6(9), 15-20. <https://ijcsmc.com/docs/papers/September2017/V6I9201704.pdf>
- Belohlavek, P. (2015). *The Unicist Theory Applied to Business Growth (SSRN Scholarly Paper ID 2597685)*. Social Science Research Network. <https://doi.org/10.2139/ssrn.2597685>
- Blackburn, R., & Brush, C. (2009). *Understanding the challenges to growth in entrepreneurial firms: Cases from the UK and USA*. https://www.eiasm.org/frontoffice/event_announcement.asp?event_id=588
- Brunette, W., Vigil, M., Pervaiz, F., Levvari, S., Borriello, G., & Anderson, R. (2015). *Optimizing Mobile Application Communication for Challenged Network Environments. Proceedings of the 2015 Annual Symposium on Computing for Development*. <https://doi.org/10.1145/2830629.2830644>
- Corpuz, R. S. A. (2016). Live Chat Technology Optimization Framework for Online Businesses. *Prism*, 21, 15–33. <https://www.researchgate.net/publication/311300088>
- Gazzawe, F. (2017). Comparison of websites and mobile applications for e-learning. In International Conference on Technology in Education 2017 (IACB, ICE & ICTE). <https://dspace.lboro.ac.uk/2134/27408>
- Geerts, D. (2006). *Comparing voice chat and text chat in a communication tool for interactive television*. <https://doi.org/10.1145/1182475.1182537>
- Gligorijevic, D., Gligorijevic, J., Raghuveer, A., Grbovic, M., & Obradovic, Z. (2018). *Modeling Mobile User Actions for Purchase Recommendation using Deep Memory Networks*. <https://doi.org/10.1145/3209978.3210138>

- Grgurina, R., Brestovac, G., & Galinac Grbac, T. (2011). *Development environment for Android application development: An experience report*. <https://dblp.org/rec/conf/mipro/GrgurinaBG11>
- Harrison, R., Flood, D., & Duce, D. (2013). Usability of mobile applications: Literature review and rationale for a new usability model. *Journal of Interaction Science*, 1(1), 1–16. <https://doi.org/10.1186/2194-0827-1-1>
- Hischier, R., & Wäger, P. (2014). The Transition from Desktop Computers to Tablets: A Model for Increasing Resource Efficiency? *Advances in Intelligent Systems and Computing*, 310, 1–14. https://doi.org/10.1007/978-3-319-09228-7_14
- Islam, Dr. M. R., & Mazumder, T. (2010). Mobile application and its global impact. *International Journal of Engineering and Technology*, 10, 72–78.
- Jayatileke, B. G., Ranawaka, G. R., Wijesekera, C., & Kumarasinha, M. C. B. (2018). Development of mobile application through design-based research. *Asian Association of Open Universities Journal*, 13(2), 145–168. <https://doi.org/10.1108/AAOUJ-02-2018-0013>
- Jobe, W. (2013). Native Apps Vs. Mobile Web Apps. *International Journal of Interactive Mobile Technologies*, 7(4), 27–32.
- Kamaraj, S. (2019). *Study on the Development of a Mobile Application for the ease of Communication for Construction Site Management*. <https://doi.org/10.13140/RG.2.2.10537.03683>
- Lomas, C., Burke, M., & Page, C. (2008). *Collaboration Tools*. <https://www.researchgate.net/publication/242677843>
- Lopes, I., Oliveira, A., & Costa, C. (2015). Tools for Online Collaboration: Do they contribute to Improve Teamwork? *Mediterranean Journal of Social Sciences*, 6(6), 1–8. <https://doi.org/10.5901/mjss.2015.v6n6s4p511>
- Mhapsekar, A., Kulkarni, P., Nagarsekar, U., & Kalbande, D. R. (2012). *Voice enabled Android application for vehicular complaint system: Using GPS and GSM-SMS*

technology. *2012 World Congress on Information and Communication Technologies*.
<https://doi.org/10.1109/WICT.2012.6409133>

Mujtaba, B. G. (2007). Wal-Mart In The Global Retail Market: Its Growth And Challenges. *Journal of Business Case Studies – Second Quarter*, 3(2), 1–10. <https://doi.org/10.19030/jbcs.v3i2.4837>

Nabeel, M. (2017). The Many Faces of End-to-End Encryption and Their Security Analysis. *2017 IEEE International Conference on Edge Computing (EDGE)*. <https://doi.org/10.1109/IEEE.EDGE.2017.47>

Pinzaru, F., & Zbucnea, A. (2017). *Mobile Applications: From Business to Social Implication*. <https://www.researchgate.net/publication/320234547>

Sarwar, M., & Soomro, T. R. (2013). Impact of smartphone's on society. *European journal of scientific research*, 98(2), 216 – 226.

The Evolution of Mobile Apps—1994 through 2016. (2016, March 17). *Arkenea*.
<https://arkenea.com/blog/evolution-of-mobile-apps/>

Vohra, G. (2017, August 24). Existence of mobile app development in fast-changing industry. *Open Source For You*. <https://www.opensourceforu.com/2017/08/mobile-app-development-fast-changing-industry/>

APPENDICES

Appendix 1: Gradle dependencies that support application build.

```
# Generated by pub
# See https://dart.dev/tools/pub/glossary#lockfile
packages:
  async:
    dependency: transitive
    description:
      name: async
      url: "https://pub.dartlang.org"
    source: hosted
    version: "2.5.0"
  boolean_selector:
    dependency: transitive
    description:
      name: boolean_selector
      url: "https://pub.dartlang.org"
    source: hosted
    version: "2.1.0"
  characters:
    dependency: transitive
    description:
      name: characters
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.1.0"
  charcode:
    dependency: transitive
    description:
      name: charcode
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.2.0"
  clock:
    dependency: transitive
    description:
      name: clock
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.1.0"
  collection:
    dependency: transitive
    description:
      name: collection
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.15.0"
  cupertino_icons:
    dependency: "direct main"
    description:
      name: cupertino_icons
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.0.2"
  fake_async:
    dependency: transitive
    description:
      name: fake_async
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.2.0"
  fancy_drawer:
    dependency: "direct main"
    description:
      name: fancy_drawer
      url: "https://pub.dartlang.org"
    source: hosted
    version: "1.0.0"
  flutter:
    dependency: "direct main"
    description: flutter
    source: sdk
    version: "0.0.0"
  flutter_test:
    dependency: "direct dev"
    description: flutter
    source: sdk
    version: "0.0.0"
  matcher:
    dependency: transitive
    description:
      name: matcher
      url: "https://pub.dartlang.org"
    source: hosted
    version: "0.12.10"
  meta:
    dependency: transitive
    description:
      name: meta
```

Appendix 2: Code for dart showing main screen with libraries to support application build.

```
import 'package:banana/screens/DashboardScreen.dart'; //Libraries
import 'package:banana/screens/LoginScreen.dart';
import 'package:banana/screens/SplashScreen.dart';
import 'package:flutter/material.dart';

void main() {
  runApp(MyApp());
}

class MyApp extends StatelessWidget {
  // This widget is the root of your application
  @override
  Widget build(BuildContext context) {
    return MaterialApp(
      debugShowCheckedModeBanner: false,
      title: 'Flutter Demo',
      theme: ThemeData(
```


Appendix 3: Code for CSS to support web based application build.

```
@import url(https://fonts.googleapis.com/css?family=Raleway:300,400,600);@charset "UTF-8";
/*
 * Bootstrap v3.3.7 (http://getbootstrap.com)
 * Copyright 2011-2016 Twitter, Inc.
 * Licensed under MIT (https://github.com/twbs/bootstrap/blob/master/LICENSE)
 */
/*! normalize.css v3.0.3 | MIT License | github.com/necolas/normalize.css */
html {
  font-family: sans-serif;
  -ms-text-size-adjust: 100%;
  -webkit-text-size-adjust: 100%;
}
body {
  margin: 0;
}
article,
aside,
details,
figcaption,
figure,
footer,
header,
hgroup,
main,
menu,
nav,
section,
summary {
  display: block;
}
audio,
canvas,
progress,
video {
  display: inline-block;
  vertical-align: baseline;
}
audio:not([controls]) {
  display: none;
  height: 0;
}
[hidden],
template {
  display: none;
}
a {
  background-color: transparent;
}
a:active,
a:hover {
  outline: 0;
}
abbr[title] {
  border-bottom: 1px dotted;
}
b,
strong {
  font-weight: bold;
}
dfn {
  font-style: italic;
}
h1 {
  font-size: 2em;
  margin: 0.67em 0;
}
mark {
  background: #ff0;
  color: #000;
}
small {
  font-size: 80%;
}
sub,
sup {
  font-size: 75%;
  line-height: 0;
  position: relative;
  vertical-align: baseline;
}
```

Appendix 4: Code for JavaScript to support web based application build.

```
(function(modules) {  
  // webpackBootstrap  
  // The module cache  
  var installedModules = {};  
  // The require function  
  function __webpack_require__(moduleId) {  
    // Check if module is in cache  
    if(installedModules[moduleId])  
      return installedModules[moduleId].exports;  
    // Create a new module (and put it into the cache)  
    var module = installedModules[moduleId] = {  
      i: moduleId,  
      l: false,  
      exports: {}  
    };  
    // Execute the module function  
    modules[moduleId].call(module.exports, module, module.exports, __webpack_require__);  
    // Flag the module as loaded  
    module.l = true;  
    // Return the exports of the module  
    return module.exports;  
  }  
  // expose the modules object (__webpack_modules__)  
  __webpack_require__.m = modules;  
  // expose the module cache  
  __webpack_require__.c = installedModules;  
}
```

Appendix 5: Questions involved during interviews.

Question One:

What is your gender?

☐ Male

☐ Female

Question Two:

What is your age?

- ☐ Below 20 years
- ☐ 21 - 30 years
- ☐ 31 - 40 years
- ☐ 41 - 50 years
- ☐ 51 years and above

Question Three:

What is your education level?

- ☐ Below Secondary Education
- ☐ Ordinary Secondary Education
- ☐ High School Education
- ☐ Diploma
- ☐ Degree
- ☐ Masters
- ☐ PhD

Question Four:

What are the forms of communication currently used in the company?

- ☐ WhatsApp
- ☐ Telegram
- ☐ Notice Board
- ☐ FaceBook
- ☐ Twitter
- ☐ Email

Question Five:

Would you recommend the mobile application for internal communication to be developed?

- ☐ Yes
- ☐ No
- ☐ Maybe

Question six:

Are majority of the employees having smartphones?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

Question seven:

Have you ever used a mobile application? *

- ☐ Yes
- ☐ No
- ☐ I don't remember

Question eight:

What feature would you recommend to be included in the mobile application?

Short answer text

.....